

Exhibit 5

<https://www.nist.gov/nist-museum/fare-fair-taximeter-testing-1920s-and-today>



NIST Museum and History Program

(<https://www.nist.gov/nist-museum>)

Is the Fare Fair? Taximeter Testing in the 1920s and Today

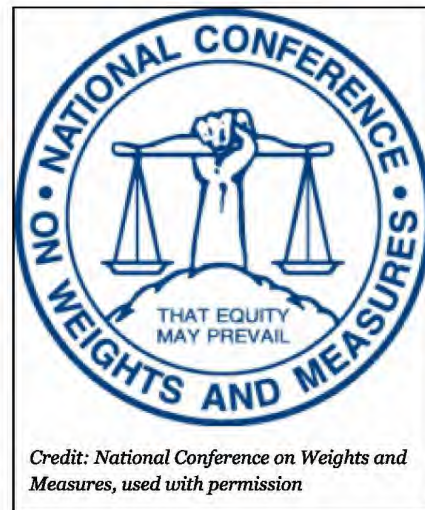


White House Reception by President Coolidge to the 21st National Conference on Weights and Measures, Washington, DC. May 25, 1928. The President can be seen at the center of the photograph.

Credit: NIST

Let Us Convene

The annual National Conference on Weights and Measures (<https://www.ncwm.com/>) (NCWM) was first organized in 1905 by the National Bureau of Standards (now known as NIST) to bring together federal, state, and municipal weights and measures officials with U.S. industry to address problems and set specifications and tolerances for weighing and measuring devices. One issue dealt with by the 1928 (<https://doi.org/10.6028/NBS.MP.87>) and 1929 (<https://doi.org/10.6028/NBS.MP.101>) NCWM was the



Credit: National Conference on Weights and Measures, used with permission

impact advances in taximeter technology would have on taxi distance/fare calculations. These issues remain relevant even today.



White House Reception by President Hoover to the 22nd National Conference on Weights and Measures, Washington, DC. June 6, 1929. The President can be seen at the center of the photograph.

Credit: NIST

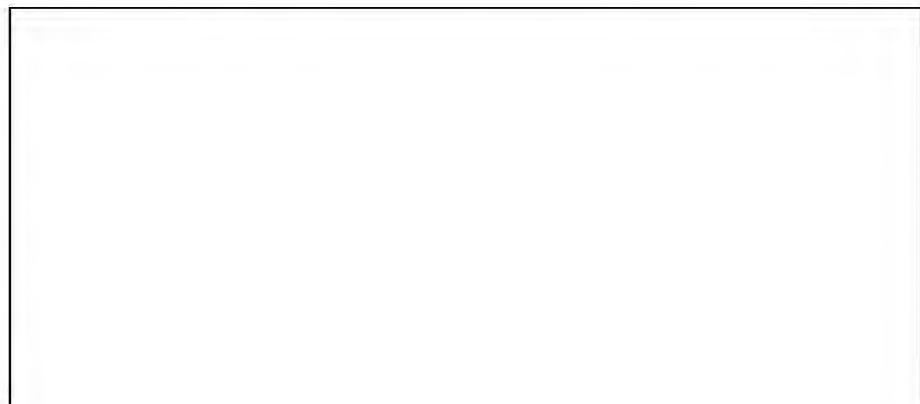
The First Metered Taxis

Although horse-drawn for-hire carriages had been operating for centuries, the modern taximeter cab was invented in Germany in the 1890s. The term ‘taxicab’ is a contraction of the German word *Taxe*, meaning tax or charge, and the French term *Cabriolet*, originally the name for a style of horse carriage that would also be applied to automobiles. New York businessman Harry N. Allen is credited with bringing the first metered taxicab service to the United States. In 1907 Allen found himself incredulous after being charged a flat \$5.00 fare (equivalent to more than \$100 today) for a less than a mile trip by horse-drawn carriage. Determined to start a service that would charge based on the distance traveled, Allen raised funds to import 65 French Darracq taximeter-equipped automobiles

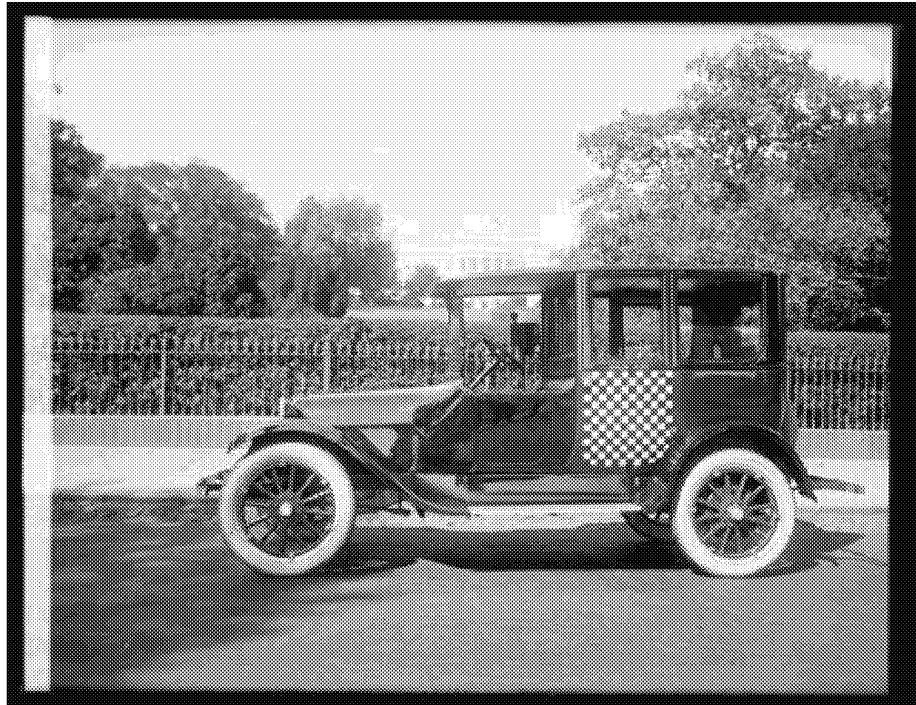
(<https://viewing.nyc/media/db1fc9bc8c8914fc89908068faacc828/>) and opened the New York Taxicab Company in October of 1907. The fare was 50 cents per mile. That was still a steep cost for the average person, but a new U.S. industry was born.

Is the Fare Fair?

By the 1920s
taxis were
common

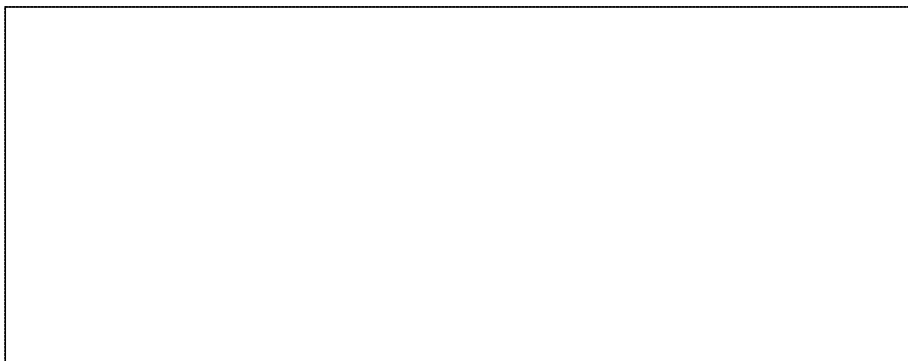


throughout the United States. Taximeters of this era were attached by cable to one of the front wheels of a taxi. The taximeter would record the revolutions of the non-driving wheel (most automobiles of the period were rear-wheel drive) to measure

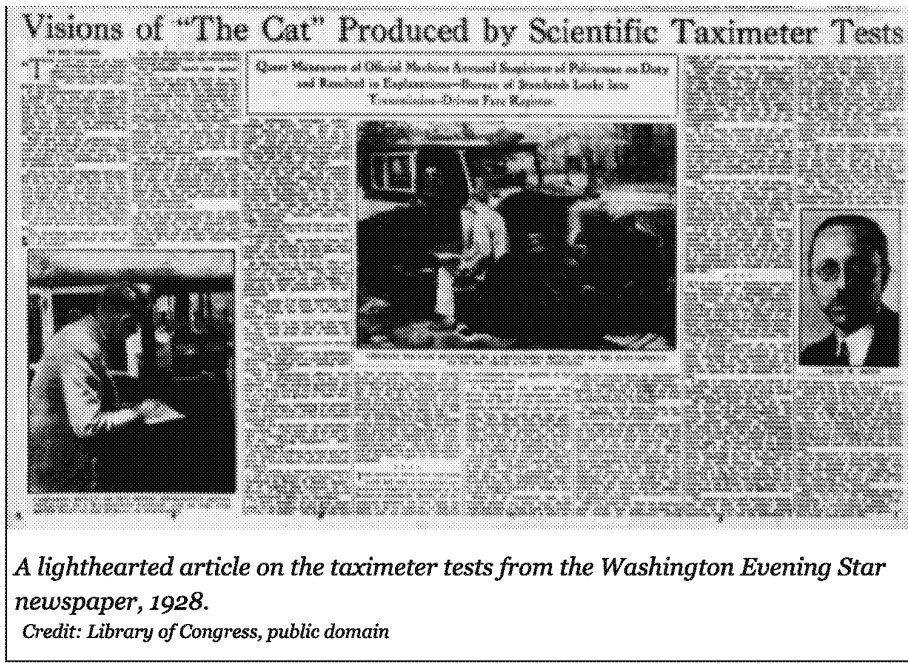


*Checker cab, Washington, D.C., c. 1921.
Credit: Library of Congress, public domain*

distance traveled and calculate the fare. But wheel-attached taximeters required frequent maintenance, and the ease of access to the taximeter equipment at the front wheel meant unscrupulous individuals could easily alter the machinery in their favor. Furthermore, automobile manufacturers were beginning to add front-wheel brakes to more vehicle models, leaving less room at the wheel to attach a taximeter. To address these issues, taximeter manufacturers developed a new type of meter attached to the taxi's transmission instead of the wheel. The sealed and internal transmission connection required less maintenance and was more tamper-proof. But would this new technology accurately calculate distance? There was concern that during foul weather spinning rear tires on wet roads would be calculated as movement, even though the taxi was not progressing forward. Ralph W. Smith, chief of the National Bureau of Standards Office of Weights and Measures (pictured third to the left of the President in the 1928 photo, top), took charge of testing the new taximeters.



With the cooperation of local taxi companies Smith and his team installed both wheel and transmission taximeters on



individual taxis for comparison tests.

Concerned that their detailed studies could at times hinder the operation of these working taxis, Smith also took the unusual move of installing the taximeters on his personal automobile,

which he referred to in his study

(<https://archive.org/details/reportoftwentyfi87unse/page/20/mode/2up>) as "The Pontiac." In addition to testing the taximeters on real-world variable routes, Smith also asked the District of Columbia Highway Department to survey an official testing course, which extended five miles (8 km) from the north side of Scott Circle in downtown

Washington, along 16th St. NW, to just beyond Alaska Ave. NW. The route was marked with 24 circular bronze medallions cemented into the street curb or on special stone monuments, identifying fifth, quarter, third, and full mile intervals. The medallions were labeled "Official Taximeter Testing Course, District of Columbia." The course was intended not only for Smith's research, but also to be used later for routine testing of taximeters by private companies and the D.C. government.

After running the taximeter tests on fixed and variable routes, with loaded and unloaded trunks, with passengers in the front or back seats, on flat roads and hills, and during all weather conditions, Smith determined that transmission taximeters worked equally as well as wheel driven ones. While it was true that spinning rear tires were measured as distance traveled by the transmission taximeters, overall the difference was negligible and within the acceptable tolerances.

There's an App for That

The National
Conference on
Weights and



Measures continues to meet annually, and although they may no longer get an audience at the White House, interest in evolving taximeter technology continues. With the creation of app-based ride sharing services which measure distance and calculate fares

using Global Positioning System (GPS) enabled mobile phones within, but not physically connected to the vehicle, the 1920s concerns about accuracy and parity with traditional taximeters have again been raised and the NCWM and NIST are working to address this through the formation of the U.S. National Work Group on Taximeters (<https://www.nist.gov/pml/weights-and-measures/legal-metrology-devices/taximeters-us-national-work-group>).

The group has developed a tentative code (<https://www.nist.gov/document/5-60-20-hb44finalpdf>) for the new software-based metering systems, known as Transportation Network Measurement Systems. The code was first published in 2018 in NIST's venerable Handbook 44: *Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices* (<https://www.nist.gov/pml/weights-and-measures/publications/nist-handbooks/other-nist-handbooks/other-nist-handbooks-2-2>). The code ensures parity between traditional taximeters and the new transportation network systems, and will be updated as the transportation-for-hire industry rapidly evolves and more services transition to the use of software-based metering.

Resources



1. Now You Know: Why Are Taxi Cabs Yellow?, TIME
(<https://time.com/4640097/yellow-taxi-cabs-history/#:~:text=Not%20that%20the%20first%20U.S.,a%20walkout%20over%20their%20pay>)
2. 'Taxi!' by Graham Russell Gao Hodges
(<https://www.nytimes.com/2007/06/17/books/chapters/0617-1st-hodg.html>)
3. The First Metered Taxi Cab Hit the Streets 109 Years Ago Today, Viewing NYC
(<https://viewing.nyc/the-first-metered-taxi-cab-hit-the-streets-109-years-ago-today/>)
4. Metered NYC Taxis Celebrate 109 Years!, NYC Yellow Cab Taxi
(<https://www.nycyellowcabs.com/blog/metered-nyc-taxis-are-109-years-old-this-month>)

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Exhibit 6

Subpart N. - Taxicab Service.

§ 13-2-401 - TAXICAB SERVICE DESCRIBED.

Taxicab service consists of service that operates on irregular routes and schedules on a call-and-demand basis, for compensation for that is usually determined by a taximeter.

Source: 1992 Code Section 8-13-301; Ord. 031106-13; Ord. 031211-11; Ord. 20130822-081; Ord. No. 20141106-054, Pt. 15, 11-17-14; Ord. No. 20220303-023, Pt. 18, 3-14-22.

§ 13-2-402 - GENERAL STANDARDS.

- (A) A holder of a taxicab service operating authority shall comply with Article 2, Division 1 (*Operating Authority*).
- (B) An applicant for a taxicab service operating authority must be able to operate the taxicab service in accordance with the requirements of this chapter, rules of the department, orders issued under this chapter, and other applicable law;
- (C) An applicant for a taxicab operating authority must agree to provide taxicab service throughout the city.
- (D) A taxicab operating authority must maintain a licensed fleet of at least 25 taxicabs, six percent of which shall be WAVs.

Source: 1992 Code Section 8-13-302; Ord. 031106-13; Ord. 031211-11; Ord. 20070405-013; Ord. No. 20141106-054, Pt. 15, 11-17-14; Ord. No. 20150604-055, Pt. 10, 6-15-15; Ord. No. 20220303-023, Pt. 19, 3-14-22.

§§ 13-2-403—13-2-431. - RESERVED.

Editor's note— Ord. No. 20220303-023, Pt. 20, effective March 14, 2022, repealed §§ 13-2-403—13-2-407, 13-2-410, 13-2-421, 13-2-429—13-2-431, 13-2-441, 13-2-501, 13-2-504, which pertained to taxicab franchise. See Code Comparative Table for complete derivation.

Exhibit 7



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changed in result by the interchange of the order of quantities.

com-mute /kəmyút/ • *v.* 1 *intr.* travel to and from one's daily work. 2 *tr.* Law change (a judicial sentence, etc.) to another less severe. 3 *tr.* change (one kind of payment) for another. 4 *tr.* exchange; interchange (two things). *b* change (to another thing). • *n.* trip made by one who commutes. • *u.* 1 see TRAVEL *u.* 1. 2 see RELIEVE *v.* 3. • see TRANSPOSE.

com-mu-tar /kəmyútar/ *n.* person who travels some distance to work.

comp. *abbr.* 1 companion. 2 comparative. 3 compensation. 4 compilation. 5 compiled. 6 compiler. 7 complete. 8 composite. 9 composition. 10 compositor. 11 comprehensive.

com-pact • *adj.* /kəmpákt, kóm-/ 1 closely or neatly packed together. 2 (of a piece of equipment, a room, etc.) well-fitted and practical though small. 3 (of style, etc.) condensed; brief. 4 (esp. of the human body) small but well-proportioned. • *v. tr.* /kəmpákt/ 1 join or press firmly together. 2 condense. • *n.* /kəmpákt/ 1 small, flat case for face powder, a mirror, etc. 2 medium-sized automobile. *u* compact disc /kəmpákt/ disc on which information or sound is recorded digitally and reproduced by laser reflection. *u* compactly *adv.* **com-pact-ness** *n.*

• *adj.* 1 closely knit, consolidated, compressed; dense, solid, firm, tight, thick. 3 terse, laconic, close, pithy, succinct, concise. • *u.* compress.

com-pact /kəmpákt/ *n.* agreement; contract.

com-pan-ion /kəmpányan/ *n.* 1 a person who accompanies or associates with another. *b* person employed to live with and assist another. 2 handbook on a particular subject. 3 thing that matches another.

• 1 a fellow, comrade, colleague, *colloq.* pal, chum, buddy. 2 manual, guide. 3 complement, counterpart.

com-pan-ion-able /kəmpányanəbəl/ *adj.* friendly; sociable. *u* com-pan-ion-ably *adv.*

• see SOCIABLE *adj.*

com-pan-ion-ship /kəmpányanship/ *n.* fellowship; friendship.

• camaraderie, comradeship, company, amity, fraternity.

com-pan-ion-way /kəmpányonway/ *n.* ship's stairway.

com-pa-ny /kúmpənee/ *n.* (*pl.* -nies) 1 a number of people assembled; crowd. *b* guest(s). 2 state of being a companion or fellow; companionship, esp. of a specific kind (*do not care for his company*). 3 commercial business. 4 troupe of entertainers.

com-pa-ra-ble /kəmpərəbəl/ *adj.* able or fit to be compared. *u* com-pa-ra-bil-ity *n.*

com-pa-ra-bly *adv.*

com-par-a-tive /kəmpárativ/ • *adj.* 1 perceptible by comparison; relative. 2 of or involving comparison. 3 *Gram.* (of an adjective or adverb) expressing a higher degree (e.g., *braver, more fiercely*). • *n.* *Gram.* comparative expression or word. *u* com-par-a-tive-ly *adv.*

com-pare /kəmpáir/ • *v.* 1 *tr.* express similarities in; liken. 2 *tr.* estimate the similarity of. 3 *intr.* bear comparison. 4 *intr.* be equivalent to. 5 *tr.* *Gram.* form comparative and superlative degrees of (an adjective or adverb). • *n.* comparison (*beyond compare*). *u* compare notes exchange ideas or opinions.

• *v.* 1 associate, analogize. 2 contrast, weigh up, juxtapose, relate, correlate. 3, 4 (*compare with*) resemble, be on a par with, be in the same class with, correspond, match, parallel, approach; rival, be a match for. • *n.* see COMPARISON 3.

com-par-i-son /kəmpárisən/ *n.* 1 comparing. 2 simile or semantic illustration. 3 similarity (*there's no comparison*). 4 (in full degrees of comparison) *Gram.* positive, comparative, and superlative forms of adjectives and adverbs. *u* beyond comparison 1 totally different in quality. 2 greatly superior.

• 1 contrast, juxtaposition, balance, weighing, likening. 3 match, resemblance, likeness, comparability, relation, relationship, commensurability, kinship.

com-part-ment /kəmpártmənt/ *n.* 1 partitioned space within a larger space. 2 watertight division of a ship.

• 1 division, section, chamber, bay, alcove, cell, pigeonhole, locker, cubbyhole, niche, cubicle, slot.

com-part-men-tal /kəmpártməntəl/ *adj.* of or divided into compartments. *u* com-part-men-tal-ly *adv.*

com-part-men-tal-ize /kəmpártməntə'liz/ *v. tr.* divide into compartments or categories. *u* com-part-men-tal-i-za-tion *n.*

com-pass /kúmpəs, kóm-/ *n.* 1 instrument showing the direction of magnetic north and bearings from it. 2 (often *pl.*) instrument within two hinged legs for taking measurements and describing circles. 3 circumference or boundary.

• 3 see BOUNDARY.

com-pas-sion /kəmpáshən/ *n.* pity inclining one to be merciful.

• see PITY *n.* 1.

com-pas-sion-ate /kəmpáshənət/ *adj.* sym-

countryman.

com-pel /kəmpél/ *v. tr.* (*com-pel-led*, *com-pel-ling*) 1 force; constrain (*compelled them to admit it*). 2 (as *compelling adj.*) rousing strong interest. *u* com-pel-ling-ly *adv.*

• 1 see FORCE *v.* 1. 2 (*compelling*) see INTERESTING.

com-pen-di-ous /kəmpéndeeəs/ *adj.* comprehensive but brief.

com-pen-di-um /kəmpéndeesəm/ *n.* (*pl.* *com-pen-di-ums* or *com-pen-di-a* /-deeə/) concise summary or abridgment.

com-pen-sate /kəmpensayt/ *v.* 1 *tr.* pay. 2 *intr.* make amends. 3 *tr.* counterbalance. 4 *intr.* offset a disability, etc., by development in another direction. *u* com-pen-sa-to-ry /-pénsatəwree/ *adj.*

• 1 recompense, make restitution or reparation to, reimburse, requite. 2 atone; expiate; offset, make up for, redress. 3 balance, counterpoise, equalize, neutralize, even (up).

com-pen-sa-tion /kəmpensáyshən/ *n.* 1 a compensating. *b* being compensated. 2 something given as recompense. *u* com-pen-sa-tion-al *adj.*

• see RESTITUTION 2.

com-pete /kəmpet/ *v. intr.* 1 contend; vie. 2 take part in a contest.

• 1 struggle.

com-pe-tence /kəmpitəns/ *n.* (also *com-pe-tency* /-tənsē/) 1 ability; being competent. 2 Law legal capacity to deal with a matter.

• 1 see PROFICIENCY (PROFICIENT).

com-pe-tent /kəmpitənt/ *adj.* adequately qualified or skilled. *u* com-pe-tent-ly *adv.*

• fit, capable; suitable, sufficient, satisfactory, acceptable.

com-pe-ti-tion /kəmpətishən/ *n.* 1 competing. 2 event in which people compete. 3 the others competing; opposition.

• 1 contention, striving; see also rivalry (RIVAL). 2 contest, match, meet, game, tournament. 3 see COMPETITOR.

com-pe-ti-tive /kəmpétitiv/ *adj.* 1 of or involving competition. 2 (of prices, etc.) comparing favorably. 3 driven to win. *u* com-pe-ti-tive-ly *adv.* **com-pe-ti-tive-ness** *n.*

com-pe-ti-tor /kəmpétitar/ *n.* person who competes; rival, esp. in business.

• opponent, adversary, antagonist; contestant, contender; (*competitors*) competition, opposition.

com-pile /kəmpil/ *v. tr.* 1 collect (material) into a list, volume, etc. 2 produce (a volume, etc.) from such material. 3 accumulate (a large number of). *u* com-pi-la-tion /kəmpiláyshən/ *n.* **com-pil'er** *n.*

• 1, 2 assemble, collate, organize, order,

from (an ailment). *b* state a grievance. *u* com-plain'er *n.* **com-plain-ing-ly** *adv.*

• 1, 2b grumble, moan, groan, wail, carp, squawk, kick, *colloq.* gripe, grouse, grouse, bitch, crab, bellyache.

com-plain-ant /kəmpláynənt/ *n.* Law plain-tiff.

com-plaint /kəmpláyn/ *n.* 1 complaining. 2 grievance. 3 ailment.

• 2 grumble, squawk, *colloq.* gripe, grouse, beef. 3 see AILMENT.

com-plai-sant /kəmpláysənt/ *adj.* willing to please; acquiescent. *u* com-plai'sance *n.*

• see PASSIVE 2, ACCOMMODATING.

com-ple-ment • *n.* /kəmplimənt/ 1 thing that completes; counterpart. 2 full number needed. • *v. tr.* /kəmplimənt/ 1 complete. 2 form a complement to. *u* com-ple-men-tai /-néntəl/ *adj.*

• *n.* 1 finishing touch, consummation; companion, twin, fellow. 2 crew, team, company, band, outfit; quota, allowance, quorum. • *u.* 1 perfect, round out. 2 supplement, add to; see also ENHANCE.

com-ple-men-tary /kəmpliméntəree/ *adj.* 1 forming a complement. 2 (of two or more things) complementing each other. *u* complementary angle either of two angles making up 90°.

• 2 see HARMONIOUS 2.

com-plete /kəmpleet/ • *adj.* 1 having all its parts; entire. 2 finished. 3 of the maximum extent (*a complete surprise*). • *n.* 1 finish. 2 make whole. 3 fill in (a form, etc.). *u* com-plete-ly *adv.* **com-plete-ness** *n.* **com-ple-tion** /-pléshən/ *n.*

• *adj.* 1 intact, uncut, unbroken, undivided, unabridged, full. 2 ended, concluded, over, done, accomplished, terminated; settled, executed, performed. 3 entire, total, thorough, absolute, utter, unqualified, pure, unmitigated. • *v.* 1 conclude, end, bring to an end, wrap up; accomplish, achieve, do; finalize. 2 round out, perfect; crown, culminate; see also make up 2. *u* completely altogether, *in toto*; lock, stock, and barrel; hook, line, and sinker; expressly, explicitly, unequivocally, truly, categorically, flatly.

com-plex • *n.* /kómpleks/ 1 building, series of rooms, etc., of related parts. 2 *Psychol.* group of usu. repressed feelings or thoughts that influence behavior. 3 preoccupation. • *adj.* /kámpléks, kóm-pleks/ complicated. *u* complex sentence sentence containing a subordinate clause or clauses. *u* com-plex-i-ty /-pléksitē/ *n.* (*pl.* -ties)

• *n.* 3 see OBSESSION. • *adj.* see COMPLICATE 2. *u* complexity convolution; intricacy, involvement.

target ~ tasteless

820

goods. 2 weight of a vehicle without its fuel or load.

target /tɑːɡɪt/ • *n.* 1 mark fired or aimed at, esp. an object marked with concentric circles. 2 person or thing aimed or fired at. 3 (also *attrib.*) objective (*target date*). 4 butt for criticism, abuse, etc. • *v. tr.* 1 identify or single out (a person or thing) as an object of attention or attack. 2 aim or direct (*target our efforts*). *on target* 'get-a-ble *adj.*

■ *n.* 1, 3 goal, aim, end. 2, 4 quarry, prey, victim. • *v.* 1 see SINGLE *v.* 2 see DIRECT *v.* 4.

tariff /tɑːrɪf/ • *n.* 1 table of fixed charges. 2 duty on a particular class of goods.

■ 1 price list. 2 tax, assessment, excise, levy, impost, toll.

Tarmac /tɑːrmɑːk/ • *n. propr.* 1 = TARMACADAM. 2 surface made of this, e.g., a runway. • *v. tr.* (tarmac) (tar-macked, tar-mack-ing) apply tarmacadam to.

tar-mac-ad-am /tɑːrmɑːkɑːdɑːm/ • *n.* material of stone or slag bound with tar, used in paving roads, etc.

tarri /tɑːrɪ/ • *n.* small mountain lake.

tar-na-tion /tɑːrnəˈnʃən/ • *int.* esp. *dial.* *sl.* damn; blast.

tar-nish /tɑːrnɪʃ/ • *v. tr.* 1 m. lessen or destroy the luster of (metal, etc.). 2 *tr.* sully. 3 *intr.* (of metal, etc.) lose luster. • *n.* 1 loss of luster, esp. as a film on a metal's surface. 2 blemish; stain. *on tar-nish-a-ble adj.*

■ *v.* 1, 3 dull, blacken, discolor. 2 disgrace, taint, blot, soil, defame, mar, damage, harm, hurt, dishonor. • *n.* 2 see DISCREDIT *n.* 1.

ta-ro /tɑːrəʊ, tɑːrɔː/ • *n.* (pl. -ros) tropical plant with edible tuberous roots.

ta-rot /tɑːrɔː, tɑːrɒ/ • *n.* 1 (in *sing.* or *pl.*) pack of mainly picture cards used in fortune-telling. 2 any card from a fortune-telling pack.

tar-pau-lin /tɑːrpəwɪn, tɑːrpə-/ (also *colloq.* tarp) • *n.* 1 heavy-duty waterproof cloth, esp. of canvas or plastic. 2 sheet or covering of this.

tar-pon /tɑːrpon/ • *n.* 1 large silvery tropical Atlantic fish. 2 similar Pacific fish.

tar-ra-gon /tɑːrɑːɡən/ • *n.* bushy herb with leaves used as a flavoring.

tar-ry /tɑːrɪ/ • *v. intr.* (-ries, -ried) linger; stay; wait. *on tar-ry'er n.*

■ loiter, procrastinate, dawdle, remain, bide one's time.

tar-sus /tɑːrsəs/ • *n.* (pl. tar-si /-si/, -see/) bones of the ankle and upper foot. *on tar-sal adj.*

tar-tan /tɑːrtən/ • *n.* 1 plaid pattern, esp. denoting a Scottish Highland clan. 2 woolen fabric woven in this pattern.

Tartar /tɑːrtɑː/ (also TARTAR /tɑːtɑːr/ except in sense 2 of *n.*) • *n.* 1 a member of a group of Central Asian peoples including Mongols and Turks. 2 Turkic language of these peoples. 3 (tartar) violent-tempered or intractable person. • *adj.* 1 of Tartars. 2 of Central Asia east of the Caspian Sea. 3 tartar sauce sauce of mayonnaise and chopped pickles, etc. *on Tartar-ian /-tɑːrɪən/ adj.*

tar-tar /tɑːrtɑː/ • *n.* 1 hard deposit that forms on the teeth. 2 deposit that forms a hard crust in wine.

task /tɑːsk/ • *n.* piece of work to be done. • *v. tr.* make great demands on (a person's powers, etc.). 1 take to task rebuke; scold. 2 task force 1 Mil. armed force organized for a special operation. 2 unit specially organized for a task.

■ *n.* duty, assignment, business, job, mission, chore. • *v.* see TAX *v.* 3. 1 take to task reprimand, censure, reproach, reprove, criticize, lecture, *colloq.* tell off. 2 task force 1 see FLIGHT¹.

task-mas-ter /tɑːskmɑːstə/ • *n.* (fem. task-mis-tress /-mɪstrɪs/) person who makes others work hard.

Tas-ma-ni-an /tɑːzməˈniːən/ • *n.* 1 native of Tasmania. 2 person of Tasmanian descent. • *adj.* of or relating to Tasmania. 3 Tasmanian devil nocturnal, badgerlike carnivorous marsupial of Tasmania.

tas-sel /tɑːsəl/ • *n.* 1 decorative tuft of loosely hanging threads or cords. 2 tassellike flowerhead of some plants, esp. corn. 3 tas'seled *adj.*

taste /teɪst/ • *n.* 1 a sensation caused in the mouth by contact of the taste buds with a substance. 2 faculty of perceiving. 3 small sample of food or drink. 4 slight experience (*taste of success*). 5 liking or predilection (*expensive tastes*). 6 aesthetic discernment in art, conduct, etc. • *v.* 1 *tr.* sample the flavor of (food, etc.). 2 *tr.* (also *absol.*) perceive the flavor of (*cannot taste with a cold*). 3 *tr.* (esp. with *neg.*) eat or drink a small portion of (*had not tasted food for days*). 4 *tr.* experience (*never tasted failure*). 5 *intr.* have a specified flavor (*tastes of onions*). 6 taste bud cells or nerve ending on the surface of the tongue by which things are tasted. *on taste-a-ble adj.* *tast'er n.* ■ *n.* 1 a flavor, smack, tang. 2 morsel, bite, nibble, tidbit; sip, nip, swallow, drop, dash, pinch. 4 palate, desire, inclination, penchant, fancy, preference, fondness. 5 discrimination, judgment, style, grace, polish. ■ *n.* 1 *lower* try *test* 2 nibble 4

unseemly, uncouth, gauche, distasteful, coarse, crude, vulgar, base, low, tacky.

tasty /tæstɪ/ • *adj.* (tast-i-er, tast-i-est) (of food) pleasing in flavor; appetizing. *on tast-i-ly adv.* *tast'i-ness n.*

■ delicious, flavorful, savory, scrumptious. *on tastiness* see FLAVOR *n.* 1.

tat' /tɑːt/ • (tat-ted, tat-ting) 1 *intr.* do tating. 2 *tr.* make by tatting.

tat' see TIT².

Tat-tar var. of TARTAR.

tat-er /tɑːtər/ • *n. sl.* = POTATO.

tat-ter /tɑːtər/ • *n.* (usu. in *pl.*) rag; irregularly torn cloth or paper, etc. 2 in tatters *colloq.* (of a negotiation, etc.) ruined; demolished. *on tat-tered adj.*

■ (tatters) scraps, shreds, bits, pieces.

■ *on tattered* ragged, torn, frayed, threadbare, shabby.

tat-ting /tɑːtɪŋ/ • *n.* 1 kind of knotted lace used as trim, etc. 2 process of making this.

tat-tle /tɑːtl/ • *v.* 1 *intr.* chatter; gossip. 2 *tr.* reveal (secrets).

■ *n.* 1 prattle, babble, jabber; blab, tell, *sl.* squeal. 2 see BLURT.

tat-tle-tale /tɑːtlɪtəl/ • *n.* one who tells tales or informs.

■ *sl.* firm, rat, squealer, stool pigeon, stoolie.

tat-too' /tɑːtʊ/ • *n.* 1 evening drum or bugle signal recalling soldiers to quarters. 2 rhythmic tapping or drumming.

tat-too' /tɑːtʊ/ • *v. tr.* 1 mark (skin) indelibly by puncturing it and inserting pigment. 2 make (a design) in this way. • *n.* such a design. *on tat-too'er n.* *tat-too'ist n.*

tau /təʊ, taw/ • *n.* nineteenth letter of the Greek alphabet (Τ, τ).

taught past and past part. of TEACH.

taunt /taʊnt/ • *n.* insult; provocation. • *v. tr.* insult; reproach (a person) contemptuously. *on taunt'er n.* *taunt'ing-ly adv.*

■ *n.* jeer, gibe, slap (in the face), *colloq.* dig. • *v.* tease, mock, torment, annoy, poke fun at, deride, heckle, sneer at, scoff at, ridicule, *colloq.* kid, rib.

taupe /təʊp/ • *adj.* 1 *n.* dark, brownish gray.

Tau-rus /tɑːwɪs/ • *n.* 1 constellation and second sign of the zodiac (the Bull). 2 person born under this sign. *on Tau're-an adj.* & *n.*

taut /taʊt/ • *adj.* 1 (of a rope, muscles, etc.) tight; not slack. 2 (of nerves) tense. 3 (of a ship, etc.) in good condition. *on taut'en v.* *taut'ly adv.* *taut'ness n.*

■ 1 stretched, rigid, stiff. 2 strained.

■ neat, tidy, shipshape. *on tauten* see TENSE¹ *v.* *tautness* see TENSION 1, 2.

tau-tol-o-gy /təʊtələʒi/ • *n.* (pl. -gies) say-

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tasty ~ teach

■ cheap, flashy, garish, tasteless, *colloq.* tacky.

tawny /tɔːwneɪ/ • *adj.* (taw-ni-er, taw-ni-est) orangish or yellowish brown. *on taw'ni-ness n.*

tax /tæks/ • *n.* 1 government revenue compulsorily levied on individuals, property, or businesses. 2 strain; heavy demand; burdensome obligation. • *v. tr.* 1 impose a tax on. 2 deduct tax from (income, etc.). 3 make heavy demands on (a person's powers or resources, etc.). *on tax'a-ble adj.* *tax'er n.*

■ *n.* 1 levy, impost, duty, tariff, toll, excise, customs, dues. 2 onus, weight, load, encumbrance, imposition, pressure. • *v.* 1 charge. 3 try, task; overwork, stretch, exhaust, drain; encumber, weigh down, saddle.

tax-a pl. of TAXON.

tax-a-tion /tæksəˈʃən/ • *n.* imposition or payment of tax.

tax-i /tæksɪ/ • *n.* (pl. taxis) (in full tax-i-cab) automobile licensed for hire and usu. fitted with a meter. • *v.* (tax-is, tax-i-ed, tax-i-ing or tax-y-ing) 1 a *intr.* (of an aircraft or pilot) move along the ground before takeoff or after landing. 2 *tr.* cause (an aircraft) to taxi. 2 *intr.* & *tr.* go or convey in a taxi.

■ *n.* cab, hack. • *v.* 2 drive, chauffeur; take a cab.

tax-i-der-my /tæksɪdərmi/ • *n.* art of preparing, stuffing, and mounting the skins of animals. *on tax-i-der-mist n.*

tax-i-me-ter /tæksɪmeɪtər/ • *n.* device fitted to a taxi, recording distance traveled and fare payable.

tax-on /tæksən/ • *n.* (pl. tax-a /tæksə/) any taxonomic group.

tax-on-o-my /tæksənəmi/ • *n.* classification of living and extinct organisms. *on tax-o-nomic /-sənəmi/ adj.* *tax-o-nom'i-cal adj.* *tax-o-nom'i-cally adv.* *tax-on'o-mist n.*

tax-pay-er /tækspeɪər/ • *n.* person who pays taxes.

Tb *abbr.* 1 tubercle bacillus. 2 tuberculosis.

Tb *sym.* Chem. terbium.

T-bone /tɛbbən/ • *n.* T-shaped bone, esp. in steak from the thin end of a loin.

tbl. *abbr.* (also *tblsp.*) tablespoon.

Te *sym.* Chem. technetium.

Td *abbr.* 1 touchdown. 2 Treasury Department.

Te *sym.* Chem. tellurium.

te var. of *tt*.

UBER_00000806

Exhibit 8

Trials@uspto.gov
571-272-7822

Paper 21
Entered: January 25, 2019

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

UNIFIED PATENTS INC.
Petitioner,
v.

HAILO TECHNOLOGIES, LLC, d/b/a BRING, LLC
Patent Owner.

Case IPR2017-01865
Patent 5,973,619

Before JOSEPH L. DIXON, MICHAEL R. ZECHER, and
PATRICK M. BOUCHER, *Administrative Patent Judges*.

DIXON, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
35 U.S.C. § 318(a) and 37 C.F.R. § 42.73

In response to a Petition (Paper 1, “Pet.”) filed by United Patents Inc. (“Petitioner”), we instituted an *inter partes* review of claims 1–7 of U.S. Patent No. 5,973,619 (Ex. 1001, “the ’619 patent”) only as to two of the five grounds of unpatentability (“grounds”) raised in the Petition. Papers 6 (“Dec. on Inst.”), 8. Patent Owner timely filed a Patent Owner Response

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(Paper 10, “PO Resp.”), and Petitioner timely filed a Reply to the Patent Owner Response (Paper 14, “Reply”). An oral hearing was held on October 10, 2018, and a copy of the transcript was entered into the record for this proceeding. Paper 20 (“Tr.”).

Although we modified our original Decision on Institution in response to *SAS Inst., Inc. v. Iancu*, 138 S. Ct. 1348 (2018), to include all five grounds raised in the Petition (Paper 8), the parties agreed to remove the previously non-instituted grounds from the trial. *See* Paper 9, 2 (“the Parties have agreed and intend to dismiss the re-instituted grounds under which the claims of the ‘619 Patent are challenged, with prejudice”); Tr. 3:18–22 (parties waiving additional grounds at oral hearing); *see PGS Geophysical AS v. Iancu*, 891 F.3d 1354, 1363 (Fed. Cir. 2018) (“Nor will we exercise any discretion to revive the non-instituted claims and grounds. Finality and expedition interests strongly counsel against such action. And so does the Court’s emphasis in *SAS* on the petitioner’s control of the contours of the proceeding.”).

We have jurisdiction under 35 U.S.C. § 6. This Decision is a Final Written Decision under 35 U.S.C. § 318(a) as to the patentability of the claims for which trial was instituted. Based on the record before us, Petitioner has not shown, by a preponderance of the evidence, that claims 1–7 are unpatentable under 35 U.S.C. § 103(a).

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I. BACKGROUND

A. The '619 Patent

The '619 patent was filed on June 10, 1997, and it relates to “[a]n automated vehicle dispatch and payment honoring system” and method. Ex. 1001, [22], [54]. Figure 1 of the '619 patent is reproduced below.

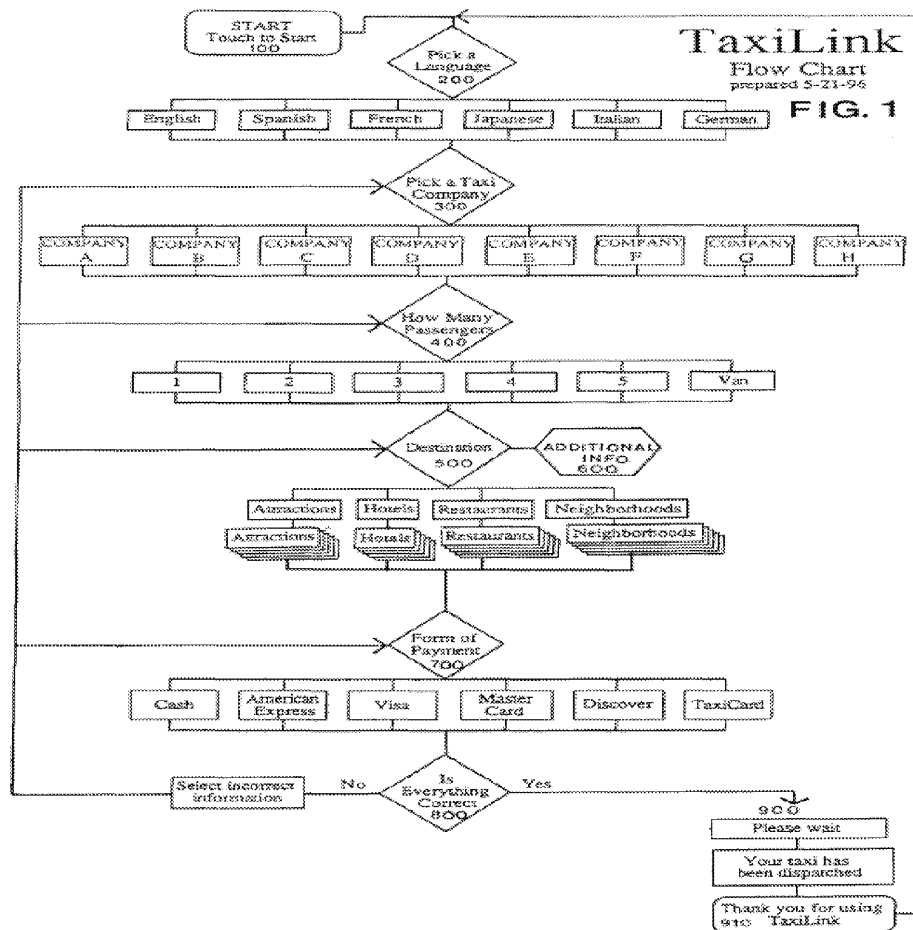


Figure 1 of the '619 patent depicts a schematic view of the flowchart of the vehicle request, or “Taxilink” software, as executed by the computer and hardware components of the vehicle dispatch and payment honoring system. *Id.* at 2:60–63. Within the system, “a computerized system which enables customers to select a transportation company, in this example a taxi

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company, from a menu of all permitted and participating companies.” *Id.* at 2:26–29. “The user can choose a desired destination and enter the number of passengers travelling.” *Id.* at 2:29–30. “The system will then display the approximate fare along with forms of payment honored by the taxi company selected.” *Id.* at 2:31–33. “Specialized software enables a customer to make any changes prior to the selection being dispatched as a request for service.” *Id.* at 2:33–35. “The system uses a telecommunication or satellite link to relay the request to the dispatcher while a receipt for the operation is printed.” *Id.* at 2:35–37. “The system improves foreign customer service by offering multi-lingual instructions along with provisions for advertising.” *Id.* at 2:37–40.

B. Illustrative Claim 1

Claim 1, the only independent claim of the ’619 patent, is illustrative of the claims at issue:

1. A method as implemented on a computer system for use by a consumer, said method for delivering instructional messages to said consumer regarding private transportation companies and estimated costs for hiring said transportation company for transporting said consumer to listed destinations and further providing an automated taxi dispatch and payment honoring system, said method comprising the steps of:

- (1) displaying a list of authorized transportation companies for selection by the operator of the computer;
- 2) prompting the consumer to insert the amount of passengers to be traveling in the transportation vehicle;
- (3) graphically illustrating destination locations;

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(4) displaying the approximate fare for the number of passengers promoted [sic, prompted] to a selected destination and types of payment options honored by said selected company;

(5) initiating a dispatch call for an available taxi from said selected taxi company;

(6) estimate the approximate arrival time for said dispatched taxi.

Ex. 1001, 6:20–40.

C. References Relied Upon

Petitioner relies on the following references.

Penzias	US 5,604,676	Feb. 18, 1997	Ex. 1003
Clagett	US 5,218,633	June 8, 1993	Ex. 1004
Nimura	US 5,231,584	July 27, 1993	Ex. 1005
Behr	US 5,543,789	Aug. 6, 1996	Ex. 1006

D. Instituted Grounds of Unpatentability

We instituted this trial as to claims 1–7 of the '619 patent on the following grounds. Dec. on Inst. 19–20.

References	Basis	Claims Challenged
Penzias, Clagett, and Nimura	§ 103(a)	1 and 7
Penzias, Clagett, Nimura, and Behr	§ 103(a)	2–6

E. Related Proceedings

The parties indicate that the '619 patent was the subject of patent-infringement lawsuits brought by Patent Owner: *Hailo Technologies, LLC d/b/a Bring v. Uber Technologies, Inc.*, 2-17-cv-03028 (C.D. Cal. Apr. 21, 2017) (*see* Ex. 1014) and *Hailo Technologies, LLC d/b/a Bring v. Lyft, Inc.*, 2-17-cv-03031 (C.D. Cal. Apr. 21, 2017). Pet. 2; Paper 4, 1.

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II. ANALYSIS

A. Claim Construction

The '619 patent expired on June 10, 2017. Ex. 1001, [22]; Pet. 3, 7. “[T]he Board’s review of the claims of an expired patent is similar to that of a district court’s review.” *In re Rambus Inc.*, 694 F.3d 42, 46 (Fed. Cir. 2012) (internal citations omitted). Thus, we construe the claims in accordance with their ordinary and customary meanings, as would have been understood by a person of ordinary skill in the art, in the context of the specification, prosecution history, and any extrinsic evidence, if in evidence. *See generally Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc).

In the Decision on Institution, we made certain preliminary constructions. *See* Dec. 5–6. We consider the claim construction issues anew in light of the full record developed during the trial. We note that only those claim terms that are in controversy need to be construed, and only to the extent necessary to resolve the controversy. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)).

Petitioner contends that “the plain and ordinary meaning is sufficient for transportation companies.” Tr. 11–12. Petitioner further contends: “Transportation companies is any vehicle for hire.” Tr. 12. Further, Petitioner proffers discussions on the interpretation of claim term “transportation companies” regarding its plain and ordinary meaning as the

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term relates to Penzias based upon preliminary interpretations in the complaints filed against the “Uber” or “Lyft” companies.¹ Tr. 12.

We make no specific findings with respect to whether the drivers for either the “Uber” or “Lyft” companies are each individually within a single company or multiple companies based upon their companies’ umbrella structures and because Petitioner has not set forth any ground which requires any factual findings on this matter.

With regard to the appropriate interpretation of the claim term “transportation companies,” we find that Figure 1 of the ’619 patent shows a

¹ Dialogue at oral hearing regarding ordinary meaning of “transportation companies”:

JUDGE BOUCHER: So, under that construction then, is a taxi company multiple transportation companies because it has multiple vehicles for hire?

MR. BOWSER: Yes; according to -- one taxi company includes multiple different cars, and they would correspond to transportation companies; and what we’re going to do is also address how the term, transportation companies is used in the claim, also how it was used in the prosecution history. And what I can tell you here --

JUDGE BOUCHER: It seems unlikely to me that someone would ascribe a plain and ordinary meaning to transportation company such that a taxi company would be equivalent to multiple transportation companies.

MR. BOWSER: Well, a transportation company -- one taxi company -- is conceivably one private company that has multiple different drivers; and what we’re going to discuss with respect to Penzias is multi-passenger vehicles like that; and also how the Clagett reference teaches multiple taxi companies, so that the user can select from one taxi company from a number of different taxi companies.

Tr. 12.

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flowchart in which a user selects one of the plural companies at step 300. The corresponding disclosure states, “all authorized taxi companies would appear along with other information and/or advertisements.” On the following screen, the user will “Select a Company” 300 which will service the request. *See* Ex. 1001, 3:58–62. Additionally, the ’619 patent discloses that “[t]he present invention embodies a computerized system which enables customers to select a transportation company, in this example a taxi company, from a menu of all permitted and participating companies.” *Id.* at 2:26–29.

Based on our review of the Specification of the ’619 patent, we determine that the claim term “transportation companies” should be accorded its plain and ordinary meaning. That is, we construe “company” as a “commercial business.” THE OXFORD DESK DICTIONARY AND THESAURUS, 146 (American ed. 1997) Ex. 3001. For a “transportation company,” the commercial business would be transportation services. We further clarify that “transportation companies” requires plural companies.

We also find the plain and ordinary meaning of “taxi: ... also taxicab” is an “automobile licensed for hire and usu. with a meter.” THE OXFORD DESK DICTIONARY AND THESAURUS, 822 (American ed. 1997) Ex. 3001.

B. Asserted Grounds of Unpatentability

1. Legal Principles

To prevail in challenging Patent Owner’s claims, Petitioner must demonstrate by a preponderance of the evidence that the claims are unpatentable. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d). “In an [*inter partes*

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review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.” *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (requiring *inter partes* review petitions to identify “with particularity . . . the evidence that supports the grounds for the challenge to each claim”)). This burden of persuasion remains with Petitioner, except in limited circumstances not present here. *See Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (citing *Tech. Licensing Corp. v. Videotek, Inc.*, 545 F.3d 1316, 1326–27 (Fed. Cir. 2008)) (discussing the burden of proof in *inter partes* review).

A claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time of the invention to a person having ordinary skill in the art. *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) objective evidence of non-obviousness, if in evidence. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

Additionally, the obviousness inquiry typically requires an analysis of “whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue.” *KSR*, 550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006) (requiring “articulated reasoning with some rational underpinning to support the legal conclusion of obviousness”)); *see In re Warsaw Orthopedic, Inc.*, 832 F.3d 1327, 1333

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(Fed. Cir. 2016) (citing *DyStar Textilfarben GmbH & Co. Deutschland KG v. C. H. Patrick Co.*, 464 F.3d 1356, 1360 (Fed. Cir. 2006)).

We analyze the challenges presented in the Petition in accordance with the above-stated principles weighing the totality of the evidence and arguments presented in the proceeding.

2. *Level of Ordinary Skill in the Art*

In determining the level of ordinary skill in the art, various factors may be considered, including the “type of problems encountered in the art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active workers in the field.” *In re GPAC, Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995) (quoting *Custom Accessories, Inc. v. Jeffrey-Allan Indus., Inc.*, 807 F.2d 955, 962 (Fed. Cir. 1986)). “[O]ne or more factors may predominate.” *Id.*

Petitioner asserts a person of ordinary skill in the art (“POSA”) at the time of the alleged invention of the ’619 patent would have had at least a Bachelor of Science degree in electrical engineering, or equivalent thereof, with a good working knowledge of computer programming. Pet. 7.

Patent Owner proffers a different level of ordinary skill in the art than Petitioner has proffered. PO Resp. 20. Patent Owner proffers

[i]nstead, a [person having ordinary skill in the art] would be someone having a similar background and body of experience as Mr. Paredes did in 1997, and thus have years of experience in user experience (UX) design and optimization, with enough computer programming experience and exposure to the business of taxi cab dispatching to understand the challenges needed to integrate disparate and unstandardized systems between VFH marketplace competitors. *See* [Ex. 2001], ¶¶ 17-19.

Id. at 21.

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Although there are slight differences between the definitions proffered by Petitioner and Patent Owner, the parties agreed that there is no meaningful distinction between them that would change the analysis in this proceeding. *See* Tr. 26–27. We agree and also find that both definitions are consistent with the level of ordinary skill in the art reflected by the prior art of record—namely, Penzias. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001); *GPAC*, 57 F.3d at 1579; *In re Oelrich*, 579 F.2d 86, 91 (CCPA 1978).

We adopt Petitioner’s articulation of the level of ordinary skill in the art for purposes of this Decision, but our conclusion would not differ if we were to accept Patent Owner’s articulation. *See* Pet. 7.

3. Scope and Content of the Prior Art

a. Penzias

Penzias relates to “transportation systems generally, and, more specifically, to a door-to-door transportation system for coordinating the provision of rides to people in lieu of their using their own personal cars or other individual means of transportation.” Ex. 1003, 1:6–10.

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Figures 1 and 2 of Penzias are reproduced below.

FIG. 1

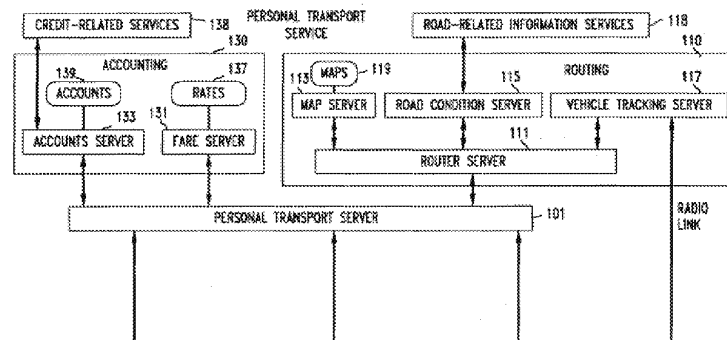


FIG. 2

Figures 1 and 2 together show an exemplary architecture of the overall system of Penzias. Ex. 1003, 2:36–41. Penzias uses multi-passenger vehicles, such as vans that are monitored and rerouted as passengers are added. A consumer requests a ride by specifying a) a pick-up location and b) the destination and, optionally, c) a desired time of arrival and d) the number of people. *Id.* at 1:45–50. Then, a suitable “path” to the destination is determined. *Id.* As shown above, the request of customer 150 is communicated to customer PT agent 151 using a conventionally available communication medium 186, e.g., telephone lines, or data networks, via a customer interface. *Id.* at 5:56–59. Customer PT agent 151 is a logical process that interfaces with customer 150 to receive the customer’s ride

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request and relay that ride request in a form compatible with personal transport server 101. *Id.* at 5:52–56; *see* Pet. 9.

Personal transport server 101 controls overall operation of the personal transport service. Ex. 1003, 3:44–46. Personal transport server dispatches vehicles in response to customer requests for rides and coordinates communication among the other units of the personal transport service. *Id.* at 3:46–49. Routing unit 110 has router server 111, which receives a layout of the roads in the area from map server 113 by accessing information stored in maps database 119. *Id.* at 2:60–62. Router server 111 also receives from vehicle tracking server 117 the position, and optionally the direction, of each of the vehicles. *Id.* at 3:7–9; *see* Pet. 9.

Upon receipt of paths from routing unit 110, personal transport server 101 submits the paths to accounting unit 130. Ex. 1003, 4:11–13. “Accounting unit 130 returns to personal transport server 101 a price for each path.” *Id.* at 4:13–14. “Personal transport server 101 relays the paths and their corresponding prices back to the customer over the same connection over which it had received the request from the customer.” *Id.* at 4:14–17. “The customer then chooses a desired path which is relayed to personal transport server 101.” *Id.* at 4:18–19. Personal transport server 101 adds the selected path to its representation of the scheduled paths. *Id.* at 4:19–21. Confirmation of the selected path may be supplied to the customer. *Id.* at 4:20–21, 6:62–63; *see* Pet. 9–10.

Accounting unit 130 includes fare server 131 connected to rates database 137. Ex. 1003, 4:62–63. Fare server 131 computes the fares for each path supplied by personal transport server 101. *Id.* at 4:62–64.

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Accounting unit 130 also includes account server 133 connected to accounts database 139. *Id.* at 5:3–5. Account server 133 is responsible for billing a passenger after completing a ride. *Id.* at 5:3–4. Account server 133 may be connected to credit services 138, e.g., commercial credit card databases or telephone customer databases. *Id.* at 5:9–6:1 (not including Table 1); *see* Pet. 9–10.

The functions of personal transport server 101, routing unit 110, and accounting unit 130 are implemented by various computers as shown in Figure 4. Ex. 1003, 9:29–40. As shown in Figure 5, each of these computers has communication interface 307 and display 309. *See* Pet.10.

The display of each computer enables a customer to enter the relevant data and see the paths and their corresponding prices over the same connection from which the request of the customer was received. Ex. 1003, 4:11–17. The display also enables a customer to select a desired path. *Id.* at 4:18–19. The consumer then pays for the selected path and receives confirmation of the selected path via the display. *Id.* at 6:63–67; Pet. 11.

b. Clagett

Clagett discloses a public pay telephone station. Ex. 1004, [57]. The station may be used by a traveler or business person desiring taxi service in a strange city. *Id.* at 7:19–21. The traveler may “call up the directory information from the telephone network directory store 72” or insert a disk containing geographic data relating to listed taxi services, which permits the user to select a taxi company from those listed in the yellow page directory information. *Id.* at 7:21–26, 47–50. The user may select a destination using map information from the disk including nearby hotels, restaurants, fast food establishments, etc. *Id.* at 7:40–42; *see* Pet. 11.

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Figure 1 of Clagett is reproduced below.

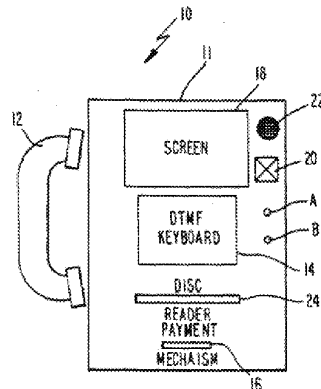


FIG. 1

Figure 1 of Clagett shows a diagrammatic illustration of a public pay telephone station constructed according to a preferred embodiment of the Clagett invention. Ex. 1004, 3:26–28. Figure 1 shows exemplary public pay station 10 with keyboard 14, a payment mechanism illustrated as coin or card slot (or both) 16, display screen 18, and cursor control switches or buttons 20. *Id.* at 3:46–53. The cursor buttons may be provided in the conventional x-y or up-down, left-right form. *Id.* at 3:54–55. “The cursor switch 20 allows the user to control the position of the screen graphics cursor.” *Id.* at 5:27–28; *see* Pet. 12. By actuating the payment mechanism of the public telephone station and inserting his/her disk containing directory information, which includes the geography of a particular city, the user can call up yellow page directory information for taxi service. Ex. 1004, 7:21–26. “The display screen 18 and the cursor control switches or button 20 enable a traveler to select a taxi company from those displayed and listed from an electronic database.” *See* Pet. 12–13; Ex. 1004, 7:19–42.

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c. Nimura

Figure 1 of Nimura is reproduced below.

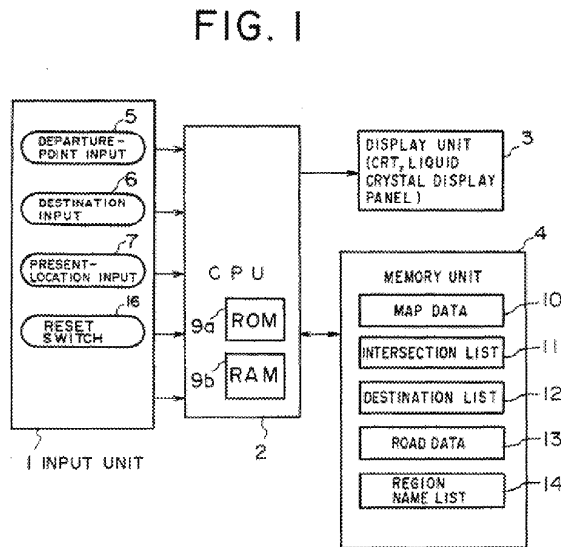


FIG. 1 of Nimura is a diagram of a navigation apparatus according to one embodiment of the Nimura invention. Ex. 1005, 4:18–19. Figure 1 of Nimura depicts input unit 1 with input means for departure point input 5 and destination input 6. *Id.* at 5:33–39. Destination list 12 is stored in memory unit 4, which is in communication with central processing unit (“CPU”) 2 and display unit 3. *Id.* at 5:33–62; *see* Pet. 14.

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Figure 11c of Nimura is reproduced below.

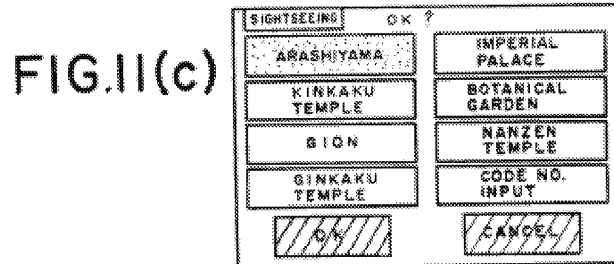


Figure 11c of Nimura shows the confirmation provided to a user after selecting an option from the sightseeing genre. Ex. 1005, 8:29–34; *see* Pet. 15.

Figures 11a–c of Nimura depict a touch panel for selecting a destination genre, reviewing listed destinations, selecting a particular destination, and viewing confirmation of the selection. Ex. 1005, 3:64–4:15. The listed destination genres in Figure 11a include sightseeing, lodgings, dining, and souvenirs. *Id.* at 3:64–4:15. These destinations are displayed in a color indicating that they are selectable items, and a desired genre is selected by touch-panel input. *Id.*; *see* Pet. 14.

4. Obviousness over Penzias, Clagett, and Nimura

Petitioner challenges claims 1 and 7 as unpatentable under 35 U.S.C. § 103(a) over the combination of Penzias, Clagett, and Nimura. Pet. 8–32.

Patent Owner and Petitioner have both argued that we should apply the plain and ordinary meaning to the claim terminology “transportation companies” based upon how a person of ordinary skill in the art would have understood that term in light of the Specification and prosecution history.

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As we held in our claim construction section above, a transportation company should be defined as a “commercial business” for transportation services, but most important is that the claim term “transportation companies” refers to plural companies.

That is, there must be more than one transportation company in the claimed “method for delivering instructional messages to said customer regarding private transportation *companies* and estimated *costs* for hiring said transportation company.” Ex. 1001, 6:21–24 (emphases added). Claim 1 further requires “displaying a list of authorized transportation *companies* for selection by the operator of the computer;” and a selection by a user where the method requires “displaying the approximate fare for the number of passengers promoted [*sic*: prompted] to a selected destination and types of payment options honored *by said selected company*.” *Id.* at 6:28–29, 6:34–36 (emphases added).²

Petitioner contends that, during the prosecution history of the ’619 patent, the term “taxi company” in the originally filed claims was replaced by “transportation company” and “private transportation companies” and, therefore, a broader interpretation is reasonable. Pet. 17; Ex. 1002, 48–49; Andrews (Ex. 1012) ¶ 44; Reply 9–10.

Petitioner provides examples of transportation companies offering vehicles for hire or such as taxi companies, individual contractors, and drivers. Pet. 17; Andrews (Ex. 1012) ¶¶ 50–51; Reply 9–10.

² The claim language was amended to be “for the number of passengers *prompted* to a selected destination” rather than as printed “promoted.” (Emphasis added.) Exhibit 1002 Prosecution History; the amendment dated, May 10, 1999, page 1.

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During the oral hearing, Petitioner clarified that Petitioner has two alternative interpretations regarding the combination of the three prior art references. Tr. 16–18. Petitioner presents two alternative interpretations of the asserted ground of unpatentability based on the combination of Penzias, Clagett, and Nimura. Tr. 16; Pet. 8–11, 16–18, 21–28.

First, Petitioner relies upon Penzias alone to teach the multiple “transportation companies” limitation. (First Alternative). Petitioner contends that the paths in Penzias are equivalent to plural transportation companies. Tr. 16–18; Pet. 9–10, 16–17; Ex. 1003, 1:7–10, 1:54–60; Reply 17–20.

Second, Petitioner relies upon Penzias together with the display of a list of “transportation companies” in Clagett to teach the multiple “transportation companies” limitation. (Second Alternative). Pet. 17–18; Reply 21–22. With regard to this second alternative, Petitioner argues that Clagett teaches a selection of a taxi company from the yellow page directory information. Pet. 11. Petitioner contends that, if the separate paths in Penzias are not considered as individual transportation companies, then Clagett teaches that a user may select from a list of taxi companies a specific taxi company from those listed in the yellow page directory with a program actuated cursor and, upon making a selection, the user presses a button to actuate an auto-dialer to initiate a call to the designated taxi company for dispatch of a taxi to the telephone station. Pet. 17; Ex. 1004, 7:19–38. We address each of these two alternatives in turn prior to addressing the parties’ remaining arguments.

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a. First Alternative

We find that Penzias does not teach or suggest multiple transportation entities/companies, but merely teaches and suggests a user interface for a single transportation company with multiple multi-passenger vans having multiple paths, which we find provides a user interface for only this single transportation company.

Petitioner contends that the phrase “private transportation companies” is only used in the preamble and does not appear anywhere else in the claims or Specification. Pet. 17. Petitioner further contends that, in the prosecution history, the phrase “private transportation companies” was added to the preamble in a Response filed on May 13, 1999 (“1999 Response”). *Id.* (citing Ex. 1002, 49). Petitioner argues that, in the remarks of the 1999 Response, it was stated that “Applicant’s invention is directed, to a computer system for [selection] of private transportation companies such as taxis.” *Id.* (quoting Ex. 1002, 50). Petitioner further argues that, based on this assertion, the phrase “private transportation companies” in the challenged claims includes taxis. Pet. 17. We find Petitioner’s assertion unavailing because it does not address the plural “[transportation] companies.”

In the First Alternative, Petitioner’s expert, Mr. Andrews, proffers that the vehicles in the system of Penzias “may” represent different transportation companies such that the paths in Penzias are offered by more than one transportation company to provide competition and quicker response times. Pet. 17; Ex. 1012, ¶¶ 47–51.

We find that Penzias is limited to a single company based on the disclosed level of control of the routes and the control of drivers of the multi-passenger vehicles. Moreover, Petitioner has provided insufficient

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evidence to the contrary. As we explained in our claim construction section above, the plain and ordinary meaning of the claim term “transportation companies” requires multiple companies, and Petitioner has provided insufficient evidence that Penzias discloses, teaches, or suggests an interface for selection from multiple transportation companies in a list.

During oral argument, Petitioner contended Penzias teaches or suggests plural transportation companies. Tr. 17–18.

When questioned regarding the interpretation of multiple paths as equating to multiple transportation companies, Petitioner’s representative identified the end of paragraph 119 of Mr. Andrews’ declaration. Tr. 19; *see* Ex. 1012.

The relevant part of Mr. Andrews’ declaration states:

The set of multipassenger vehicles in Penzias *could include* some drivers representing the same transportation companies or *some could operate* a company as the sole owner such as “Joe’s taxi company LLC.” One of ordinary skill in the art designing a system such as that disclosed in Penzias would be motivated to provide options from different transportation companies, at least because Penzias provides the cost for each route, and competition between various transportation companies enhances the offerings based on cost, allows comparison shopping, and generally gives greater freedom to consumers interfacing with taxi services. Based on at least these factors, one of ordinary skill in the art would have been motivated to *enable the paths in Penzias to be associated with multiple transportation companies*.

Ex. 1012, ¶ 119 (emphases added). Additionally, Mr. Andrews states:

A path in *Penzias* may also involve transfers with multiple rides in different multi-passenger vehicles such that a path is not necessarily provided by a single specific transportation company, but *could represent several*.

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Id. ¶ 120 (emphasis added).

We find Mr. Andrew’s supporting testimony to be based upon speculation and conjecture. While Mr. Andrews speculates that the multiple paths “could represent” several transportation companies, Mr. Andrews provides no evidence to support a finding that Penzias teaches or suggests a user interface for the multiple transportation companies. Consequently, we do not credit Mr. Andrews’ testimony in this regard because it is not supported by the disclosure in Penzias. *See* 37 C.F.R. § 42.65(a) (“Expert testimony that does not disclose the underlying facts or data on which the opinion is based is entitled to little or no weight.”).

We have reviewed Petitioner’s analysis, which is rebutted by Patent Owner, and we conclude that the First Alternative based upon the teachings of Penzias alone for the claimed multiple “transportation companies” is deficient because Petitioner has not shown that Penzias teaches or suggests multiple “transportation companies,” but merely shows multiple routes by different drivers of multi-passenger vans all controlled by a single transportation company. As a result, Penzias does not teach or suggest “displaying a list of authorized transportation companies for selection by the operator of the computer,” where the user selects a desired company, followed by displaying the proximate fare for the selected location and payment options honored by the selected company, and then initiating a dispatch call for available taxi from the selected company, as required by the method of independent claim 1. We find that Penzias only provides a process for a single “transportation company” and does not provide any teaching or suggestion to expand the user interface and process for multiple “transportation companies.”

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b. Second Alternative

In the Petitioner's Second Alternative, Petitioner relies upon Clagett to teach and suggest multiple transportation companies and a user interface thereto.

In the Second Alternative, Petitioner's expert, Mr. Andrews, contends that, to the extent Penzias is not considered to disclose private transportation companies, Clagett discloses a system permitting "a traveler or business person desiring taxi service in a strange city" to select an option from the taxi companies in a city as listed in a yellow page directory. Pet. 17; *see* Ex. 1004, 7:20–25; Ex. 1012, ¶ 79.

In Clagett, a microprocessor may identify a taxi company capable of rendering prompt service to the location of the particular telephone station. Ex. 1004, 7:30–33. However, Clagett indicates a user selects a taxi company from those listed in a yellow page directory with a program actuated cursor and then presses a button to actuate an auto-dialer to initiate a call to the designated taxi company for dispatch of a taxi to the telephone station. *Id.* at 7:33–38.

Petitioner contends a POSA would have been motivated to enable the paths in Penzias to be associated with various taxi companies, as taught by Clagett, because the taxi companies provide security and the resulting competition yields better prices and response times. Pet. 17–18; *see* Ex. 1012, ¶¶ 160–162.

Additionally, Petitioner contends a POSA would have been further motivated to modify the combination of Penzias and Clagett with the teachings of Nimura to enable a consumer to select from listed destinations

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and to receive messages about the listed destinations, such as confirmation of the selected destination as shown in Figure 11c of Nimura. Pet. 18, 32; *see* Ex. 1012, ¶¶ 125–127, 161. Figures 11a–b of Nimura depict a touch panel enabling a user to select a genre and then a particular destination from listed destinations. Pet. 18; *see* Ex. 1012, ¶¶ 125–127.

In the Patent Owner Response, Patent Owner proffers:

A caller using the *Clagett* phone can automatically dial the number of a locally-selected taxi company – from a digital list of companies listed on the phone’s display to arrange for a pickup at that phone’s recorded location. *See* EX1004 7:19-40. There is no way to digitally specify number of riders, destination locations, or receive approximate fares for a trip between that phone and the destination location. *See id.* Where *Clagett* discloses that “[t]his same methodology may be utilized for the purpose for selecting nearby hotels, restaurants, fast food establishments, etc.”, the specification is referring to the caller’s ability to select from a list of local establishments, and call them to discuss matters related to their business. The specification does not disclose conveying the system allowing for the selection of hotels or restaurants to a particular taxi dispatcher. Finally, using the “payment mechanism” does not result in a payment to the contacted taxi service, but instead is a required prerequisite for using the phone at all, much like the payment of a nick[el], dime, or quarter for using a standard pay phone for a telephone call. *See* EX1004, 7:22-25.

PO Resp. 15–16.

Although we agree with Petitioner that information for telephonically calling multiple companies is displayed in a list to the user on the telephone, Petitioner has not identified how *Clagett* provides further disclosure of additional user interaction steps beyond verbal communications with a selected company that is “auto-dialed.” Petitioner has not identified any

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additional user interface steps taught by Clagett that would permit a user to obtain transportation services by a means other than via traditional voice-based telephone communication. Consequently, the combination of Penzias and Clagett would not teach or suggest the additional computer interface functionality required by independent claim 1. As a result, Petitioner has not explained sufficiently how the combination of Penzias and Clagett (in view of Nimura) would teach or suggest the claimed:

[a] method as implemented on a computer system for use by a consumer, said method for delivering instructional messages to said consumer regarding private transportation companies and estimated costs for hiring said transportation company for transporting said consumer to listed destinations and further providing an automated taxi dispatch and payment honoring system.

Ex. 1001, 6:20–26.

Additionally, we find the selection step in the combination of the Penzias and Clagett would merely teach or suggest providing a user interface for a single transportation company. But, we cannot agree with Petitioner that the combination would suggest to one of ordinary skill in the art at the time of the invention in 1997 to provide an interface to multiple transportation companies, thereby allowing the user to select between multiple companies and then provide corresponding further user interface for the selected company which would continue the process of initiating dispatch for the selected company and providing an estimate of approximate arrival time of the dispatched taxi for the selected company (vehicle for hire). Consequently, Petitioner has not shown that Clagett teaches or suggests any additional functionality for interfacing to the user. Petitioner

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relies upon Clagett for the displaying of a list of authorized transportation companies for selection by an operator of computer, but Clagett merely teaches a telephone interface for multiple taxi companies, and Petitioner provides no teaching or suggestion in Clagett of subsequent underlying process steps beyond the traditional verbal dialogue with a telephone operator at any selected taxi company.

Although Penzias may teach or suggest some of the method steps of independent claim 1, Petitioner has not shown that Penzias teaches or suggests to one of ordinary skill in the art (either as identified by Patent Owner or Petitioner) how to combine the limited interface of Clagett with the single interface of Penzias.

Petitioner's proffered rationale for the motivation for the Second Alternative is summarized in the Reply as follows:

Second, Petitioner showed that, based on the teachings of the applied references, it would have been obvious to combine *Penzias*, *Clagett*, and *Nimura* according to known methods to yield predictable results. Pet., 31–32. The Petition provided adequate reasoning based on rational underpinnings for why one of ordinary skill in the art would have modified the asserted prior art. Pet., 31–32 (citing Ex. 1012, ¶¶ 160–162); *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006); *KSR*, 550 U.S. at 418. Accordingly, the Board should reject Patent Owner's erroneous problem-solution argument about why a POSA would have combined the asserted references.

Reply 25–26. Again, we disagree with the Petitioner and find that the proffered combination falls short of merely yielding predictable results.

Petitioner has provided insufficient evidence that, at the time of the invention in 1997, it would have been obvious to one of ordinary

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skill in the art to provide a user interface for multiple transportation companies to deliver instructional messages to the consumer to allow the consumer to select a desired company and provide the relevant claimed information to ultimately dispatch a taxi/transportation vehicle/vehicle for hire from the selected company.

We may speculate that, although the Clagett teaches a directory of companies for a user to contact a single selected transportation company, Clagett is silent as to how the single selected transportation company would provide a user interface for any of the claimed steps 2–6 of independent claim 1. As a result, the combination of Penzias with Clagett would provide a useful user interface system only for one selectable transportation company. If the user selected any other transportation company beyond the single transportation company as taught by Penzias, there would be no computer implementable system for the user to perform the method steps 2–6, which effectively negates the plural selectable [private; authorized] transportation companies because the user interface would not perform steps 2–6 for plural companies.

Neither Petitioner nor Patent Owner address, in detail, Nimura and neither Petitioner nor Patent Owner has argued that Nimura would have remedied this deficiency in the combination of Penzias and Clagett identified above. Therefore, we need not address Petitioner’s reliance on Nimura to teach certain aspects of independent claim 1 because Petitioner does not contend Nimura cures the deficiencies in Petitioner’s reliance on Penzias and Clagett to teach discussed aspects of independent claim 1.

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Therefore, we find that even if one of ordinary skill in the art would have combined the teachings of Penzias and Clagett as argued by Petitioner in the Petition, the combination would not have taught or suggested the multiple “transportation companies” limitation. At most, we find the combination of Clagett with Penzias would teach or suggest that, if a user selected the single transportation company that has a computer user interface, then the user could perform other than the plural companies limitations of independent claim 1, but not if the user selected any other transportation company. Additionally, Petitioner provides no persuasive evidence as to how the computer user interface of Penzias could be loaded to the pay telephone at the time of the invention beyond the memory disk, which stores the phone directory. Nor does Petitioner provide any persuasive evidence regarding the operating system and differences thereto of Penzias to load and operate a computer user interface at the pay telephone of Clagett, which Petitioner asserts teaches the additional method steps 2–6 required by independent claim 1. While one user may select a taxi company from the phone book of Clagett, neither Clagett, Penzias, nor a combination thereof teaches or suggests a user interface for multiple transportation companies for the six (6) separate steps/functions recited in the language of independent claim 1. Nor has Petitioner identified how POSA would have modified the teachings of Penzias regarding a single user interface such that it is applicable to a user interface for multiple “[transportation] companies.”

c. Prosecution History Argument

Petitioner proffers that the prosecution history of the ’619 patent mentions that multiple types of transportation services may be

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summoned/ordered. Tr. 24–25; Pet. 17 (citing Ex. 1012, ¶ 47–51) (“[T]he invention could readily be used to summons any other type of transportation service, including but not limited to shuttlebuses, limousines, private cars for hire, city buses and other types of vehicles for hire.” (quoting Ex. 1001, 5:39–43)).

We determine the prosecution history provides no express information to change the claim interpretation beyond the plain and ordinary meaning of the claim limitations. As a result, irrespective of the level of skill in the art, as identified by either the Petitioner or Patent Owner, we find the combination of Penzias and Clagett does not account properly for the multiple “transportation companies” limitation, as advanced by Petitioner in the proffered ground based on obviousness.

Neither Petitioner nor Patent Owner have sufficiently addressed Nimura as it relates to the above-noted deficiency with regards to the multiple “transportation companies,” and, therefore, we need not address Nimura beyond finding that Nimura does not remedy the above-noted deficiency.

d. Unified Communications Arguments

Petitioner further argues:

For example, Patent Owner alleges the problem surmounted by Mr. Parades was “the need for a unified communication, dispatching, and payment honoring system.” *Id.* at 8 [PO Reply, 8–11]. But as laid out in the Petition, Penzias disclosed such a unified system before Mr. Parades, rendering such argument moot. Pet., 8–11.

What’s more, Patent Owner attempts to discredit the testimony of Petitioner’s expert, Scott Andrews, via a newly

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proposed definition of the POSA. POR, 20–21. Even putting aside that the Board considers relevant expert testimony regardless of the level of skill, Trial Practice Guide Update, 3, Patent Owner fails to provide a rational basis for excluding a highly qualified, experienced electrical engineer, such as Mr. Andrews. Those in glass houses should not throw stones: it is the testimony of Mr. Parades that should be looked at askance in light of his financial interest in the ‘619 Patent.

(Reply 3).

We disagree with Petitioner’s conclusion and do not find the argument to be moot. Rather, we find that Penzias merely discloses a system for a single transportation company with all its corresponding processing and dispatching of vehicles for hire. Even in light of the proffered financial interests of Mr. Paredes, Petitioner has not shown any teaching or suggestion in Penzias, Clagett, and Nimura, either alone or in combination, to provide the claimed “method as implemented on a computer system for use by a consumer, said method for delivering instructional messages to said consumer regarding private transportation companies and estimated costs for hiring said transportation company for transporting said consumer to listed destinations and further providing an automated taxi dispatch and payment honoring system,” as recited in the language of independent claim 1.

At most, the combination of Clagett with Penzias, at the time of the invention in 1997, would provide a listing of plural contacts for a user to verbally discuss and verbally order dispatch of a taxi or vehicle for hire, but this combination does not suggest the single computer user interface system of Penzias is capable of providing multiple interfaces for separate transportation companies or providing a single universal user interface for multiple transportation companies.

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e. Temporal limitation argument

With respect to the Petitioner’s argument regarding the “payment honoring system,” Petitioner contends that this limitation lacks a “temporal limitation requiring prebilling and merely refers to a system for a customer to pay a company providing a ride, such as by using a credit card.” Reply 7–8 (citing Ex. 1001, 2:43, 4:39–40; Pet. 20).

Although we agree with Petitioner that independent claim 1 does not set forth specific express temporal limitations, the express sequence of steps of independent method claim 1 must be met by the combination of teachings. We find the sequence of steps in independent claim 1 referring to previous steps and system elements sets forth an inherent temporal sequence in the claimed method. Claim 1 requires displaying a list of authorized transportation companies for selection in step 1 and refers back to “said selected company” and “said selected taxi company.” Consequently, the prior art combination must teach or suggest:

- (1) displaying a list of authorized transportation companies for selection by the operator of the computer;
- (2) prompting the consumer to insert the amount of passengers to be traveling in the transportation vehicle;
- (3) graphically illustrating destination locations;
- (4) displaying the approximate fare for the number of passengers promoted to a selected destination and types of payment options honored by said selected company;
- (5) initiating a dispatch call for an available taxi from said selected taxi company;
- (6) estimate the approximate arrival time for said dispatched taxi.

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As a result, Penzias alone does not provide the display of a list of authorized transportation companies for selection and Clagett merely provides a display of transportation companies' contact information, but does not provide any of the other claimed method steps in the claimed sequence of steps. Therefore, the combination does not teach or suggest the claimed method steps in the claimed sequence of steps.

f. Long Felt Need Argument

With respect to Petitioner's Reply to the Patent Owner's long felt yet unmet need in the industry by providing a vehicle for hire service that enabled customers to "self serve," we need not reach the long felt need argument because we find the base combination to be insufficient to establish obviousness, as discussed above. Reply 26–27.

g. Financial Interest Argument

Finally, Petitioner proffers that Mr. Paredes admitted that he has a financial interest in the '619 patent and we should consider Mr. Paredes financial interest and accord his testimony appropriate weight. Reply 29.

We need not reach or evaluate the financial interest in the '619 Patent because we find the base combination of Penzias, Clagett, and Nimura to be insufficient to establish obviousness.

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h. Conclusion

We have reviewed Petitioner’s analysis, which is now rebutted on this record, and conclude that Petitioner lacks teachings or suggestions for the recited limitations regarding the multiple “transportation companies” and selection of a single transportation company and the continuation of the method steps 2–6 recited in independent claim 1. Although Petitioner sets forth a line of reasoning for the proffered combination relying on the three prior art references and Mr. Andrews’s testimony, Petitioner has not shown, by a preponderance of the evidence, that the prior art references, individually or in combination, teach or suggest the subject matter of independent claim 1.

By virtue of its dependency, dependent claim 7 includes all the limitations of independent claim 1. As we explain above, we found Petitioner’s proffered combination to be insufficient to show unpatentability of independent claim 1. As a result, Petitioner’s same combination does not evidence the unpatentability of dependent claim 7.

Accordingly, we conclude that Petitioner has not demonstrated, by a preponderance of the evidence, that claims 1 and 7 are unpatentable under 35 U.S.C. § 103(a) over the combination of Penzias, Clagett, and Nimura.

5. Obviousness over Penzias, Clagett, Nimura, and Behr

Petitioner challenges dependent claims 2–6 as unpatentable under 35 U.S.C. § 103(a) over the combination of Penzias, Clagett, Nimura, and Behr. Pet. 32–44.

We find Petitioner has not identified how Behr remedies the deficiency in Petitioner’s arguments and evidence of obviousness in the base

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combination of Penzias in view of Clagett and Nimura. For the same reasons discussed above, those arguments are not persuasive to dependent claims 2–6. Therefore, Petitioner has not demonstrated that the subject matter of claims 2–6 would have been obvious to one of ordinary skill in the art at the time of the invention based upon the combination of Penzias, Clagett, Nimura, and Behr.

Accordingly, we conclude that Petitioner has not demonstrated, by a preponderance of the evidence, that claims 2–6 are unpatentable under 35 U.S.C. § 103(a) over the combination of Penzias, Clagett, Nimura, and Behr.

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that, based on a preponderance of the evidence, claims 1–7 of the '619 patent have not been shown to be unpatentable;

FURTHER ORDERED that, because this is a Final Written Decision, parties to this proceeding seeking judicial review of our decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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Exhibit 9

HowStuffWorks / Auto / Auto Basics

How Taxi Meters Work

By: Jamie Page Deaton



Most cab riders rely on the meter to determine the fare, but don't give a thought to how the meter actually works.
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If you live in an urban area and frequently use a taxi, you know that dealing with taxi cabs means dealing with a lot of variables. Every time you go for a cab, you have to wonder if the driver will know the best route, if he'll be chatty, if he'll be a safe driver and most importantly, if you'll be able to get a cab at all. As anyone who's ever tried to hail a cab in the rain can tell you, traveling by taxi can sometimes feel like a crap shoot.

But, with all the variables you expect to encounter in a cab, one that most people don't give a thought to is the taxi meter. That little box next to the driver is supposed to be an impartial arbiter of time, distance and cost -- making sure that neither you nor the driver gets ripped off. Most cab riders rely on the meter to determine the fare, but don't give a thought to how the meter actually works.

Understanding how taxi meters works can help put your mind at ease when you take a cab. That's especially true if you travel to cities that you're unfamiliar with. When you travel, a cab driver can be an impromptu tour guide, taking you to local spots that the guide books and most tourists miss. On the other hand, travelers can also feel at the mercy of a cab driver. Knowing how a taxi meter and taxi fares work can help you be your own advocate to make sure that you and the taxi cab driver are treated fairly. Plus, if you know how a taxi meter works, you'll have a nice nugget of information to get a conversation with your driver rolling.

Keep reading to learn how a taxi meter determines your cab fare.

Measuring Distance and Time



All taxi meters measure the distance a cab covers, plus any time spent waiting.
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To put it simply, taxi meters measure distance and time. They then convert those measurements into a fare. Taxi fares are set by the area the taxi cab operates in -- in other words, it might cost more to travel the same distance or time in one city than it does in another. Fares may also change based on how many people are in the taxi, if the driver has to help you with your bags and if the taxi has to cross state or municipal lines to get you where you're going.

No matter where they operate, however, all taxi meters measure the distance a cab covers, plus any time spent waiting. That way, the driver gets compensated for time, so they don't lose out on money just because they're stuck in traffic. It's also why a cab ride from point A to point B may cost you more when there's traffic than when there's not, even if the distance covered is the same.

A taxi meter uses electric pulses to measure both distance and time. To get the distance traveled, the meter relies on a sensor attached to the cab's transmission. The sensor sends an electric pulse to the meter every time the cab travels a given distance. Inside the meter itself is a timer that sends out a pulse when a set amount of time passes. Pulses come from either sensor at intervals that are smaller than the fare interval. For example, a cab might charge you based on every 100 yards (91.4 meters) of travel, but the distance meter will pulse at each yard (0.9 meters). When the meter gets 100 pulses, it adds to the amount of the fare.

Here's an example of fares from New York City. Just hailing a cab and getting in will cost you \$2.50. For every fifth of a mile (0.3 kilometers) you travel, 40 cents is added to the fare (a fifth of a mile is four city blocks). For every minute the cab sits without moving, another 40 cents gets added to the fare.

Real traffic conditions aren't that simple, however. In a typical New York cab ride, you'll deal with stop-and-go traffic. To deal with stop-and-go traffic, meters merge calculations from both the time and the distance sensors, counting whichever pulse -- time or distance -- arrives first. Remember, the pulses come more often than the actual distance or wait time. So, if you wait 30 seconds in traffic and then cover two blocks in New York City, the taxi meter will merge the two and add 40 cents to the fare: 20 cents for the distance traveled and 20 cents for the time spent waiting.

Common Fares



Some areas have other surcharges that are added to your time and distance charges. The cab driver enters those additional fares on the meter.

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PURDY

No matter what, you know you're going to get charged for the time you spend in a cab and the distance you travel; however, some areas have other fares that are added to your time and distance charges. The cab driver enters those fares on the meter itself.

The most common fare type is a simple pickup fee. In the New York City example we mentioned on the previous page, it costs \$2.50 just to get into a cab. If you get a cab in New York between 4 and 8 p.m., you'll get charged an additional peak-hour surcharge of \$1.00. After 8 p.m., there's a night surcharge of 50 cents. Plus, the passenger is responsible for any tolls, and there's a 50-cent sales tax on each cab ride.

Most municipalities only cover fares within their limits. Generally speaking, if you ask a cab to leave city limits, you get charged a different set of fares. For example, if you catch a cab in New York to go to Newark Airport, you get charged a Rate Code 3: the normal time and distance traveled rate, plus a surcharge of \$15. If you take a cab from New York City to Westchester or Nassau Counties, the portion of the trip that's within those counties costs twice as much as the rate in the city. It's 80 cents for every fifth of a mile (0.3 kilometers) or minute of waiting time. New York cabs don't charge for additional passengers, but cabs in Washington D.C. do -- it's \$1.50 for an additional passenger. D.C. cabs also charge 50 cents if the driver has to help you with more than one bag.

Most cities require cabs to have all fares posted in the cab, so you can have a good idea of what you should be charged. Of course, that doesn't always stop a very few unscrupulous drivers from trying to take advantage of passengers, particularly if the passengers don't know the area well.

Taxi Meters and Scams



You can protect yourself from scams by knowing the fare codes for the city you're in and making sure the driver is using the right one.

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One of the advantages of taxi meters is that they provide an accurate measure of what the fare should be. However, that doesn't mean that there aren't ways for taxi drivers to take advantage of their passengers. While the vast majority of cab drivers would never take advantage of a passenger, it pays to be on your guard in case you encounter one of the few drivers who would.

A common taxi driver scam is to get more money from a fare by taking the long way. While that sometimes means taking a less-than-direct route, in egregious cases it can mean driving passengers around in circles. This type of scam usually only works on people who are unfamiliar with the city they're in. If you're traveling, keep a map handy and know the basics of the most direct route for where you want to go. You can even download smartphone apps that calculate the most direct route and let you know what the fare should be.

While taking the long way is a low-tech scam, drivers can also take advantage of passengers by adding surcharges or changing the fare type to one that costs more. Remember how fares that take the cab into Westchester and Nassau Counties from New York City cost double the rate of travel within the city? Fares within the city are Fare Code 1; drivers set the fare code when they pick up passengers. In 2010, New York City officials found that cab drivers had been charging the Nassau and Westchester fare rates for fares in the city by entering Fare Code 4, which tells the meter to calculate the fare at twice the rate for travel within the city. You can protect yourself from scam like this by knowing the fare codes for the city you're in and making sure the driver is using the right one. Fare codes should be posted in the cab. If you feel like the driver is using the wrong code, get their license information (which should also be posted in the cab) and report them to their city's taxi commission.

Taxi meters use objective measures to protect drivers and passengers. As long as you pay attention to the meter and know your rights, there's no reason to worry that your next cab ride will be anything less than wonderful – assuming, that is, you can find one.

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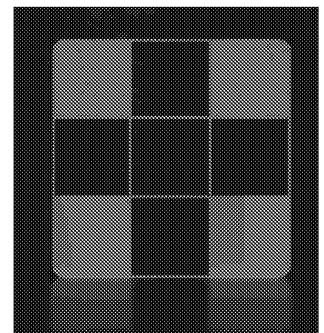
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Exhibit 10

United States Patent

[19]

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Apr. 21, 1981

Oka et al.

[45]

[54]

ELECTRONIC TRIP METER FOR AN AUTOMOTIVE VEHICLE

[75]

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[22]

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U.S. Cl. 364/561; 364/424; 235/92 DN; 235/95 R

[58]

Field of Search 364/561, 424, 432, 444, 364/446, 449; 235/92 DN, 92 PE, 92 MT, 95 R, 96, 97; 33/142; 73/490

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Primary Examiner—Charles E. Atkinson

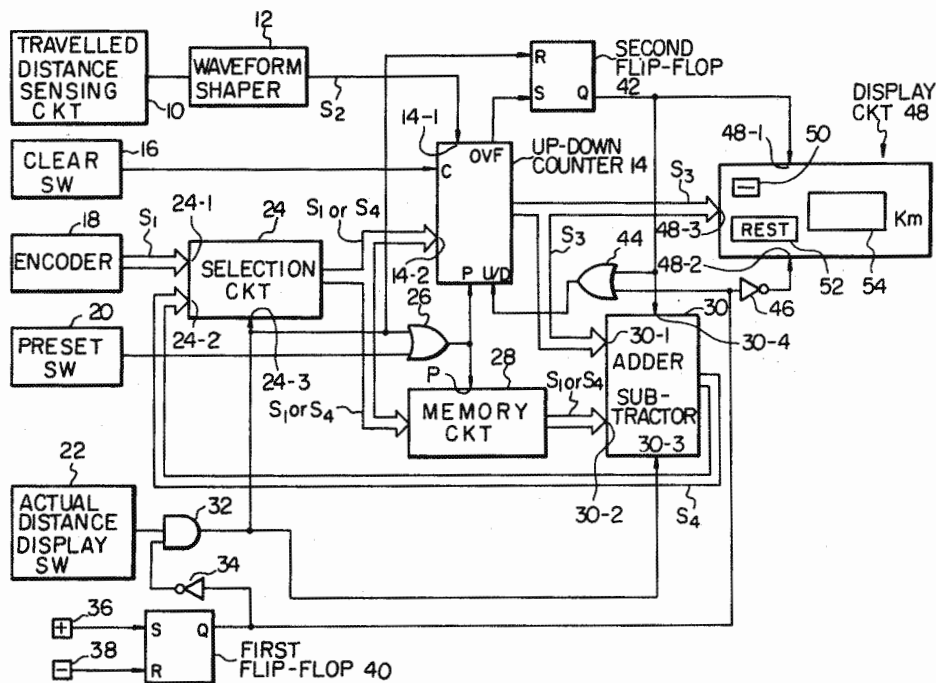
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ABSTRACT

An electronic trip meter for an automotive vehicle comprises an up-down counter, a memory circuit, an adder-subtractor, a display circuit, and other auxiliary circuits. The up-down counter produces a signal indicative of a remaining distance to a goal by subtracting an actually travelled distance from a preset distance between two points for displaying the remaining distance by the display circuit. When the vehicle reaches the goal, the adder-subtractor produces a signal indicative of the actually travelled distance in accordance with the output signals of the up-down counter and the memory circuit in which the preset distance is stored. The adder-subtractor output signal is then fed to the up-down counter for displaying the actual distance between the two points and to the memory circuit for correcting the preset distance whereby a remaining distance to the starting point in a return trip is easily and accurately obtained. The trip meter may be also utilized for a trip beyond the goal.

13 Claims, 3 Drawing Figures



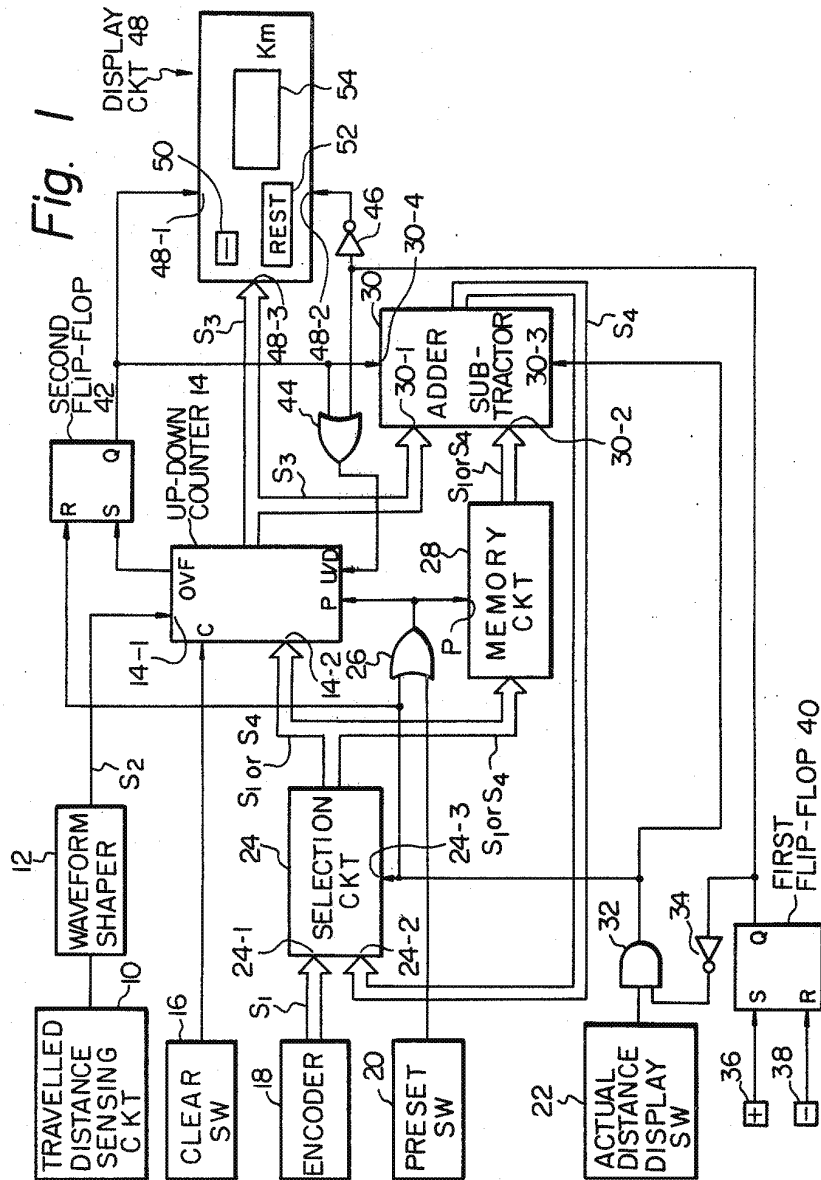
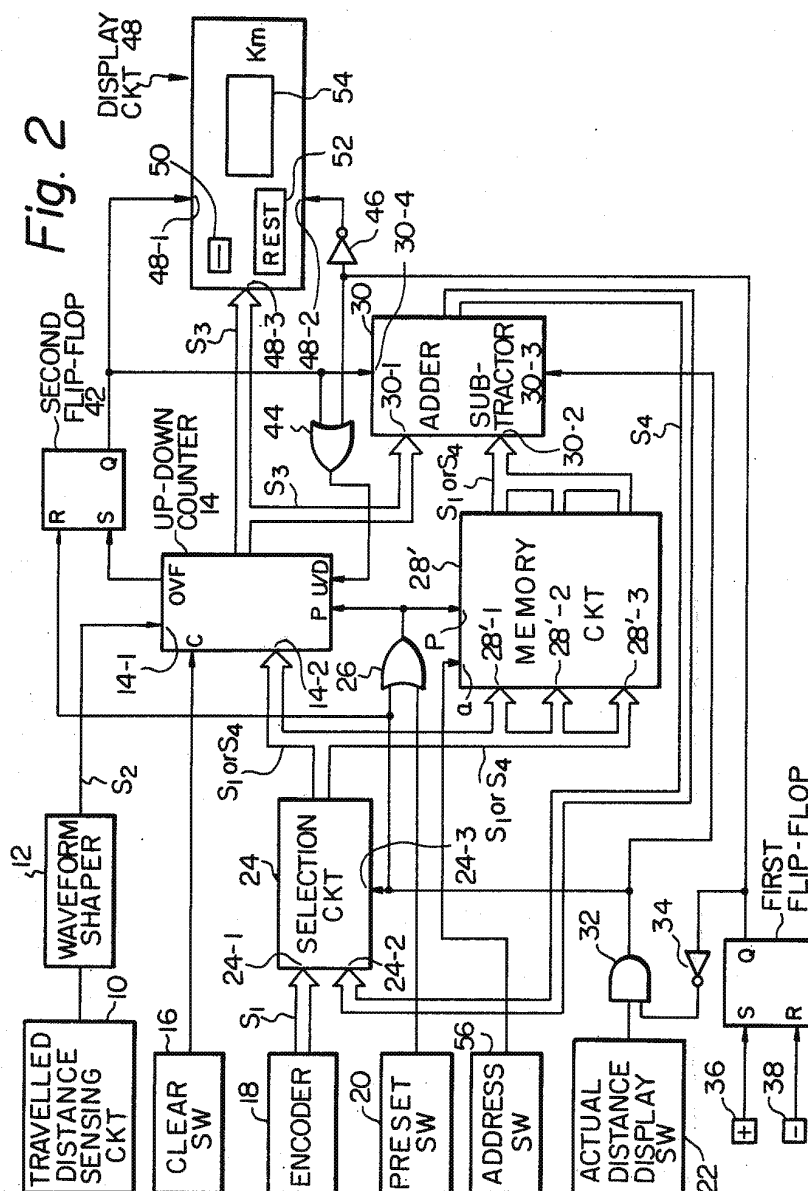


Fig. 2



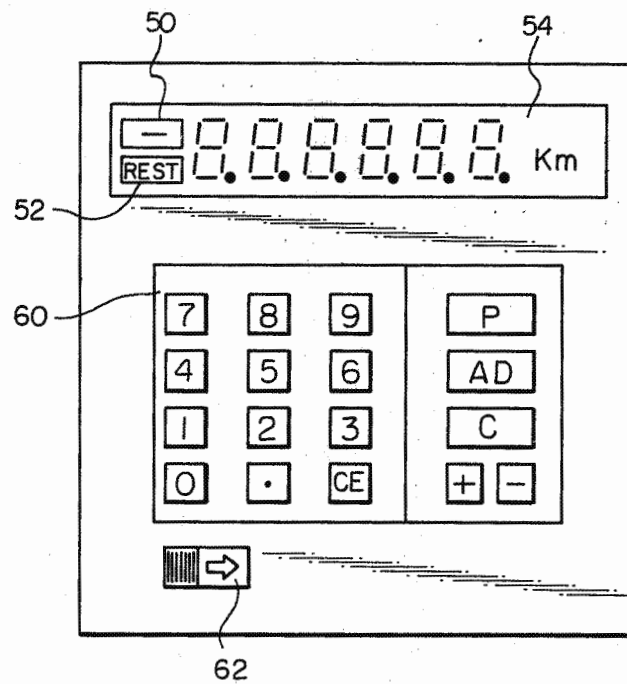
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Sheet 3 of 3

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Fig. 3



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ELECTRONIC TRIP METER FOR AN AUTOMOTIVE VEHICLE

FIELD OF THE INVENTION

The present invention generally relates to a trip meter for a motor vehicle. More particularly, the present invention relates to an electronic trip meter.

BACKGROUND OF THE INVENTION

Generally conventional type of trip meters are of the mechanical type. In such trip meters a mechanical counter including a numeral display device is driven via reduction gears by a drive shaft operatively connected to the transmission or other mechanism of the vehicle. When the driver of the vehicle intends to measure a distance between two points he will drive between, the driver resets the trip meter to zero so that the trip meter will count over the distance travelled, from zero. The trip meter is used not only for merely measuring the travelled distance but also for estimating the remaining distance to a goal or an objective point when the driver is aware of the distance between the two points, i.e. the starting point and the objective point. In order to ascertain the remaining distance on the way to the objective point the driver, however, must subtract the actually travelled distance which is displayed from the known distance by mental calculation.

For eliminating the inconvenience of such mental calculations, a trip meter which displays the remaining distance is desirable. Such a trip meter can be easily imagined since it is possible to ascertain the remaining distance by reducing a preset distance (numerals) in an opposite manner thereby subtracting the actually travelled distance from a preset distance. Although this type of a trip meter is convenient while the actually travelled distance does not exceed the preset distance, it is troublesome for the driver to ascertain the actual distance travelled if the distance exceeds the distance preset in the meter since he must add the distance corresponding to the excess to the preset distance. Moreover, if the preset distance is radically different from the actually travelled distance, the vehicle driver may not be able to determine if the displayed distance indicates the remaining distance or the excess of the distance. Therefore, such a trip meter which displays only the remaining distance cannot satisfy all of the present day driver needs.

SUMMARY OF THE INVENTION

The present invention has been developed in order to overcome the above mentioned drawbacks of the conventional type trip meters.

According to the present invention an electronic trip meter which comprises an up-down counter, a memory circuit, an adder-subtractor, a display circuit and other circuits such as a travelled distance sensing circuit and logic gates, is provided. The up-down counter produces a signal indicative of the difference between a distance actually travelled by the vehicle and a preset distance so that a remaining distance to an objective point of a predetermined course or an excess distance over the preset distance is obtained. The display circuit displays a distance represented by the output signal of the up-down counter. The display circuit further displays a sign which indicates whether the distance displayed is of the remaining distance or the excess distance in ac-

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cordance with the relationship between the actually travelled distance and the preset distance.

The preset distance is stored in the memory circuit while the adder-subtractor is responsive to the output signals of the up-down counter and the memory circuit. The adder-subtractor produces an output signal indicative of an actually travelled distance. The adder-subtractor output signal is then fed to the input of the up down counter and the memory circuit so that the actually travelled distance between the starting point and the objective point is displayed by the display circuit. With this arrangement the stored signal indicative of the known distance is taken place by the output signal of the adder-subtractor indicative of an actual distance. The actual distance may be utilized for a return trip or another trip beyond the first objective point.

It is therefore, an object of the present invention to provide an electronic trip meter for a vehicle in which the remaining distance to be travelled before reaching an objective point is easily obtained.

Another object of the present invention is to provide such a trip meter in which, when the distance actually travelled is greater than the distance preset into the trip meter, the excess distance is easily ascertained.

Further object of the present invention is to provide such a trip meter in which an actually travelled distance is easily ascertained.

Yet another object of the present invention is to provide such a trip meter in which stored preset distance is corrected by the actually travelled distance if the preset distance is erroneous.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects and features of the present invention will become more readily apparent from the following detailed description of the preferred embodiments taken in conjunction with the accompanying drawings in which:

FIG. 1 shows in a block diagram form a first preferred embodiment of the trip meter according to the present invention;

FIG. 2 shows in a block diagram form a second preferred embodiment of the trip meter according to the present invention; and

FIG. 3 shows a front elevation of an operating set of the trip meter according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 illustrates in block diagram form a first preferred embodiment of the trip meter according to the present invention. The circuitry arrangement of the trip meter includes a travelled distance sensing circuit 10, a waveform shaper 12, a presettable up-down counter 14, a clear switch 16, an encoder 18, a reset switch 20, an actual distance display switch 22, a selection circuit 24, a first OR gate 26, a memory circuit 28, an adder-subtractor 30, an AND gate 32, a first NOT gate 34, an adding switch 36, a subtracting switch 38, a first flip-flop 40, a second flip-flop 42, a second OR gate 44, a second NOT gate 46, and a display circuit 48.

The travelled distance sensing circuit 10 includes a pulse signal generator (not shown) which generates a pulse signal each time the vehicle travels a pre-determined unit distance. The pulse signal generator may be operatively connected to a drive shaft of the transmission (not shown) or to the odometer (not shown) of the vehicle. The output of the travelled distance sensing

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circuit 10 is connected to an input of the waveform shaping circuit 12, such as a schmitt trigger circuit, which produces a pulse signal having a logic level in response to the pulse signal applied from the travelled distance sensing circuit 10. The output of the waveform shaping circuit 12 is connected to a first input 14-1 of the up-down counter 14. The clear switch 16 is of a manual type switch and is connected to a clear terminal "C" of the up-down counter 14. The encoder 18 consists of a keyboard and a decimal-binary converter such as a BCD (binary-coded decimal) circuit (not shown). The outputs of the encoder are connected to first inputs 24-1 of the selection circuit 24, where the connections thereof are shown by a thick directed line which indicates a plurality of wires. Other thick directed lines shown in FIG. 1 respectively indicate a plurality of wires in the same manner. The encoder 18 is utilized for setting a known distance, which may be obtained from a map, to be travelled. The vehicle driver operates the keyboard of the encoder 18 to set the known distance before he starts from a starting point. The selection circuit 24 has a second input 24-2 to which another signal indicative of a different distance, which will be described later, is applied, and an output which is connected to a second input 14-2 of the up-down counter 14 and to an input of the memory circuit 28. The selection circuit 24 selectively supplies one of the input signals to the up-down counter 14 and to the memory circuit 28 in response to a selection command signal applied to the control terminal 24-3 thereof.

The preset switch 20 and the actual distance display switch 22 are respectively of the type of manual switches and are respectively connected to a second input of the first OR gate 26 and to a first input of the AND gate 32. The adding switch 36 and the subtracting switch 38 are also respectively manual type switches and are respectively connected to a set terminal "S" and a reset terminal "R" of the first flip-flop 40. Each of the above mentioned five switches, i.e. the clear switch 16, the preset switch 20, the actual distance display switch 22, the adding switch 36, and the subtracting switch 38, is arranged to produce an output logic "1" pulse when operated. The output "Q" of the first flip-flop 40 is connected to an input of the first NOT gate the output of which is connected to a second input of the AND gate 32. The output "Q" of the first flip-flop 40 is further connected to an input of the second NOT gate 46 and to a second input of the second OR gate 44. The output of the AND gate 32 is connected to the control terminal 24-3 of the selection circuit 24, to a second input of the first OR gate 26, to a reset terminal "R" of the second flip-flop 42, and to a subtracting control terminal 30-3 of the adder-subtractor 30. The output of the first OR gate 26 is connected to a preset control terminal "P" of the up-down counter 14 and to a preset control terminal "P" of the memory circuit 28.

An overflow output terminal "OVF" of the up-down counter 14 is connected to a set terminal "S" of the second flip-flop 42 the output "Q" of which is connected to an adding control terminal 30-4 of the adder-subtractor 30 and to a first input 48-1 of the display circuit 48. The output "Q" of the second flip-flop 42 is further connected to a first input of the second OR gate 44 the output of which is connected to an up-down control terminal U/D of the up-down counter 14. The output terminal of the up-down counter 14 is connected to a first input 30-1 of the adder-subtractor 30 and to third input 48-3 of the display circuit 48. The output of

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the memory circuit 28 is connected to a second input 30-2 of the adder-subtractor 30 the output of which is connected to a second input 24-2 of the selection circuit 24. The output of the second NOT gate 46 is connected to a second input 48-2 of the display circuit 48.

The functions and operations of the first preferred embodiment of the trip meter shown in FIG. 1 will be described hereinbelow. When the known distance D_1 is set in the encoder 18, the encoder produces an output signal S_1 indicative of the known distance D_1 . The signal S_1 is applied via the selection circuit 24, when the control terminal 24-3 thereof is supplied with a logic "0" signal, to the up-down counter 14 and to the memory circuit 28. Since the actual distance display switch 22 normally produces a logic "0" signal which is supplied to the first input of the AND gate 32, the AND gate 32 provides a logic "0" signal to the control terminal 24-3 of the selection circuit 24, and other circuits connected thereto. When no pulse is applied to the first input 14-1 of the up-down counter 14, the signal S_1 is transferred to the output thereof so that the preset distance D_1 is displayed at the third display portion 54 of the display circuit 48. The clear switch 16 and the preset switch 20 normally produce logic "0" signals and thus the logic "0" signals are respectively applied to the clear terminal "C" of the up-down counter 14 and to the second input of the first OR gate 26.

When the vehicle is at a starting point, the vehicle driver operates the subtracting switch 38 so that a logic "1" pulse signal is applied to the reset terminal "R" of the first flip-flop 40 to obtain a logic "0" signal at the output "Q" of the same. The logic "0" signal is applied to the second input of the second OR gate 44, to the first NOT gate 34, and to the second NOT gate 46. The second NOT gate 46 converts the logic "0" signal into a logic "1" signal so that the second input 48-2 of the display circuit 48 is supplied with the logic "1" signal. The display circuit 48 includes first, second and third display portions 50, 52 and 54. The first display portion 50 displays "-" sign when the first input 48-1 is supplied with a logic "1" signal, the second display portion 52 displays "REST" sign when the second input 48-2 is supplied with a logic "1" signal, and the third display portion 54 displays numerals in accordance with a signal S_3 applied to the third input 48-3.

The second flip-flop 42 is arranged to produce a logic "1" signal at the output thereof when a logic "1" signal indicative of the overflow of the up-down counter 14 is applied from the overflow output terminal "OVF" of the up-down counter 14 to the set terminal "S" of the second flip-flop 42. The logic "1" signal indicative of the overflow is referred to as an over flow signal and is produced when the number of pulses applied to the first input 14-1 exceeds a number which corresponds to a distance represented by the signal applied to the second input 14-2 of the same. Since both of the inputs of the second OR gate 44 are fed with logic "0" signals, the second OR gate 44 produces a logic "0" signal accordingly with which the up-down counter 14 functions as a down (subtracting) counter. As mentioned before, the first input 14-1 of the up-down counter 14 is supplied with a signal S_2 which is a train of pulses produced as the vehicle travels. The number of the pulses indicates an actually travelled distance D_2 . Assuming the signal S_1 indicates the known distance D_1 , the up-down counter 14 produces an output signal S_3 indicative of the difference $D_1 - D_2$ between the two distances D_1 and D_2 . The output signal S_3 , therefore, indicates the

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remaining distance D_3 to the goal or an objective point with respect to the actually travelled distance D_2 . The signal S_3 is fed to the adder-subtractor 30 and to the display circuit 48 so that the remaining distance D_3 , i.e. $D_1 - D_2$, is displayed in a form of numerals at the third display portion 54 of the display circuit 48 while the sign of "REST" is also shown at the second display portion 52. If the preset distance, i.e. the known distance D_1 , for example, between the starting point and the goal is 100 Km, 100 is displayed at the third display portion 54 when the vehicle is at the starting point. When the vehicle has actually travelled as far as 70 Km, 30 is displayed at the same as the remaining distance D_3 . Simultaneously, the "REST" sign is also displayed at the second display portion 52. Although the above shown numerals are numbers occupying the position the left of the decimal, it is preferable that the displayed numbers be accurate to the first or second decimal place.

The above mentioned function of the trip meter occurs continuously so that the numerals indicative of the remaining distance D_3 at the third display portion 54 keeps decreasing. If the preset known distance D_1 equals the actual distance D_a between the starting point and the objective point, the numerals at the third display portion 54 of the display circuit 54 becomes "0" Km when the vehicle has reached the objective point since the known distance D_1 and the actually travelled distance D_2 are the same.

However, the preset known distance D_1 is not necessarily the same as the actual distance D_a . Distances shown on maps are sometimes erroneous. Further, the vehicle driver may change route on the way to the goal so that the actual distance D_a differs from the preset distance D_1 . There are two possibilities of the deviation of the actual distance D_a from the preset distance D_1 . The first possibility is that the actual distance D_a is shorter than the preset distance D_1 while the second possibility is that the actual distance D_a is longer than the preset distance D_1 . In the former case the "REST" sign at the second display portion 52 and numerals indicative of the difference $D_1 - D_2$ at the third display portion 54 are respectively displayed even though the vehicle has reached the objective point. For example, if the actually travelled distance as far as the objective point is 96 Km upon the set of 100 Km as the known distance, the difference, i.e. 4 Km as well as the "REST" sign are displayed at the display circuit 48, when the vehicle reaches the objective point. This means that the preset known distance D_1 is erroneous, viz. longer than the actual distance D_a . In such a case the vehicle driver operates the actual distance display switch 22 to produce a logic "1" pulse signal at the output thereof. The logic "1" pulse signal is then supplied to the first input of the AND gate 32 the second input of which is supplied with another logic "1" signal from the first NOT gate 34. Upon presence of logic "1" signals at the inputs thereof the AND gate 32 produces a logic "1" pulse signal at the output thereof which is supplied to the control terminal 24-3 of the selection circuit 24, to the first input of the first OR gate 26, to the reset terminal "R" of the second flip-flop 42, and to the subtracting control terminal 30-3 of the adder-subtractor 30. Upon presence of the logic "1" pulse signal at the subtracting control terminal 30-3 the adder-subtractor 30 starts functioning as a subtractor. Since the first and second inputs 30-1 and 30-2 of the adder-subtractor 30 have respectively been supplied with the signals S_3 and

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S_1 before the actual distance display switch 22 is operated, the adder-subtractor 30 produces an output signal S_4 indicative of the difference between distances D_1 and D_3 which are respectively indicated by the signals S_1 and S_3 . When the vehicle arrives at the objective point, the actually travelled distance D_2 represented by the number of pulses of the signal S_2 corresponds to the actual distance D_a between the starting point and the objective point. Namely, the output signal S_4 of the adder-subtractor 30 is indicative of the actual distance D_a since $D_1 - D_3 = D_1 - (D_1 - D_a)$. The output signal S_4 of the adder-subtractor 30 indicative of the actual distance D_a which is the actually travelled distance between the two points, is then fed to the second input 24-2 of the selection circuit 24.

Upon presence of the logic "1" signal at the control terminal 24-3, the selection circuit 24 selects the signal S_4 instead of the signal S_1 . Therefore, the signal S_4 is then fed to the second input 14-2 of the up-down counter 14 and to the input of the memory circuit 28. Simultaneously the logic "1" signal produced by the AND gate 32 is fed via the first OR gate 26 to the preset terminals "P" of the up-down counter 14 and the memory circuit 28 so that stored signals S_1 and S_2 in the up-down counter 14 and the stored signal S_2 in the memory circuit 28 are respectively cleared. After the above mentioned clearance, the signal S_4 indicative of the actual distance D_a is respectively stored in the up-down counter 14 and the memory circuit 28. The stored signal S_4 is supplied to the third input 48-3 of the display circuit 48 from the up-down counter 14 so as to indicate the actual distance D_a at the third display portion 54 of the same. Meanwhile the adder-subtractor 30 receives at the first and second inputs 30-1 and 30-2 thereof the same signals S_4 from the up-down counter 14 and the memory circuit 28.

In the previously described latter case, viz. actual distance D_a is longer than the preset distance D_1 , a logic "1" signal indicative of the overflow of the stored signal of the up-down counter 14 is produced at the overflow terminal "OVF" of the same to set the second flip-flop 42 when the vehicle has travelled as far as the preset distance D_1 . Upon presence of the overflow signal the second flip-flop 42 produces a logic "1" output signal which is fed to the adding control terminal 30-4 of the adder-subtractor 30, to the up-down control terminal U/D of the up-down counter 14 via the second OR gate 44, and to the first input 48-1 of the display circuit 48. Accordingly, the minus sign "-" at the first display portion 50 of the display circuit 48 is displayed while the adder-subtractor starts functioning as an adder and the up-down counter 14 starts functioning as an up (adding) counter. Therefore, the numerals displayed at the third display portion 54 increases from zero as the vehicle keeps travelling toward the objective point. In other words, the output signal S_3 of the up-down counter 14, which previously indicated the remaining distance D_3 as far as the actually travelled distance D_2 becomes equal to the preset distance D_1 , starts indicating the distance D_4 travelled in excess of the preset distance D_1 .

As an example, assuming the preset distance is 100 Km and the vehicle has still not reached the objective point when the vehicle has travelled 100 Km because the actual distance D_a between the starting point and the objective point is, in fact, 110 Km, the numeral at the third display portion 54 of the display circuit 48 becomes "0". Of course the displayed numerals "0" is

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erroneous since the vehicle is 10 Km from the objective point. After the numerals become "0", the numerals start increasing like 1, 2, 3 . . . When the vehicle finally reaches the objective point, the numerals indicate the actually travelled distance D_4 , i.e. 10 Km while the "-" sign is also displayed at the first display portion 50. The "REST" sign is also displayed since the second input terminal 48-2 of the display circuit 48 keeps receiving logic "1" signal from the second NOT gate 46.

The vehicle driver operates the actual distance display switch 22 when the vehicle arrives at the objective point in the same manner as in the former case. Therefore, a logic "1" pulse signal produced by the AND gate 32 is delivered to the selection circuit 24, to the first OR gate 26, to the second flip-flop 42, and to the adder-subtractor 30 in the same manner. The adder-subtractor 30 functions as an adder since the first adding control terminal 30-4 of the same is fed with a logic "1" signal although the subtracting control terminal 30-3 is also fed with a logic "1" signal from the AND gate 32. This means that the adder-subtractor is arranged to function as adder whenever the adding control terminal 30-4 receives a logic "1" signal irrespectively of the signal applied to the subtracting control terminal 30-3. Since the first and second input terminals 30-1 and 30-2 of the adder-subtractor 30 are respectively fed with signals S_3 indicative of the actually travelled distance D_4 , i.e. 10 Km, and S_1 indicative of the preset distance D_1 , the adder-subtractor 30 produces an output signal S_4 indicative of the sum D_5 of the distances where the sum D_5 is expressed in terms of $D_1 + D_4$, i.e. 110 Km in this example. The signal S_4 is then fed to the second input 24-2 of the selection circuit 24 so that the signal S_4 is fed to the up-down counter 14 and to the memory circuit 28 via the selection circuit 24 since the selection circuit 24 is responsive to the logic "1" signal applied to the control terminal thereof. As in the same manner as the former case the signals S_1 and S_2 stored in the up-down counter 14 and the signal S_1 stored in the memory circuit 28 are respectively cleared upon presence of the logic "1" pulse signal applied to the preset terminals "P" thereof via the first OR gate 26 from the AND gate 32. Then the newly provided signal S_4 indicative of the sum D_5 is respectively stored in the up-down counter 14 and the memory circuit 28. The signal S_4 indicative of the sum D_5 is forwarded to the display circuit 48 in the same manner so that the sum D_5 , i.e. 110 Km is displayed at the third display portion 54 of the display circuit 48. The adder-subtractor 30 meanwhile receives the signal S_3 indicative of the sum D_5 and the signal S_4 also indicative of the sum D_5 at the first and second input terminals 30-1 and 30-2.

From the foregoing description it will be clearly understood that in the above mentioned both cases the trip meter according to the present invention displays the remaining distance D_3 until the actually travelled distance D_2 reaches the preset distance D_1 . Further, the trip meter displays the excess distance, i.e. an actually travelled distance D_4 which the vehicle has travelled beyond the preset distance D_1 if the actual distance D_a between the starting point and the objective point is longer than the preset distance D_1 . Further, the trip meter displays the actual distance D_a from the starting point to the objective point when the actual distance display switch 22 is operated at the objective point. The function of the trip meter is not limited to the display of the above mentioned various distances. Further features of the trip meter will be described hereinbelow.

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The second feature of the trip meter resides in the fact that the trip meter may be utilized for a return trip if the vehicle returns to the starting point via the same rout from the objective point.

As described hereinabove, the third display portion 54 of the display circuit 48 displays the actual distance D_a between the starting point and the objective point when the actual distance display switch 22 is operated. Since the actual distance D_a between the starting point and the objective point, i.e. the actually travelled distance D_2 , is stored in the up-down counter 14, the up-down counter 14 starts producing an output signal S_3 accurately indicative of the remaining distance to a new goal which is the original starting point by subtracting an actually travelled distance D_2 indicated by the signal S_2 from the actual distance D_a indicated by the signal S_4 . With this provision, if the vehicle returns to the original starting point via the same rout, the numeral at the third display portion 54 of the display circuit 48 is supposed to display "0" when the vehicle reaches the original starting point.

The third feature of the trip meter according to the present invention, resides in the fact that the trip meter may be utilized for measuring the actually travelled distance between the starting point and a second objective point which is beyond of the first objective point. When the vehicle driver intends to drive the vehicle toward a second objective point beyond the first objective point, he operates the adding switch 36 for producing a logic "1" signal at the output thereof. The logic "1" signal is applied to the set terminal "S" of the first flip-flop 40 to produce a logic "1" signal at the output terminal "Q" of the same. The logic "1" signal is then applied via the second OR gate 44 to the up-down control terminal U/D of the up-down counter 14. Meanwhile the logic "1" signal is inverted by the first and second NOT gates 34 and 46 so that logic "0" signals are respectively applied to the second input of the AND gate 32 and to the second input terminal 48-2 of the display circuit 48. With this arrangement, the up-down counter 14 starts functioning as an up(adding) counter. Since the signal S_4 indicative of the actual distance D_a between the starting point and the first objective point is already stored in the up-down counter 14, the up-down counter 14 produces an output signal S_3 indicative of the distance between the starting point and the point at which the vehicle is travelling. In other words, the output signal S_3 of the up-down counter 14 indicates a distance which is expressed in terms of $D_a + D_6$ wherein D_6 is a distance travelled after the vehicle passes the first objective point.

A table which shows the relationship among the above mentioned various distances is made hereinbelow for convenience.

- Da: an actual distance between a starting point and a first objective point; (indicated by the signal S_4)
- D₁: a preset distance between the starting point and the first objective point, which may be obtained from a map; (indicated by the signal S_1)
- D₂: a distance actually travelled by the vehicle from the starting point, D_2 corresponds to D_a when the vehicle reaches the first objective point; (indicated by the signal S_2)
- D₃: a remaining distance expressed in terms of $D_1 - D_2$; (indicated by the signal S_3)
- D₄: an excessive distance, i.e. an actually travelled distance after the vehicle has travelled over the preset distance D_1 ; (indicated by the signal S_3)

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D₅: a sum of the distances D₁ and D₄, D₅ corresponds to D_a when the vehicle reaches the first objective point; (indicated by the signal S₄)

D₆: a distance actually travelled by the vehicle from the first objective point; (indicated by the signal S₂)

The fourth feature of the trip meter is that the signal stored in the up-down counter 14 may be cancelled whenever the vehicle driver wishes to do so by operating the clear switch 16. The clear switch 16 is arranged to produce a logic "1" pulse signal when operated which is supplied to the clear terminal "C" of the up-down counter 14. For instance, in case that the vehicle is at the first objective point and is going to leave for the second objective point, the vehicle driver may operate the clear switch 16 for cancelling the signal S₄ indicative of the actual distance D_a between the starting point and the first objective point if the vehicle driver wants to see only the actually travelled distance between the first objective point and the second objective point. In such a case all the vehicle driver has to do is to operate the clear switch 16 and the adding switch 36.

The fourth feature of the trip meter is that the trip meter may be utilized for a plurality of preset distances. In order to preset a plurality of distances the memory circuit 28 should include a plurality of memory circuits.

Hence, reference is now made to FIG. 2 which shows a second preferred embodiment of the trip meter according to the present invention. The circuit arrangement of the second embodiment has the same construction as the first embodiment shown in FIG. 1 except that a memory circuit 28' includes a plurality of memory circuits (no numerals). In this embodiment the memory circuit 28' includes three addressed memories the input of which are designated by reference numerals 28'-1, 28'-2 and 28'-3 respectively and three read out circuits, such as buffer registers (not shown). The memory circuit 28' is arranged to write information applied to the input terminals 28'-1, 28'-2 and 28'-3 in an addressed memory. One addressed memory is selected among three addressed memories in accordance with a signal applied to an address terminal "a" of the memory circuit 28'. The address switch 56 is operated to produce three output signals with each of which a corresponding addressed memory is selected. An input signal is then stored in a selected addressed memory in response to a logic "1" signal applied to the preset terminal "P" of the memory circuit 28' from the first OR gate 26. The written information is read out respectively in the same manner in response to the signals applied to the address terminal "a" from the address switch 56.

If the vehicle driver is aware of three distances, such as a first distance d₁ between the starting point and a first objective point, a second distance d₂ between the first objective point and the second objective point, and a third distance d₃ between the second objective point and the third objective point, he presets these three distances d₁, d₂ and d₃ in the addressed memories of the memory circuit 28' by using the encoder 18, the address switch 56 and the preset switch 20. The vehicle driver operates the keyboard of the encoder 18 so as to encode the first distance d₁. After the first distance d₁ is encoded, the vehicle driver operates address switch 56 and the preset switch 20 so as to write the first distance d₁ in the first addressed memory. In the same manner the second and third distances d₂ and d₃ are successively written in the second and third addressed memories. The written distances d₁, d₂ and d₃ are respectively read out by operating the address switch 56. The

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read out distances is applied to the second input 30-2 of the adder-subtractor 30.

When the vehicle is at the starting point, the vehicle driver operates the preset switch to read out a signal indicative of the first distance at the output of the memory circuit 28'. Then the driver operates the clear switch 16 to clear signals stored in the up-down counter 14. Before leaving the starting point the vehicle driver operates the actual distance display switch 22 and the subtracting switch 38 so that the adder-subtractor 30 starts functioning as a subtractor. Since the signal S₃ applied to the first input 30-1 of the adder-subtractor 30 from the up-down counter 14 represents zero, the adder-subtractor 30 produces an output signal S₄ indicative of the first distance d₁ which is then applied to the second input 24-2 of the selection circuit 24. Upon presence of a logic "1" signal at the control terminal 24-3 the selection circuit 24 permits transmission of the signal S₄. The output signal S₄ of the selection circuit 24 is then fed to the second input 14-2 of the up-down counter 14 so that numerals correspond to the first distance d₁ are displayed at the third display portion 54 of the display circuit 48. As the vehicle moves, the up-down counter 14 produces an output signal S₃ indicative of the difference between the first distance d₁ and an actually travelled distance D₂ so that a remaining distance to the first objective point is displayed. The "REST" sign is also displayed at the same time. Therefore, the second embodiment of the trip meter functions in the same manner as the first embodiment until the vehicle reaches the first objective point. When the vehicle arrives at the first objective point, the actual distance display switch 22 may be operated again so as to display the actual distance D_a between the starting point and the first objective point.

At the first objective point the address key 56 is operated to read out the second distance d₂. Before leaving for the second objective point the subtracting switch 38 is operated so that the remaining distance to the second objective point is displayed in the same manner. The trip meter may be used for the third distance d₃ in the same manner. Although the memory circuit 28' includes only three addressed memories, the number of the addressed memories may be increased if desired for storing more than three known distances.

For the return trip the trip meter may be utilized to display each of the remaining distances since the actual distance between the starting point and the first objective point, the actual distance between the first objective point and the second objective point, and the actual distance between the second objective point and the third objective point are respectively stored in the addressed memories.

FIG. 3 illustrates a front elevation of an operating set utilized for the first preferred embodiment of the trip meter according to the present invention. The operating set consists of first, second and third display portions 50, 52 and 54 and a keyboard panel 60. The first to third display portions 50, 52 and 54 are the same as those shown in FIGS. 1 and 2. The keyboard panel 60 includes ten keys 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9 corresponding to numerals 0 to 9, a decimal key ".", a clear error key CE, a preset key "P", an actual distance display switch key "AD", a clear key "C", an adding switch key +, and a subtracting switch key -.

The ten keys 0 to 9 and the decimal key "." are used for encoding a known distance into a binary signal. The clear error key CE is used for cancelling erroneous

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signals produced by misoperation of the ten keys 0 to 9 and the decimal key. The preset key P, the actual distance display key AD, the clear key C, the adding key +, and the subtracting key - respectively correspond to the preset switch 20, the actual distance display switch 22, the clear switch 16, the adding switch 36, and the subtracting switch 38 which are shown in FIG. 1. A key lock switch 62 is disposed at the lower portion of the front panel of the operation set. The key lock switch 62 is utilized for disconnecting the various keys disposed on the keyboard 60 from the corresponding circuit. Therefore, when the key lock switch 62 is turned on, operations of the keys on the keyboard 60 do not influence the trip meter at all so that undesirable operations of the trip meter due to a careless touch of the keys is prevented.

The operating set is preferably mounted on the instrument panel of the vehicle so that the vehicle driver can readily operate the keys and see the display portions 50, 52 and 54. Although the operating set shown in FIG. 3 is for the first preferred embodiment of the trip meter, almost the same operating set may be utilized for the second preferred embodiment where the operating set for the second embodiment includes a key corresponding to the address switch 56 shown in FIG. 2.

The preferred embodiments of the trip meter are constructed by discrete elements as shown in FIGS. 1 and 2. However, if desired, the trip meter according to the present invention may be substituted by a micro computer. It is therefore, further understood by those skilled in the art that the foregoing descriptions are preferred embodiments of the disclosed trip meter and that various changes and modifications may be made in the invention without departing from the spirit and scope thereof.

What is claimed is:

1. An electronic trip meter for a vehicle, comprising:
 - (a) first means for producing a first signal representative of a known distance;
 - (b) second means for producing a second signal representative of a distance traveled by said vehicle;
 - (c) third means for producing a third signal representative of the difference between the distances respectively represented by said second signal and another input signal;
 - (d) fourth means selectively transmitting said first signal or a fourth signal to said third means as said another input signal;
 - (e) fifth means for visually indicating the distance represented by said third signal;
 - (f) sixth means for producing a fifth signal when the distance represented by said second signal exceeds the distance represented by said another input signal;
 - (g) seventh means for storing said another input signal;
 - (h) eighth means for producing an output signal representative of the difference between the distance respectively represented by said third signal of said third means and said another input signal stored in said seventh means by subtracting the former from the latter upon absence of said fifth signal, and upon presence of said fifth signal the eighth means producing an output signal representative of the sum of the distances respectively represented by said third signal of said third means and said another input signal stored in said seventh means, said

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output signal of said eighth means being fed to said fourth means as said fourth signal; and

- (i) ninth means for controlling said third, fourth and seventh means to set said fourth signal into said third means and store said fourth signal into said seventh means in place of said first signal.
2. An electronic trip meter as claimed in claim 1, wherein said second means comprises a pulse generator for producing a pulse signal each time said vehicle travels over a predetermined unit distance.
3. An electronic trip meter as claimed in claim 2, wherein said third means comprises a presettable up-down counter responsive to said pulse signal fed from said pulse generator, said known distance being preset in said up-down counter, said up-down counter producing a signal indicative of a remaining distance to an objective point by subtracting an actually travelled distance indicated by the number of said pulses from said known distance when said actually travelled distance is below said preset distance, said up-down counter producing a signal indicative of an excess distance over said known distance by counting the number of said pulses from zero after said actually travelled distance equals said known distance.
4. An electronic trip meter as claimed in claim 3, wherein said sixth means comprises means for detecting an overflow of said up-down counter, the up count and down count functions of said up-down counter being controlled in response to the detection of said overflow.
5. An electronic trip meter as claimed in claim 3, further comprising manual switch means for controlling the up count and down count functions of said up-down counter.
6. An electronic trip meter as claimed in claim 1, further comprising clear means for clearing signals stored in said third means.
7. An electronic trip meter as claimed in claim 1, wherein said seventh means comprises memory means, and wherein said eighth means comprises an adder-subtractor.
8. An electronic trip meter as claimed in claim 7, wherein said memory means comprises a plurality of addressed memories for storing a plurality of known distances.
9. An electronic trip meter as claimed in claim 1, further comprising display means for displaying a sign which indicates that the distance displayed by said fifth means is a distance remaining to said objective point.
10. An electronic trip meter as claimed in claim 1, further comprising display means for indicating that said distance displayed by said fifth means is an excess distance.
11. An electronic trip meter for a vehicle, comprising:
 - (a) encoding means for producing a first signal indicative of a known distance between a starting point and an objective point;
 - (b) travelled distance sensing means for producing a second signal indicative of a distance actually travelled by said vehicle;
 - (c) an up-down counter having a first input connected to said travelled distance sensing means, a second input, a clear terminal, a preset terminal, an up-down control terminal, an overflow terminal, and an output, said up-down counter producing a third signal in accordance with said second signal and a signal applied to said second input terminal thereof;

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- (d) a clear switch connected to said clear terminal of said up-down counter for clearing signals stored in said up-down counter when operated;
 - (e) a preset switch for producing an output signal when operated;
 - (f) a first OR gate having a first input, a second input connected to said preset switch, and an output connected to said preset terminal of said up-down counter;
 - (g) actual distance display switch for producing an output signal when operated;
 - (h) an AND gate having a first input connected to said actual distance display switch, a second input and an output connected to said first input of said first OR gate;
 - (i) a first flip-flop having set and rest terminals respectively connected to switches, and an output connected via a first NOT gate to said second input of said AND gate;
 - (j) selection circuit having a first input connected to said encoding means, a second input, a control terminal connected to said output of said AND gate and an output connected to said second input of said up-down counter, said selection circuit selectively permitting transmission of said first signal or a signal applied to said second input thereof in response to a signal applied to said control terminal thereof;
 - (k) a memory circuit having an input connected to said output of said selection circuit, a preset terminal connected to said output of said first OR gate, and an output;
 - (l) a second OR gate having first input, a second input connected to said output of said first flip-flop, and an output connected to said up-down control terminal of said up-down counter;
 - (m) a second flip-flop having a set terminal connected to said overflow terminal of said up-down counter, a reset terminal connected to said output of said AND gate, and an output connected to said first input of said second OR gate;
 - (n) an adder-subtractor having a first input connected to said output of said up-down counter, a second input connected to said output of said memory circuit, a first control terminal connected to said output of said AND gate, a second control terminal connected to said output of said second flip-flop, and an output connected to said second input of said selection circuit, said adder-subtractor producing a fourth signal indicative of either the difference between distances respectively represented by said first and third signals or the sum of the distances in response to signals applied to said first and second control terminals; and
 - (o) a display circuit having a first input connected to said output of said second flip flop, a second input connected via a second NOT gate to said output of said first flip-flop, and a third input connected to said output of said up-down counter, said display circuit displaying numerals indicative of a distance in accordance with said third signal, displaying a negative sign upon presence of a signal at the first input thereof, and displaying a sign which indicates that the numerals correspond to the remaining distance to the objective point upon presence of a signal at the second input thereof.
12. An electronic trip meter for a vehicle, comprising:
- (a) encoding means for producing a plurality of first signals each of which is indicative of a known distance between two points;
 - (b) travelled distance sensing means for producing a second signal indicative of a distance actually travelled by said vehicle;
 - (c) an up-down counter having a first input connected to said travelled distance sensing means, a second input, a clear terminal, a preset terminal, an up-down control terminal, an overflow terminal, and an output, said up-down counter producing a third signal in accordance with said second signal and a signal applied to said second input terminal thereof;
 - (d) a clear switch connected to said clear terminal of said up-down counter for clearing signals stored in said up-down counter when operated;
 - (e) a preset switch for producing an output signal when operated;
 - (f) a first OR gate having a first input, a second input connected to said preset switch, and an output connected to said preset terminal of said up-down counter;
 - (g) actual distance display switch for producing an output signal when operated;
 - (h) an AND gate having a first input connected to said actual distance display switch, a second input and an output connected to said first input of said first OR gate;
 - (i) a first flip-flop having set and reset terminals respectively connected to switches, and an output connected via a first NOT gate to said second input of said AND gate;
 - (j) selection circuit having a first input connected to said encoding means, a second input, a control terminal connected to said output of said AND gate and an output connected to said second input of said up-down counter, said selection circuit selectively permitting transmission of said first signal or a signal applied to said second input thereof in response to a signal applied to said control terminal thereof;
 - (k) a memory circuit having a plurality of addressed memories, a preset terminal connected to said output of said first OR gate, and an address terminal; each of said addressed memories having an input connected to said output of said selection circuit and an output, each of said addressed memories being enabled in accordance with a signal applied to said address terminal;
 - (l) an address switch for producing a plurality of signals to select one of the said addressed memories;
 - (m) a second OR gate having first input, a second input connected to said output of said first flip-flop, and an output connected to said up-down control terminal of said up-down counter;
 - (n) a second flip-flop having a set terminal connected to said overflow terminal of said up-down counter, a reset terminal connected to said output of said AND gate, and an output connected to said first input of said second OR gate;
 - (o) an adder-subtractor having a first input connected to said output of said up-down counter, a second input connected to said outputs of said addressed memories contained in said memory circuit, a first control terminal connected to said output of said AND gate, a second control terminal connected to said output of said second flip-flop, and an output

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connected to said second input of said selection circuit, said adder-subtractor producing a fourth signal indicative of either the difference between distances respectively represented by said first and third signals or the sum of the distances in response to signals applied to said first and second control terminals; and

(p) a display circuit having a first input connected to said output of said second flip flop, a second input connected via a second NOT gate to said output of said first flip-flop, and a third input connected to said output of said up-down counter, said display circuit displaying numerals indicative of a distance in accordance with said third signal, displaying a negative sign upon presence of a signal at the first input thereof, and displaying a sign which indicates that the numerals correspond to the remaining distance to the objective point upon presence of a signal at the second input thereof.

13. A method of supplying a vehicle driver with distance information, comprising the steps of:

- (a) producing a plurality of first signals respectively representative of a plurality of known distances of legs of a predetermined travelling course at a starting point of said course, said first leg being defined by said starting point and a first objective point and remaining legs being defined by subsequent objective points along said predetermined course;
- (b) storing said first signals;
- (c) producing a second signal representative of a distance actually travelled by said vehicle travels;
- (d) subtracting the actually travelled distance from said known distance of said first leg for obtaining the distance remaining to said first objective point;
- (e) visually indicating said remaining distance;

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(f) detecting whether said actually travelled distance is greater than said known distance of said first leg or not;

(g) visually indicating that said remaining distance is of negative value when said actually travelled distance exceeds said known distance of said first leg before said vehicle reaches said first objective point;

(h) subtracting said remaining distance from said known distance of said first leg when said actually travelled distance is less than said known distance of said first leg to obtain the actual distance of said first leg;

(i) adding said remaining distance to said known distance of said first leg when said actually travelled distance is greater than said known distance of said first leg at said first objective point to obtain the actual distance of said first leg;

(j) storing said actual distance of said first leg in place of said known distance of said first leg;

(k) repeating said steps of (d) to (j) for the following legs until the vehicle reaches the last objective point of said predetermined travelling course;

(l) subtracting the actually travelled distance from said actual distance of the last leg for obtaining the distance remaining to the objective point separating said last leg and the second last leg on the way back to said starting point from said last objective point in a return trip along said predetermined course;

(m) visually indicating said second mentioned remaining distance; and

(n) repeating said steps of (l) and (m) for the remaining legs until the vehicle returns to said starting point.

* * * * *

Exhibit 11

United States Patent [19]
Ricard

[11] **4,409,685**
[45] **Oct. 11, 1983**

[54] **METHODS AND TAXIMETERS FOR CALCULATING A TAXI FARE**

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[21] Appl. No.: **228,741**

[22] Filed: **Jan. 27, 1981**

[30] **Foreign Application Priority Data**

Feb. 7, 1980 [FR] France 80 02900

[51] Int. Cl.³ **G07B 13/00; G06F 15/20**

[52] U.S. Cl. **377/20; 235/30 R;**
364/467

[58] Field of Search 235/92 TC, 30 R, 92 DM,
235/92 DN, 92 R; 364/467

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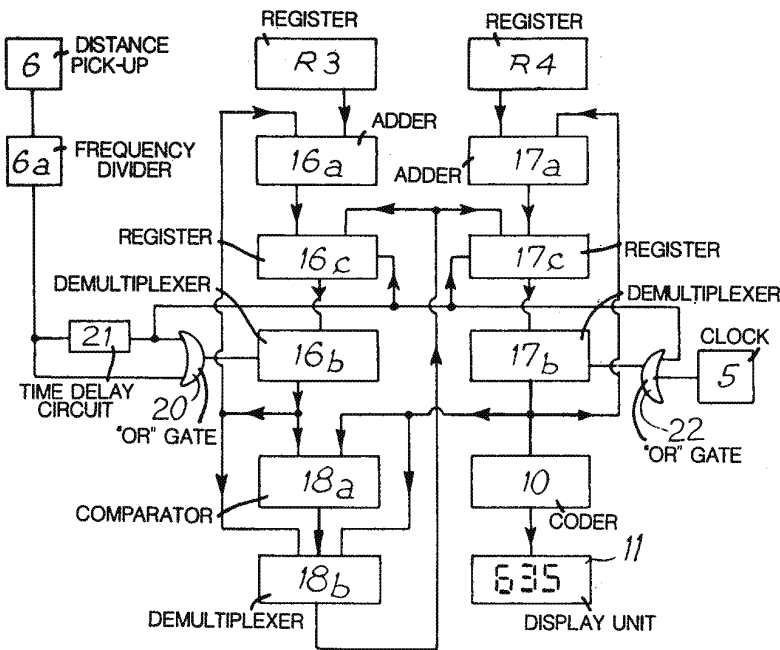
Primary Examiner—Howard Britton
Attorney, Agent, or Firm—Brumbaugh, Graves,
Donohue & Raymond

[57] **ABSTRACT**

Electronic taximeter comprising a clock, a distance pick-up, a counter registering the number n1 of clock pulses delivered between two distance pulses, three registers R2, R3, R4 in which are recorded constant numbers n2, p2 and p1, a multiplier circuit, a selector circuit, a totalizing counter and a luminous display unit.

Each taxi run is split into successive portions of equal length, and the fixed unit price p2 and the price n1.p1 variable with the speed are worked out for each portion, after what the highest of the two is selected and a total fare is displayed by adding up the partial prices.

6 Claims, 4 Drawing Figures



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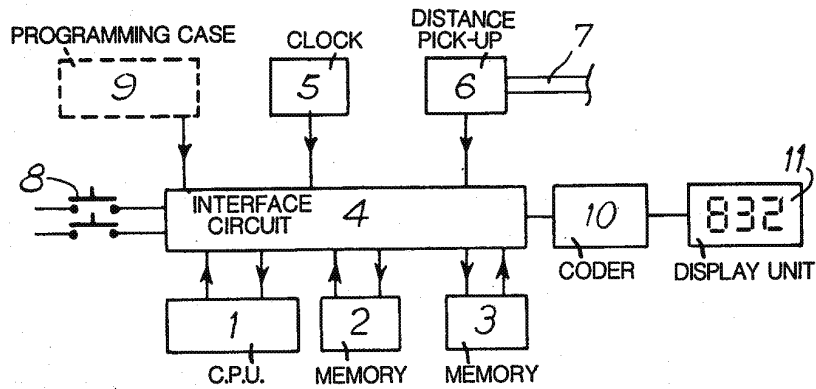


Fig. 1

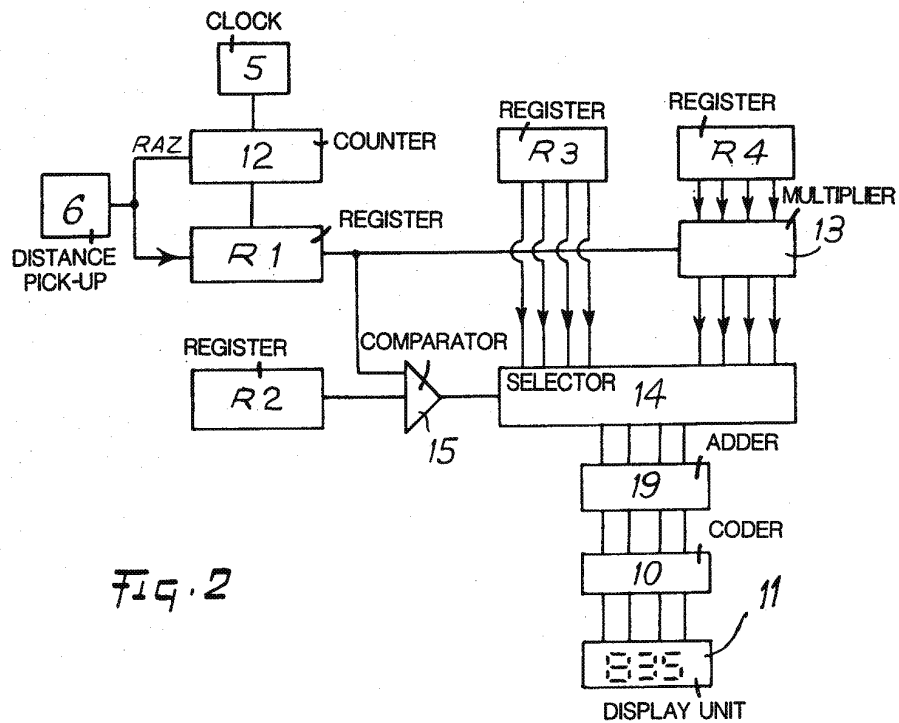
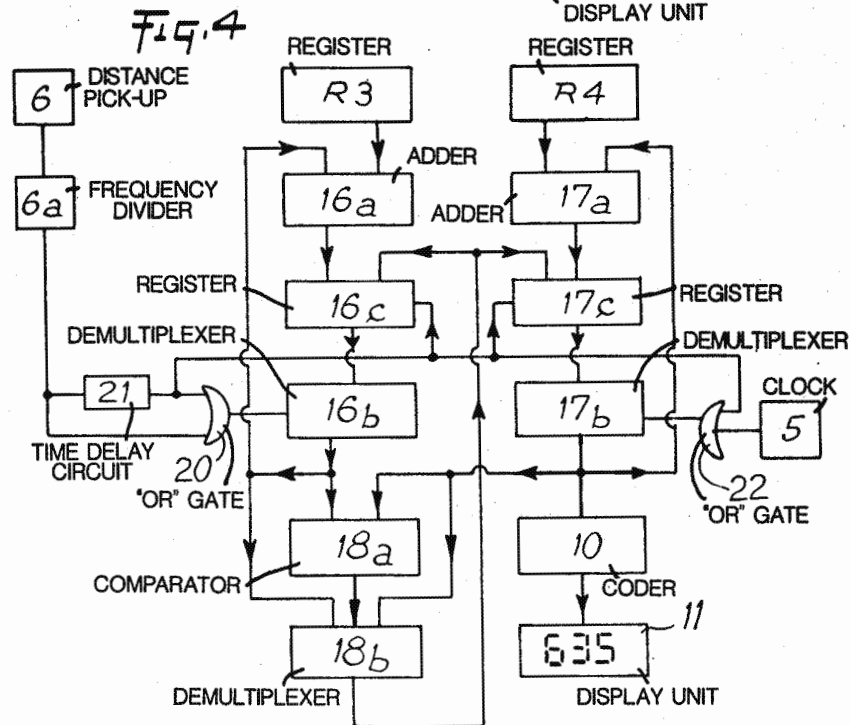
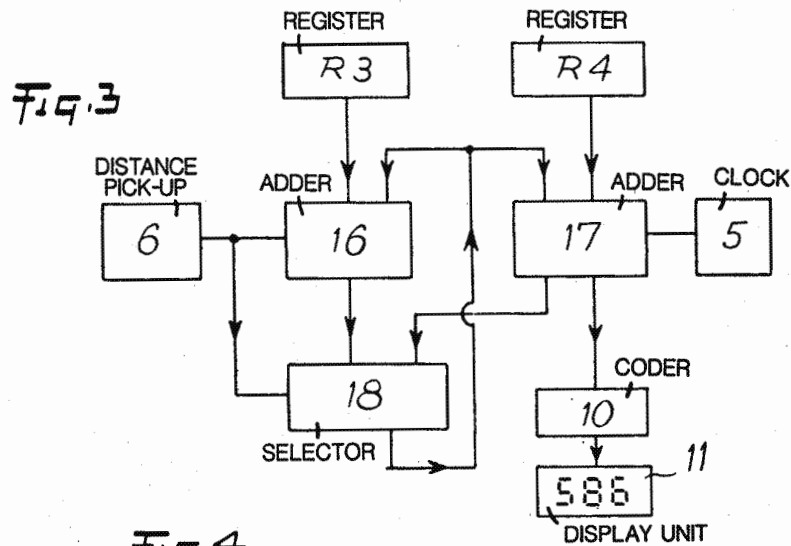


Fig. 2

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METHODS AND TAXIMETERS FOR CALCULATING A TAXI FARE

The present invention relates to methods and to taximeters for calculating a taxi fare.

The technical sector of the invention is that of construction of electronic taximeters.

It should first be recalled that the taxi fare which is displayed by a taximeter is obtained by continually comparing the rate per kilometer with a rate per hour and by applying every time the highest of the two.

With the known mechanical taximeters, this selection is done automatically by comparing the speed of rotation of two pinions which rotate, one at a constant speed and the other proportionally to the speed of the vehicle, and it is the pinion rotating the fastest which drives the price counter.

The known electronic taximeters comprise, on the one hand, a clock delivering pulses of constant frequency and, on the other hand, means for picking up the distance travelled which deliver pulses in a number proportional to the distance travelled by the vehicle.

Electronic taximeters comprise a calculation unit which works out a taxi fare by adding up partial prices which correspond to successive elementary portions whose length or duration can be equal or not. For each portion of a taxi run, the calculating unit sets up the partial fare by multiplying either the distance travelled by the set price of the unit of distance, or the time spent by the set price of the unit time.

The electronic taximeters comprise a logic unit of selection which decides for each elementary portion of taxi run whether the calculating unit should take into account either the distance covered or the time spent. Said logic unit is an essential part of an electronic taximeter and the accuracy of the fare calculation is largely dependent on the criteria of selection used in the said logic unit of selection.

There is a vehicle moving speed, called conjunction speed, which is that for which the price of a portion of taxi run is the same whether the rate per kilometer or the rate per hour is applied.

Various methods and devices have been proposed to calculate electronically the partial fares with an accuracy of the order of $\pm 1\%$ on the total fare, which is the required accuracy.

French Pat. No. 1 514 687 (KIENZLE) describes a comparison device, called overload circuit, which comprises a flip-flop, receiving at each one of its two input terminals the pulses issued respectively from a pick-up of distance travelled and from a clock.

Said flip-flop is associated to a logic gate and to two diodes and lets through those pulses whose frequency is the highest.

The functioning of this device is based on a distance pick-up and on a clock, both delivering pulses of similar frequency when the taxi travels at a speed which is equal to the conjunction speed. But the frequency of the distance pick-up is linked to the number of revolutions effected by the vehicle wheels in one second, and this frequency is low, of the order of only a few hertz, so that such a device lacks precision.

British Pat. No. 1 240 325 (J. F. Bruce SANDERS) as well as U.S. Pat. No. 3,512,706 corresponding thereto, describe an electronic taximeter which comprises both an oscillator and a distance pick-up sending for example two pulses per revolution of the driving shaft. The

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device comprises means permitting to stop the counting of the waiting time as soon as the taxi starts moving. When the handle of the taximeter is placed in the "hired" position, the pulses of distance travelled reset constantly a divider placed next to the clock and no waiting time is billed.

According to a variant, the taximeter comprises an oscillator whose frequency corresponds to that of the distance pick-up when the taxis travels at the minimum speed or conjunction speed.

A logic device comprising two flip-flops and gates allows the distance pulses through the counting unit if their frequency is higher than that of the clock pulses.

This device, like the previous one, necessitates the use of a clock whose frequency is equal to the frequency of the distance pulses when the taxi travels at the conjunction speed, this limiting to a larger extent the accuracy of these devices.

U.S. Pat. No. 4,118,775 (P. H. BOYCE) describes another device which is composed of two storage registers of the RAM type. In one of these registers R1, is recorded a constant number of pulses corresponding to the number of distance pulses which would be delivered by the distance pick-up for a very specific period, for example one second, if the taxi were travelling at the conjunction speed. In a second register R2 are recorded the distance pulses delivered by a distance pick-up. Every second, the contents of R2 are transferred to a calculating unit WR and compared with the number recorded in R1. If R2 is higher than R1, R2 is chosen. In the event of the contrary, R1 is chosen.

There is a risk with this type of device of serious errors being made when the taxi travels at a speed close to the conjunction speed.

Indeed, the distance pick-up currently used are revolution pick-ups which are associated to the tachometric cable actuating the vehicle mileometer and speedometer, which latter is connected to the output shaft of the gear-box.

The number of revolutions of a tachometric cable per kilometer travelled by the vehicle is generally between 700 and 1200, i.e. each revolution corresponds to a travelled distance which is situated between 0.80 m and 1.50 m approximately.

Taking a normal practical instance wherein the conjunction speed is 7.2 Km/hour, wherein the distance pick-up delivers two pulses per cable revolution and wherein the tachometric cable effects 1000 revs. per kilometer travelled, i.e. one rev per meter travelled, we see that we obtain four pulses per second at the conjunction speed. When the taxi moves at around that speed, the number of distance pulses sent every second will then have to be compared with the number four. It is therefore obvious that the position of the first distance pulse with respect to the beginning of each comparison period can vary by a period which is equal to a quarter of the comparison period and for the same travelling speed of the taxi, the number of distance pulses counted per second can therefore vary between three and five, hence a cause for serious error in the fare which greatly exceeds the accepted tolerances.

In order to overcome this disadvantage, it would be possible to increase the duration of the comparison periods so as to compare larger numbers of distance pulses per period. But then another cause for error is introduced in that, during one and the same period, the instantaneous speed of the taxi can depart from the average speed. Theoretically, it would be possible to

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increase the frequency of the distance pulses, but one is rapidly restricted when taking this course, by the technological limitations related to the constructions of distance pick-ups which will not be either too cumbersome or too expensive, and it is an accepted fact that in practice, the pick-ups of distance travelled deliver at the maximum three pulses per meter travelled, i.e. six pulses per second at the conjunction speed, whereas it is currently known to build for a very low price, electronic clocks which oscillate at the frequency of 1 KHz.

Taximeters exist which calculate a predetermined number of pulses corresponding to a specific sum and which increment the displayed fare every time the counted number of pulses reaches the predetermined number.

U.S. Pat. No. 3,970,827 (H. IKUTA et al.) describes a taximeter of this type which comprises a speed detection circuit which detects when the speed of the vehicle is less or greater than a reference speed equal to the conjunction speed and which controls a selection circuit letting through either the clock pulses or the pulses delivered by the distance pick-up.

A counter adds up the pulses traversing the selector.

When the number of pulses recorded by the said counter reaches a predetermined value, the counter actuates a pulse generator delivering a predetermined number of pulses which increase the displayed price by a constant quantity or basic portion.

This particular mode of display of the fares by successive basic portions give rise to errors in the fares which it is the object of the present invention to eliminate.

The object of the present invention is to propose electronic means based on a new method of splitting a taxi run in very short successive elementary portions, and permitting, when the taxi travels at a speed approaching the conjunction speed, to select with great accuracy, the portions of run which should be billed in relation to the distance travelled and those which should be billed according to the rate per hour.

The methods according to the invention for calculating a taxi fare displayed on a taximeter comprise known operations according to which the distance travelled by the taxi is measured by means of a distance pick-up which delivers a number of pulses proportional to said distance and the duration of the taxi run is measured by means of an electronic clock which delivers pulses of constant and high frequency.

The object of the invention is reached with methods which consist in the following operations:

the taxi run is split into successive elementary portions of equal length, which is the constant distance travelled by the taxi between two successive pulses sent by the distance pick-up or by a frequency divider connected therewith;

the number of pulses n_1 delivered by the said clock during each elementary portion, i.e. between two successive pulses delivered by the distance pick-up or by the frequency divider, is counted;

after each portion a constant number p_2 which is the unit fare for a distance equal to the constant length of each portion is compared with a variable number $n_1.p_1$ which is the partial price of the portion obtained by multiplying the price p_1 of a unit time equal to the period of the said clock by the duration of each portion n_1 ;

the highest of these two numbers is selected as partial price of the said elementary portion;

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and the total fare is calculated by adding up the said partial prices.

According to a first method:

a constant number n_2 which is equal to the number of pulses delivered by the said clock for the period necessary to travel one portion at the conjunction speed, is recorded in a register;

after each elementary portion, the variable number of pulses n_1 is compared with the number n_2 ;

and depending on whether n_1 is greater or smaller than n_2 , either the price $n_1.p_1$ or the price p_2 is selected as partial price of the elementary portion.

According to a preferred variant:

to a first adder circuit are connected, first a register R3 in which is recorded the unit price p_2 and second, the said pick-up and the contents of the said adder is increased by a value equal to p_2 every time the pick-up delivers a pulse;

to a second adder circuit are connected, first a register R4 in which is recorded the unit price p_1 and second the said clock, and the contents of the second adder are increased by a value equal to p_1 every time the clock delivers a pulse;

the outputs of the said adders are connected to a selective switching circuit comprising a comparator comparing the numbers recorded in the two counters and a demultiplexer which routes towards the output terminal the highest of the two;

the output of the said switching circuit is reconnected in parallel on the said adder circuits, so that after each pulse delivered by the said pick-up, the highest of the two figures recorded in the said adder circuits comes to be recorded in the two adder circuits;

and the output of the clock pulse counter is connected to a luminous display device.

A taximeter according to the invention is of the known type comprising a distance pick-up which delivers a number of pulses proportional to the distance travelled by the taxi, an electronic clock, means for dividing each taxi run into successive elementary portions and for calculating a partial price of each portion, a totalizing counter totalling the said partial prices and a luminous display means for displaying the price recorded in the said accumulating counter.

A taximeter according to the invention comprises:

a register R3 in which is recorded a constant number equal to the unit price p_2 of a distance equal to the constant distance travelled by the taxi between two pulses delivered by the said distance pick-up;

a register R4 in which is recorded a number equal to the unit price p_1 of a hired duration equal to the period of the said clock;

a pulse counter counting the number of pulses n_1 delivered by the said clock between two pulses delivered by the said pick-up;

and logic circuits which compare after each pulse delivered by the said pick-up the number p_2 with the product $n_1.p_1$ and select as partial price of the said portion the highest of the two numbers.

According to a first embodiment, a taximeter according to the invention comprises:

a register R1 which is connected to the output terminals of the said pulse counter;

a second register R2 in which is recorded a constant number n_2 equal to the number of pulses delivered by the said clock during the period separating two

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pulses delivered by the said counter when the taxi travels at the conjunction speed;

a multiplier circuit to which are connected the register R4 and the register R1 and which calculates the product $n1.p1$;

a comparator comparing the numbers $n1$ and $n2$ recorded in the registers R1 and R2;

and a demultiplexer circuit with two inputs, connected respectively to the register R3 and the multiplier circuit, which demultiplexer circuit is controlled by the logic signal delivered by the said comparator, so that it transmits the product $n1.p1$ if $n1$ is higher than $n2$ and that it transmits the price $p2$ recorded in the register R3 if $n1$ is smaller than $n2$ and the output terminal of the said demultiplexer circuit is connected to an accumulating counter.

According to another preferential embodiment, a taximeter according to the invention comprises:

a first adder circuit on which are connected the said distance pick-up and the said register R3, which first pick-up is of the type whose contents are increased by an amount equal to $p2$ every time it receives a pulse from the pick-up;

a second adder circuit on which are connected the said clock and the register R4, said second adder being of the type whose contents are increased by an amount equal to $p1$ every time it receives a clock pulse;

a selecting logic circuit comprising two input terminals connected to the input terminals of the two adders and a control terminal connected to the output terminal of the distance pick-up, which selecting circuit is of the type which compares the numbers recorded in the adders every time it received a pulse from the pick-up and which lets through the highest of the two numbers and the output terminal of the selecting circuit is reconnected in parallel on the two adders, so that after each pulse delivered by the pick-up, the same number equal to the number P is found in the two adders which was there after the preceding pulse, increased by the higher of the two numbers $p2$ and $n1.p1$ recorded respectively in the two adders between two pulses of the pick-up, the number $n1$ being the number of clock pulses delivered between two pulses of the distance pick-up and the second adder is used as a price accumulating counter and is connected to the luminous display means of the taximeter.

The invention results in new electronic taximeters equipped with a logic unit which splits each taxi run into successive elementary portions, of equal length, whereas the known taximeters work by successive portions of equal duration. This modification in the splitting of the taxi run entails a simplification of the circuits and a more accurate selection of the partial prices when the taxi travels at an average speed approaching the conjunction speed.

Indeed, this splitting up into portions of equal length means that the comparisons are made on the duration of each portion of taxi run, which durations are measured by numbers of electronic clock pulses. And it is commonly known to produce electronic clocks whose frequency is high, for example of the order of KHz or more.

The selection effected by the logic circuits according to the invention is dependent on a comparison between

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two high numbers of clock pulses, for example, numbers reaching several hundreds, and the accuracy of decision which is of the order of one to two clock pulses is therefore very great. Moreover, the splitting into portions of equal length permits to divide the taxi run into very short elementary portions of the order of a fraction of a meter, which are infinitesimal portions with respect to the total length of the run.

The method of splitting the taxi run into portions of equal length permits the division of the run into a much higher number of portions than the method wherein the taxi run is split into portions of constant period, in that part of the run which is travelled at a higher speed than the conjunction speed which is generally the most expensive part of a taxi run and therefore it permits to improve the overall accuracy of the calculation of the total fare.

The description refers to embodiments with discrete components (non-integrated) but the methods according to the invention can easily be performed with integrated circuits of the microprocessor type comprising memories in which are stored the successive operations of splitting into portions and comparing the partial prices.

The invention will be more readily understood on reading the following description with reference to the accompanying drawings in which:

FIG. 1 is a block diagram showing the essential parts of an electronic taximeter and their inter-connections.

FIG. 2 is a diagram of the logic unit which splits the taxi run into successive portions of run and which selects the price of each elementary portion.

FIG. 3 is a diagram of a preferential variant of the aforesaid logic unit.

FIG. 4 is a diagram of an embodiment of the circuits of FIG. 3.

FIG. 1 shows very diagrammatically the essential members of an electronic taximeter of the type comprising a microprocessor composed of a central processing unit 1 and of memories 2, 3 etc. . . produced in the form of large scale integrated circuits (LSI circuits).

The memories 2, 3 etc. . . comprise read only memories (ROM) and random access memories (RAM).

The ROM memories contain the permanent data necessary to the operation of the taximeter, and in particular the instruction setting out the working programme of the central processor 1.

The RAM memories contain the temporal data, such as for example the cost of the time unit and of the distance unit depending on the rates used and on local regulations.

The calculating unit 1 and the memories communicate together and with data input and output members via an interface circuit 4.

The data input member comprises an electronic clock 5 and a pick-up 6 which is connected to a tachometric cable 7 which is plugged into the output shaft of the speed-box and turns at the same speed as said shaft. The pick-up 6 delivers pulses in number proportional to the number of rotations of the output shaft of the speed-box and therefore to the distance travelled by the taxi. The input members also comprise switches or pushbuttons 8 which are on the housing of the taximeter and permit for example to indicate the exact moment when a taxi is hired by a client and what rate should be applied according to local regulations which set down several types of rates, such as day rate, night rate, town rate, out-of-town rate, etc. . . .

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A special input member 9 has been shown in dotted line and does not form part of the taximeter. Said reference 9 illustrates a programming case which is at the disposal of the Office of the Inspector of Weights and Measures or any other official services whose duty it is to control that the taximeters are in good working order.

The programming case is connected by way of a multi-conductor cable to a socket provided on the taximeter and it permits to modify the unit prices recorded in a RAM type memory whenever the current official regulations make it necessary.

The output members comprise a coding circuit 10 and a luminous display unit 11 on which the face is displayed throughout the whole length of the taxi run.

FIG. 1 is a simplified description of an electronic taximeter of the known type. This type of taximeter being already known it is deemed unnecessary to give a more detailed description of it. The said description has been limited to the essential members which are evoked in the rest of the present description.

It must be recalled that the main difficulty to overcome in an electronic taximeter is the splitting of a taxi run into successive elementary portions of run and to decide, for each elementary portion, whether it should be priced on the basis of the distance or on the duration of the portion.

When the taxi travels at a speed approaching the conjunction speed, this decision becomes difficult to take and its precision constitutes an essential condition to the good accuracy of the taximeter.

A taximeter being an instrument designed to work out a public price, it becomes absolutely essential that this price should be established with great accuracy and based on reliable criteria.

The choice between a rate per kilometer of an hourly rate to be applied to each elementary portion of run is obviously dependent of the type of splitting into portions which has been selected, and it will be all the more accurate that the successive portions are many and short.

In order to give an idea, let us take a numerical example which is not restrictive in any way, but is designed to give an order of magnitude. Supposing that the clock 5 issues pulses whose frequency is 1 KHz. Supposing that the basic hourly rate is FF. 36 per hour, i.e. 1 centime per second and 0.001 centime per clock pulse. And supposing that the distance pick-up 6 delivers one pulse per meter travelled and that the basic rate per kilometer is FF. 4, i.e. 0.4 centime per meter.

The conjunction speed at which the costs of distance travelled and of hired time are balanced is 9 Km/hr.

When a taxi travels in town, its speed is often approaching the conjunction speed and in this case it is very important in order to obtain the exact price, to make the right decision.

When the taxi travels at 9 Km/hr, it covers 2.5 m/sec. and the distance pick-up then delivers 2.5 pulses per second.

It is immediately obvious that the known devices which compare the frequency of the clock and of the distance pick-up could not operate in this instance, which nevertheless corresponds to an electronic clock and to a distance pick-up of a conventional type.

It is equally obvious that the selection devices which split the taxi run into portions of run of equal duration, for example portions of about one second, and which periodically compare the number of pulses delivered by

the distance pick-up with the number of pulses which it would deliver in one second at the conjunction speed, i.e. 2.5, will work very inaccurately.

The selection devices according to the invention eliminate these drawbacks by using a method which consists in splitting the taxi run into successive portions of run of equal length but of unequal duration, and more particularly into portions of run which correspond to the distance travelled by the taxi between two pulses, successive or not, of the distance counter. In the numerical example considered, the run is split into portions 1 meter long.

The clock pulses are counted through each portion and they are compared to a reference value, which is equal to the number of pulses which would be delivered by the clock if the taxi was travelling at the conjunction speed.

In the numerical example considered, at the conjunction speed of 9 Km/hr, the taxi travels 2.5 m/sec. and throughout the period taken to travel one portion of 1 meter, the clock delivers 400 pulses. It is immediately obvious that around the conjunction speed, the comparison will be concerned with a number approaching 400 and that an error of one or two pulses will entail a very small relative error, undoubtedly less than 1%.

If the comparison reveals, during the travelling of one portion, a number of clock pulses greater than the reference value, the taxi travels at a speed which is lower than the conjunction speed and this portion is counted at the hourly rate. In the opposite case, it is counted at the rate per kilometer. In both cases, the price of the portion just covered is added up to the price already recorded and the total price is recorded in a totalizing counter which is connected to a luminous display unit via known circuits.

FIG. 2 shows an embodiment in discrete components (non-integrated) of a device according to the invention for splitting a taxi run into portions of run and working out the price of each such portion. An example of embodiment in discrete components has been chosen for clarity's sake. It is obvious that the discrete components can be incorporated in calculating units or in storage units as integrated circuits, for example in the units 1 to 3 of FIG. 1.

Said FIG. 2 also shows a clock 5 and means 6 for picking up the distance travelled by the taxi. The clock 5 is connected on a binary pulse counter 12 whose binary outputs are connected on a register R1. The output of the pick-up 6 is connected in parallel on the register R1 and on the resetting of the counter 12. Each time the said pick-up 6 delivers a pulse, said pulse controls the transfer and the storage into the register R1 of the number n1 of pulses counted by the counter 12 and the resetting of the counter 12 which immediately starts a new counting up of the clock pulses. Thus, for each pulse delivered by the pick-up 6, a binary number n1 is transferred into the register R1 which number n1 is equal to the number of clock pulses delivered between two distance pulses, successive or not, i.e. a number of clock pulses which measures the variable time period taken by the taxi to travel one portion of run of constant length.

The device comprises a second register R2 in which is recorded, in binary, a reference value equal to the number n2 of pulses which would be delivered by the clock, through the period taken to cover one portion travelled at the conjunction speed, for example a number equal to 400 in the numerical example considered.

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The reference R3 represents a third register in which is recorded in binary, a number p2 equal to the price of the distance unit travelled by the taxi between two distance pulses, successive or not. In the numerical example considered, the distance travelled between two distance pulses is 1 meter and the unit price recorded in the register R3 is equal to 0.4 centime.

The reference R4 represents a fourth register in which is recorded in binary a figure equal to the price p1 of the time period elapsing between two successive clock pulses. In the numerical example considered, the figure 0.001 centime is recorded, in R4, which is the price of a millisecond of hiring of the taxi.

The registers R1, R2, R3 and R4 are for example sections of RAM memories in integrated circuits.

The reference 13 represents a binary multiplier circuit which is connected, on the one hand, on the output of the register R1 and on the other hand, on the register R4 and which works out the product of the number n1, recorded in the register R1, by the unit price p1, recorded in the register R4. The product n1.p1 represents the cost of the travel time for one portion whereas the price p2 is the cost of the constant distance covered for each portion.

It will be noted that $p2 = n2.p1$ by definition of the conjunction speed.

The binary output of the register R3 and of the multiplier 13 are connected on demultiplexer circuit 14 which is a selector circuit of a known type so-called two-towards-one, which enables to route towards outputs, one or the other of two binary pieces of information fed into the circuit. The routing is controlled by a logic signal delivered by a comparator 15 which compares the numbers n1 and n2 recorded in the registers R1 and R2. If n1 is greater than n2, the logic signal delivered by the comparator 15 routes towards the output of the selector 14, the product n1.p1 delivered by the multiplier 13. If on the contrary, n1 is less than n2, the logic signal delivered by the comparator 15 routes towards the output of the selector 14 the price p2 recorded in the register R3. The output of the selector 14 is connected on a totalizing counter 19 in which the number delivered by the selector 14 is added to the previously recorded number. The binary outputs of the totalizing counter 19 are connected via known circuits 10 on a luminous display unit 11 on which is displayed the fare. Of course, after each comparison, the register R1 is reset until the next distance pulse.

As shown in FIG. 2, the device splits the taxi run into successive portions of run and selects the price rate to be applied for each portion, these operations being controlled by the pulses delivered by the pick-up 6. When the taxi is hired but stationary, the pick-up 6 issues no pulses and therefore it is necessary to add to the device which has just been described an additional circuit permitting to count up the hiring time of the taxi as soon as the taxi moving speed becomes clearly less than the conjunction speed.

FIG. 3 shows a variant embodiment of a device which uses the method according to the invention whereby the taxi run is split into successive portions of equal length and which enables to do away with the addition of an extra circuit, in the case where the taxi is hired but stationary.

The reference 5 represents the electronic clock and the reference 6 the distance pick-up. The reference R3 and R4 represent, as in FIG. 2, registers in which are recorded respectively the price p2 of the distance unit

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corresponding to the constant length of each portion of run and the price p1 of the time unit which elapses between two successive clock pulses.

The output of the pick-up 6 and the register R3 are connected on an adder circuit 16 and every time the pick-up 6 delivers a pulse, the content of the adder circuit 16 goes up by an amount which is equal to the price p2 recorded in the register R3.

Likewise, the clock 5 and the register R4 are connected on an adder circuit 17, and every time the clock delivers a pulse, the content of the adder circuit 17 goes up by an amount which is equal to the price p1 recorded in R4.

The device comprises a logic circuit of selection and routing 18, which plays the same part as the circuits 14 and 15 of FIG. 2 and which is composed, on the one hand, by a comparator for comparing the numbers recorded in the totalizing counter 16 and 17 and on the other hand, by a demultiplexer of the two-towards-one type. The circuit 18 is connected, on the one hand, on the outputs of the adder circuits 16 and 17 and, on the other hand, on the output of the pick-up 6, every time the pick-up 6 delivers a new pulse, said pulse controls the comparator included in the circuit 18, which comparator compares the numbers recorded in the adder circuits 16 and 17 and routes the higher of these two numbers towards the output of the circuit.

The output of the circuit 18 is reconnected in parallel on the two adder circuits 16 and 17 and the selected value is recorded up in the two adder circuits in the place of the value precedingly recorded therein. The same price P is therefore recorded in the two adder circuits 16 and 17 at the start of each portion and, at the end of each portion, the circuit 18 compares thus a price $P + p2$ recorded in the adder circuit 16 with a price $P + n1.p1$ recorded in the adder circuit 17, n1 being the number of pulses delivered by the clock 5 during the portion of run. It is therefore clear that the comparison is made solely between, on the one hand, p2 and, on the other hand, n1.p1 since the same term P is found on both sides.

At the end of each elementary portion of run, two partial prices of the said portion are compared, one of them p2 corresponding to the length of the portion and the other, n1.p1 corresponding to the time spent to travel the portions, and the highest of these two partial prices is selected and recorded in the two adder circuits 16 and 17.

If for example the taxi has travelled one portion at a speed less than the conjunction speed, n1.p1 is greater than p2 and therefore the same value $P + n1.p1$ is recorded in the two adder circuits 16 and 17 at the end of a portion, which value will represent the total fare at the end of the portion.

The adder circuit 17 is used as a totalizing counter and is connected via known circuits 10 on a luminous display unit 11 where the total fare is displayed according to the official regulations in application.

If the taxi is stationary, the price recorded in the adder circuit 17 continues to increase automatically by amounts equal to the price of a waiting time unit, every time the clock 5 delivers a pulse.

When the run comes to an end and the fare is to be paid, the price counting stops instantly, to the millisecond, this eliminating all causes for errors in the fare.

FIG. 4 shows an embodiment of the circuits of FIG. 3. Said figure shows the same registers R3 and R4, the

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pick-up 6 which can be connected on a programmable frequency divider 6a, and the clock 5.

The circuits 16 and 17 of FIG. 3 each comprise three circuits 16a, 16b, 16c and 17a, 17b, 17c.

The circuits 16a, 17a are adder circuits.

The circuits 16b, 17b are registers or memories.

The circuits 16c, 17c are demultiplexer of the two-towards-one type.

The output of the register 16b is reconnected on an input of the adder circuit 16a, and the output of the register 17b is likewise reconnected on an input of the adder circuit 17a.

The adder circuit 16a adds up continuously the price p2 recorded in the register R3 with the number recorded in the register 16b. The added circuit 17a does the same.

The circuit 18 of FIG. 3 is composed of a comparator 18a and of a demultiplexer 18b of the two-towards-one type. The binary output of the register 16b is connected in parallel on an input of the comparator 18a and on an input of the demultiplexer 18b. Likewise, the binary output of the register 17b is connected in parallel on the second input of the comparator 18a and on the second input of the demultiplexer 18b. The output of the demultiplexer 18b is reconnected in parallel on an input of each of the two demultiplexers 16c and 17c.

The output of the frequency divider 6a is connected on an input of an OR gate 20 and on a time-delay circuit 21, for example a monostable, whose output is connected in parallel on the second input of the OR gate 20, on the routing control of the demultiplexers 16c and 17c and on one input of an OR gate 22, on a second input of which is also connected the clock 5. The output of the OR gate 20 is connected on the loading validation terminal of the register 16b and the output of the OR gate 22 is connected on the loading validation terminal of the register 16b and the output of the OR gate 22 is connected on the loading validation terminal of the register 17b.

The functioning is now explained.

In the absence of pulses from the frequency divider 6a, the routing circuit of the demultiplexer 17c selects the output of the adder circuit 17a. Every time the clock 5 delivers a pulse, said pulse controls the transfer into the register 17b of the content of the adder circuit 17a which is equal to the immediately preceding content of the register 17b increased by one amount p1 contained in the register R4.

When the frequency divider 6a delivers a pulse, said pulse acts immediately on the loading control of the register 16b and as the demultiplexer 16c is also in the position where it selects the information coming from the adder circuit 16a, the register 16b receives the content of the adder which is equal to the immediately preceding content of the register 16a increased by an amount equal to the unit price p2 recorded in the register.

Permanently, the comparator 18a compares the two numbers recorded in the registers 16b and 17b and controls the demultiplexer 18b so that the latter routes in parallel towards the second inputs of the demultiplexers 16c and 17c, the highest number of the two.

After a slight delay due to the circuit 21, the latter delivers a second pulse which reaches the routing control of the demultiplexers 16c and 17c switching them towards selecting the information released by the output of 18b. At the same time, the delayed pulse crosses the gates 20 and 22 and controls the simultaneous trans-

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fer in the two registers 16b and 17b of the highest number of the two precedingly recorded in the two registers 16b and 17b.

Despite the structural differences, the device according to the FIGS. 2, 3 and 4 utilize the same method.

Indeed the device according to FIG. 2 compares two numbers n1 and n2 and selects a partial price which is equal, either to p2 if $n2 < n1$, or to $n1.p1$ if $n1 > n2$. Now, $p2 = n2.p1$ by definition of the conjunction speed which is that where the partial prices of an elementary portion of run are equal.

The comparison which is made between n1 and n2 is the same if the two terms are multiplied by the same number p1 and it therefore comes back to comparing $n1.p1$ to $n2.p1$ which is equal to p2, i.e. to comparing the partial prices of each elementary portion and to selecting the highest of the two.

The device according to FIG. 3 effects the selection by comparing two numbers respectively equal to $P + p2$ and to $P + n1.p1$ and therefore compares also a partial price $n1.p1$ which is based on the duration of the portion at a special price p2 which is based on the constant length of each portion.

It is therefore obvious that the two devices start from the same method which permits to simplify the circuits, and consist in splitting each taxi run into elementary portions of equal length, which portions can be very short, about 1 meter or even less, so that the instantaneous speed of the taxi cannot substantially depart from the average speed during one portion, and then in comparing the partial prices of each portion, i.e. a partial price p2 based on the distance travelled which is the same for each portion since they all have the same length and a partial price $n1.p1$ which is proportional to the duration n1 of each portion.

In the examples illustrated in FIGS. 2 and 3, the distance pick-up is connected directly on the counter 12 or on the adder circuit 16 and the taxi run is split into portions whose length is constant and corresponds to the distance travelled by the taxi between two successive pulses. It is specified that a programmable frequency divider 6a can be inserted between the pick-up 6 and the circuits 12 and R1 or 16 and 18, so that the taxi run is split into portions whose constant length is equal to the distance travelled by the taxi between two successive pulses delivered by the frequency divider, i.e. between two pulses of the distance pick-up which pulses are separated by a constant number of pulses which can be caused to vary according to the rates applied.

The decoding circuit 10 forming part of the display unit 11 receives continuously at its inputs, the amount of the fare expressed in logic signals.

Said logic signals can be binary signals or else they can be converted into decimal code using a well known converter (B C D converter).

The decoder 10 is a well-known circuit which permits to light up either luminous modules with seven segments or any other display means composed of luminous modules or liquid crystals.

According to certain official regulations, the displayed price should not vary continuously but only by jumps of constant value. In this case, the apparatus according to the invention can easily be adapted by associating it to known logic circuits or by the partial use of a microprocessor.

What is claimed is:

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1. Method for calculating a taxi fare displayed on an electronic taximeter, according to which the distance travelled by the taxi is measured by means of a distance pick-up, which delivers a number of pulses proportional to said distance, and the duration of the taxi run is measured by means of an electronic clock which delivers pulses of constant and high frequency, wherein the taxi run is split into elementary portions of equal length, which is the constant distance travelled by the taxi between two successive pulses delivered by the distance pick-up; the number of pulses $n1$ delivered by the said clock during each elementary portion, i.e. between two successive pulses of the distance pick-up is counted; a constant number $p2$ which is the unit price of a travelled distance equal to the constant length of each portion, is compared after each portion, to a variable number $n1.p1$ which is the partial price of the portion obtained by multiplying the price $p1$ of a time unit equal to the period of the said clock, by the duration $n1$ of each portion; the highest of the two numbers then selected as partial price of the said elementary portion; and wherein the total fare is calculated by adding up the said partial prices.

2. The method of claim 1, wherein a constant number $n2$ equal to the number of pulses delivered by the said clock during the period needed to travel one portion at the conjunction speed, is recorded in a register; wherein the variable number of pulses $n1$ is compared, after each elementary portion, to the number $n2$; and wherein, depending on whether $n1$ is greater or smaller than $n2$, either the price $n1.p1$ or the price $p2$ is selected.

3. The method of claim 1, wherein on a first adder circuit are connected, on the one hand, a register $R3$ in which is recorded the unit price $p2$ and on the other hand, the said pick-up and the content of the said adder circuit is increased by an amount equal to $p2$ every time the pick-up delivers a pulse; wherein on a second adder circuit are connected, on the one hand, a register $R4$ in which is recorded the unit price $p1$ and, on the other hand, the said clock, and the content of the said second adder circuit is increased by an amount equal to $p1$ every time the clock delivers a pulse; wherein the outputs of the said adder circuits are connected on a selective routine circuit which comprises a comparator comparing the numbers recorded in the two counters and a demultiplexer routing towards the output the highest of the two numbers; and wherein the output of the said routing circuit is reconnected in parallel on the said adder circuits, so that after each pulse delivered by the said pick-up, the greater of the two numbers recorded in the two adder circuits comes to be recorded in the two adder circuits and the output of the circuit adding the clock pulses is connected on a luminous display unit.

4. Electronic taximeter of the type comprising a distance pick-up which delivers a number of pulses proportional to the distance travelled by the taxi, an electronic clock, means for splitting each taxi run into successive elementary portions and for calculating the partial price of each portion, a totalizing counter for the said partial prices and a luminous display unit which displays the price recorded in the said totalizing counter, wherein said taximeter comprises: a register $R3$

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in which is recorded a constant number equal to the unit price $p2$ of a distance equal to the constant distance travelled by the taxi between two pulses issued by the said distance pick-up; a register $R4$ in which is recorded a number equal to the unit price $p1$ of a hiring duration equal to the said clock period; a pulse counter which counts up the number of pulses $n1$ delivered by the said clock between two pulses delivered by the said pick-up; and logical circuits which compare after each pulse delivered by the said pick-up, the number $p2$ to the product $n1.p1$ and which selects as partial price of the said portion the highest of the two numbers.

5. The electronic taximeter of claim 4, wherein said taximeter comprises: a register $R1$ which is connected on the output of the said pulse counter; a second register $R2$ in which is recorded a constant number $n2$ equal to the number of pulses delivered by the said clock during the interval between two pulses delivered by the said pick-up when the taxi travels at the conjunction speed; a multiplier circuit on which are connected the register $R4$ and the register $R1$ and which calculates the product $n1.p1$; a comparator which compares the numbers $n1$ and $n2$ recorded in the registers $R1$ and $R2$; a demultiplexer circuit with two inputs, connected respectively on the register $R3$ and on the multiplier circuit, which demultiplexer is controlled by the logic signal delivered by the said comparator, so that it transmits the product $n1.p1$ if $n1$ is greater than $n2$ and that it transmits the price $p2$ recorded in the register $R3$ if $n1$ is smaller than $n2$ and the output of the said demultiplexer is connected on a totalizing counter.

6. The electronic taximeter of claim 4, wherein said taximeter comprises: a first adder circuit on which are connected the said distance pick-up and the said register $R3$, which first adder circuit is of the type whose content is increased by an amount equal to $p2$ every time it receives a pulse from the pick-up; a second adder circuit on which are connected the said clock and the said register $R4$, the said second adder being of the type whose content is increased by an amount equal to $p1$ every time it receives a clock pulse; a selector logic circuit comprising two inputs connected on the outputs of the two adder circuits and a control terminal connected on the output of the distance pick-up, which selector circuit is of the type which compares the numbers recorded in the adder circuits every time it receives a pulse from the pick-up and which lets through the greatest of the two numbers and the output of the selector circuit is reconnected in parallel on the two adder circuits so that after each pulse delivered by the pick-up, there is in the two adders the same number equal to the number P which was there after the preceding pulse, increased by the greatest of the two numbers $p2$ and $n1.p1$ recorded respectively in the two adder circuits between two successive pulses of the pick-up, the number $n1$ being the number of clock pulses delivered between two successive pulses of the distance pick-up and one of the adder circuit is used as a price totalizing counter and is connected on the luminous display unit of the taximeter.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 4,409,685

Page 1 of 2

DATED : October 11, 1983

INVENTOR(S) : Claude F. Ricard

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 2, line 9, "taxis" should read -- taxi --;
Column 2, line 16, "wen" should read -- when --;
Column 7, line 36, "of" should read -- or --;
Column 9, line 55, "wich" should read -- which --;
Column 10, line 47, "portions" should read -- portion --;
Column 11, line 57, after "ter" insert -- R3. --;
Column 12, line 26, "simlify" should read -- simplify --;
Column 13, line 20, after "numbers" insert -- being --;
Column 14, line 9, "logical" should read -- logic --;
Column 14, line 28, "transmit" should read -- transmits --;
Column 14, line 30, "then" should read -- than --;
Column 14, line 31, "né" should read -- n2 --;
Column 14, line 45, "dictance" should read -- distance --; and

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 4,409,685

Page 2 of 2

DATED : October 11, 1983

INVENTOR(S) : Claude F. Ricard

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 14, line 59, "circuit" should read -- circuits --.

Signed and Sealed this

Fourteenth **Day of** *February 1984*

[SEAL]

Attest:

GERALD J. MOSSINGHOFF

Attesting Officer

Commissioner of Patents and Trademarks

Exhibit 12



US005917434A

United States Patent [19]
Murphy

[11] **Patent Number:** **5,917,434**
[45] **Date of Patent:** **Jun. 29, 1999**

[54] **INTEGRATED TAXIMETER/GPS POSITION TRACKING SYSTEM**

[75] Inventor: **Michael D Murphy**, Sunnyvale, Calif.

[73] Assignee: **Trimble Navigation Limited**, Sunnyvale, Calif.

[21] Appl. No.: **08/490,561**

[22] Filed: **Jun. 15, 1995**

[51] **Int. Cl.**⁶ **G08G 1/123**

[52] **U.S. Cl.** **340/991; 340/994; 340/995; 701/201; 701/207; 701/217**

[58] **Field of Search** 340/990, 991-995, 340/988, 994, 434; 342/357, 457; 364/443, 449.1, 450, 460, 424.04; 235/95 R, 96; 701/201, 202, 207, 208, 209, 213, 215, 216, 217

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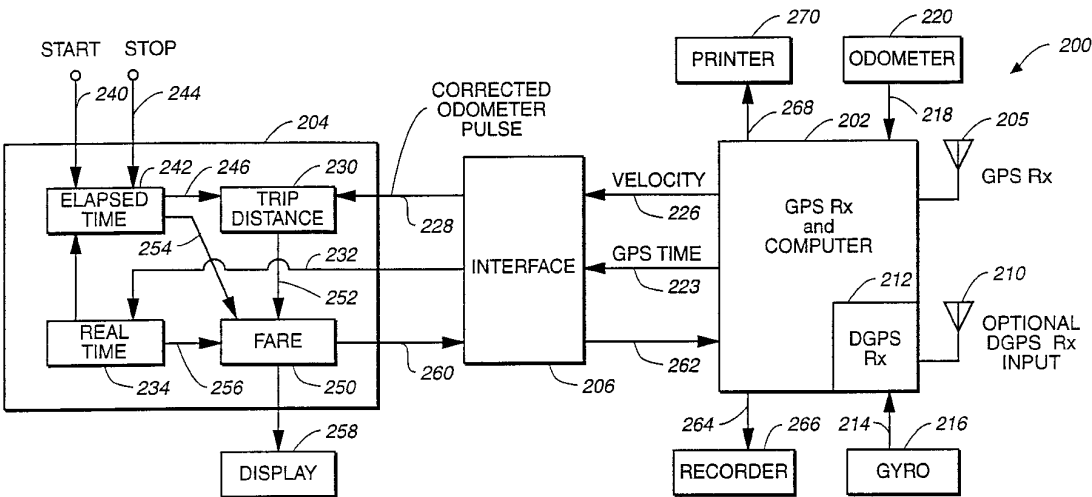
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Primary Examiner—Jeffery A. Hofsass
Assistant Examiner—Van T. Trieu
Attorney, Agent, or Firm—Patrick T. King

[57] **ABSTRACT**

A taximeter system includes a taximeter or trip meter for a truck integrated with an integral GPS receive/computer for providing GPS position and time information. The odometer input pulses to the taximeter are accurately calibrated by using GPS position, velocity, and time information to generate corrected odometer pulses which are provided to the odometer input terminal of the taximeter. The GPS system is integrated into the taximeter for calibrating and cross checking of input odometer pulses to provide reliable, consistent distance measurements by the taximeter. The integrated taximeter and GPS system provided according to the invention uses GPS position, velocity, and time information to produce incontrovertibly accurate corrected, odometer input pulses and GPS time signals for the taximeter to precisely compute elapsed time and distance traveled. Dead reckoning operation of the system is available when the GPS receiver has service outages. A calibrated mileage meter for trucks also includes an integral GPS receive/computer for providing accurately calibrated odometer pulses to the mileage meter. Certain locations can be tagged and a printer and recorder are recorded for documentation of trip information such as when a vehicle enters or leaves a state, proof of a path followed by a vehicle, delivery of good at a certain site, operation within speed limits, certification of operation within a certain geographic area.

4 Claims, 6 Drawing Sheets



U.S. Patent

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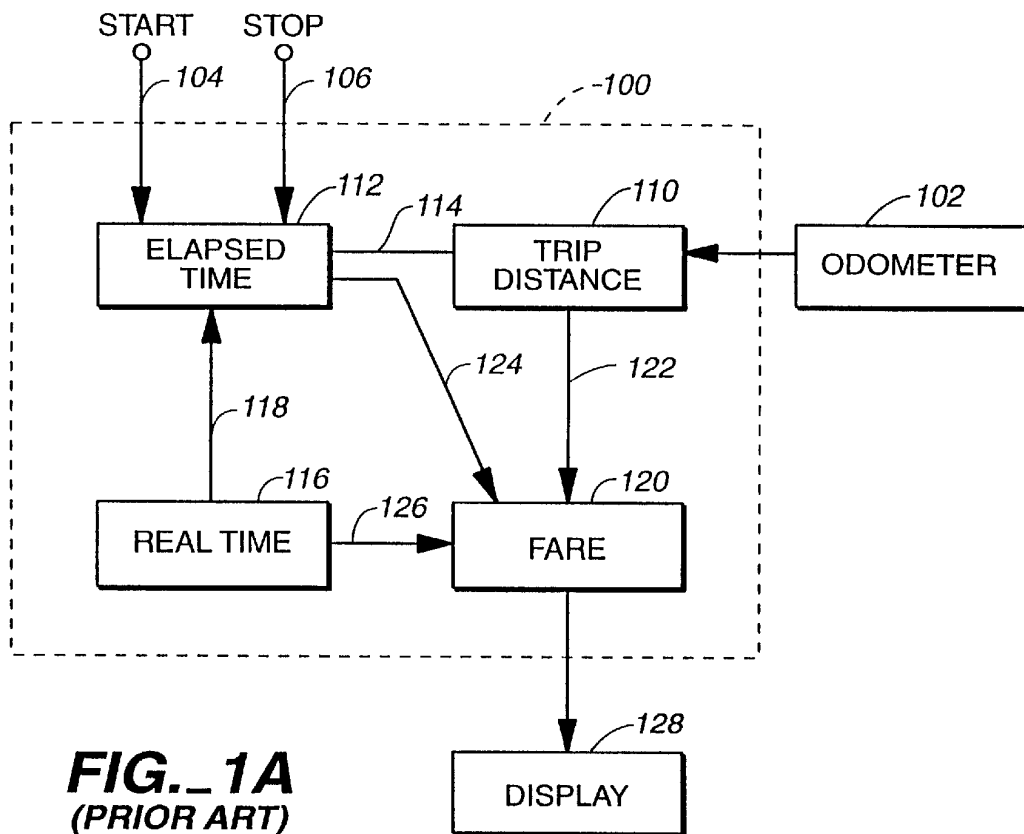


FIG. 1A
(PRIOR ART)

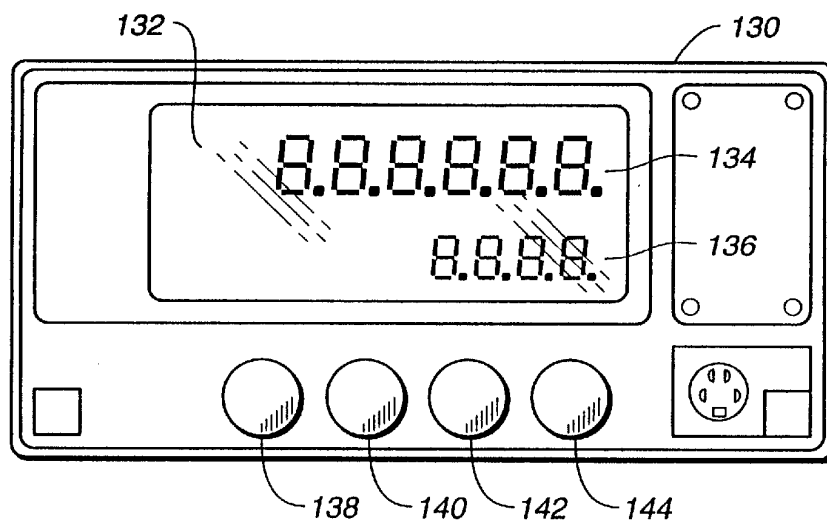


FIG. 1B

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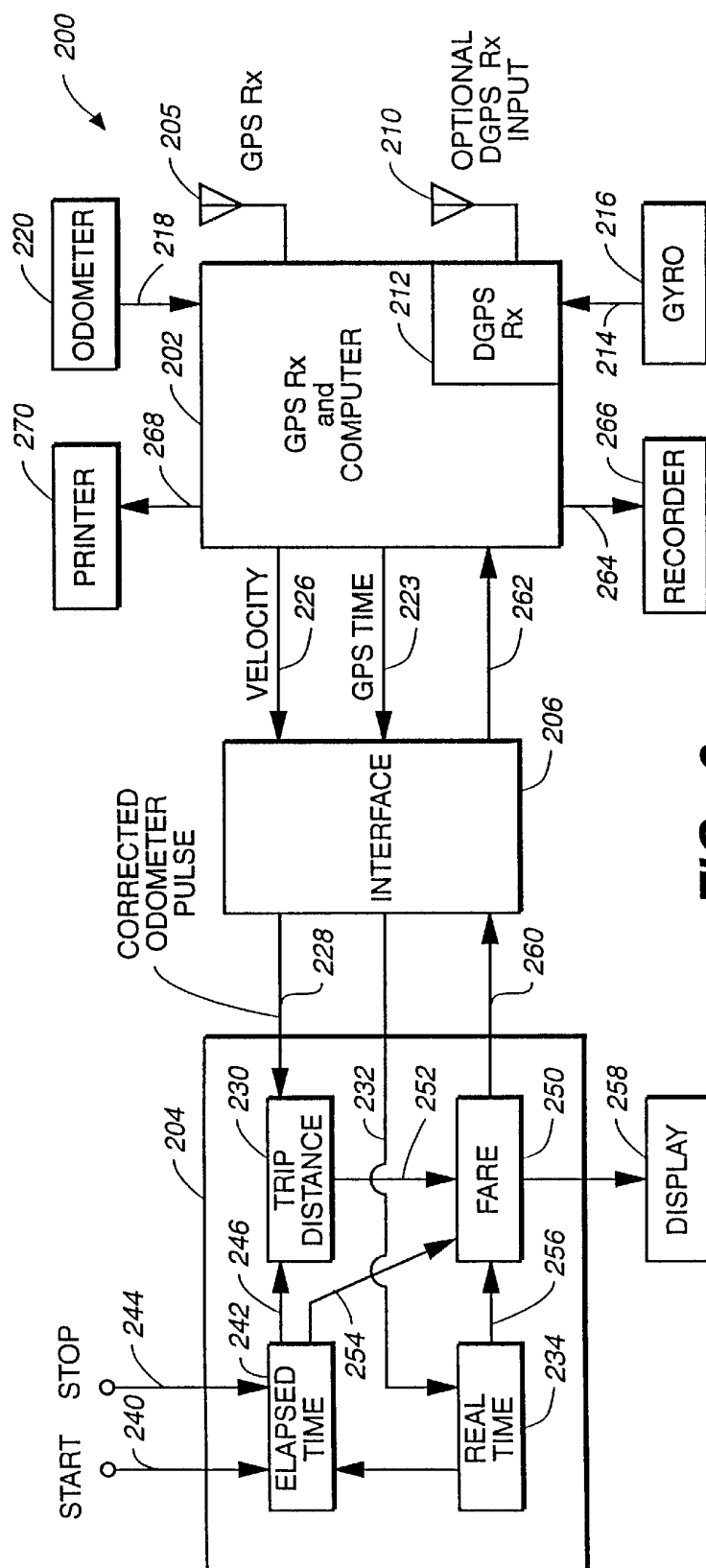
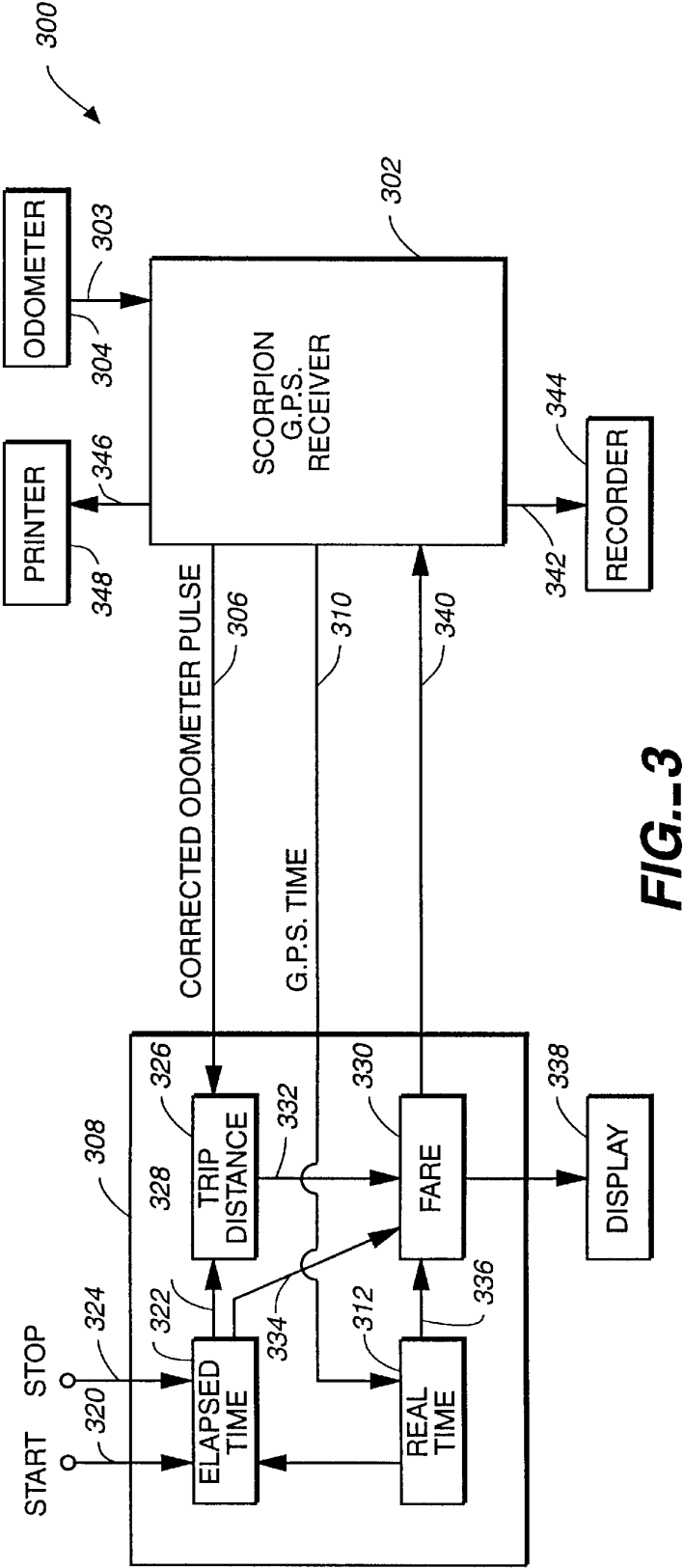


FIG. 2



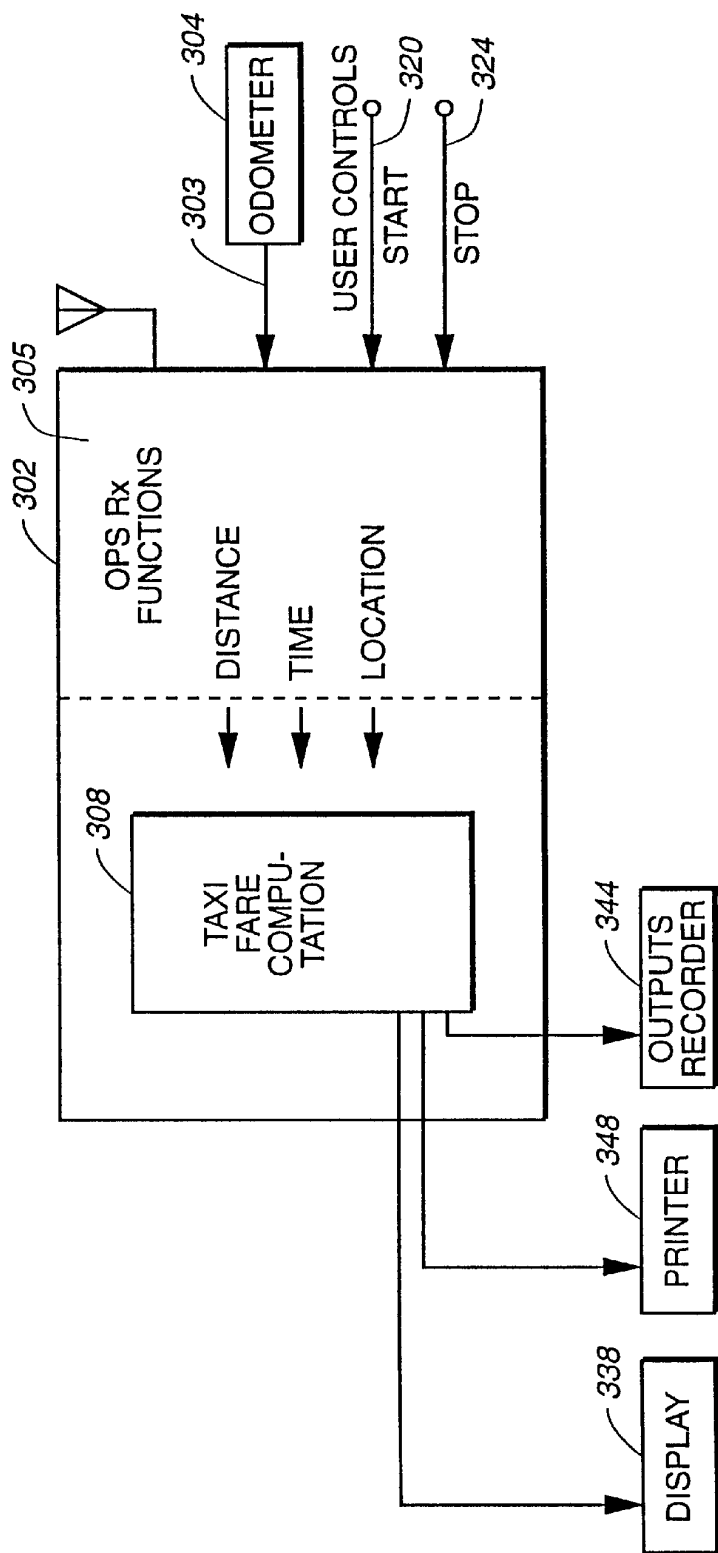


FIG. 4

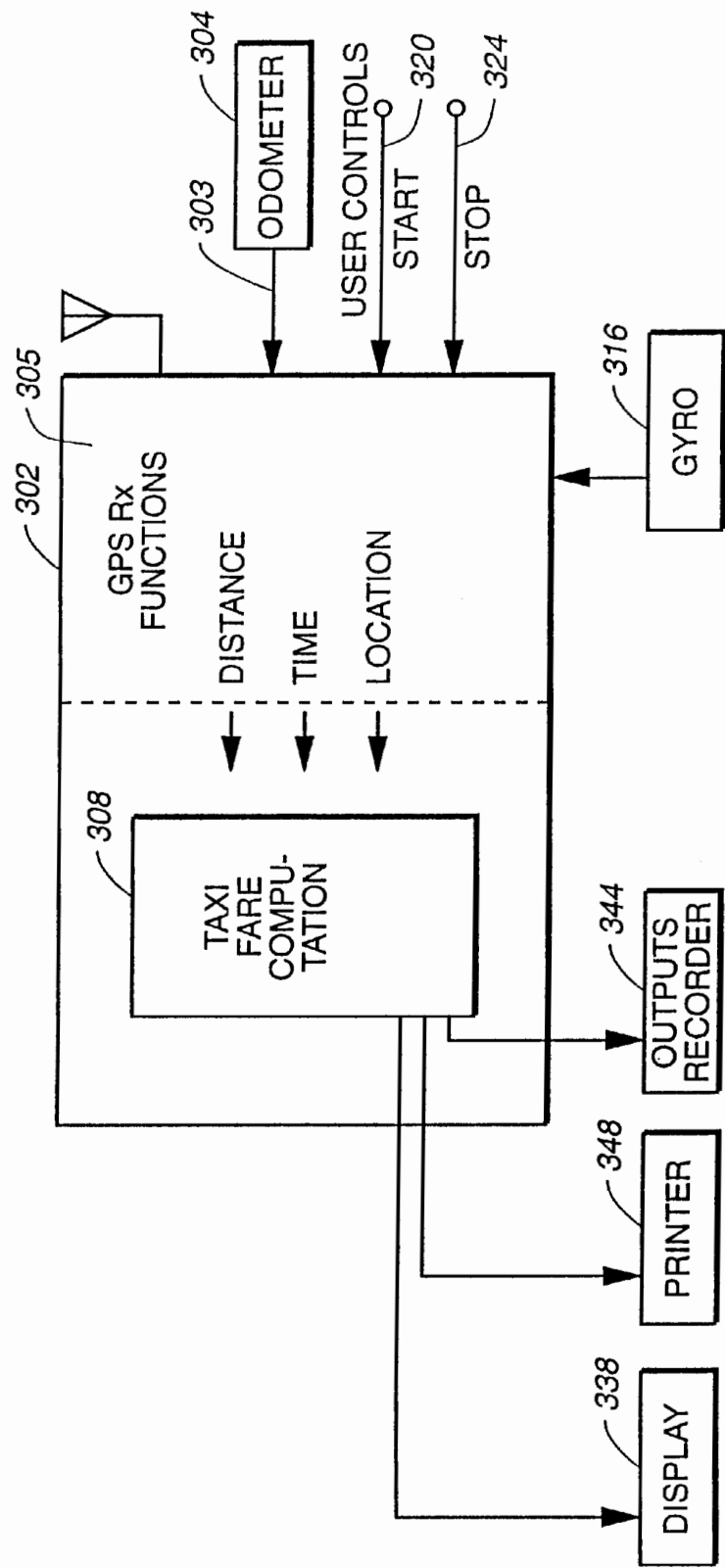


FIG. 5

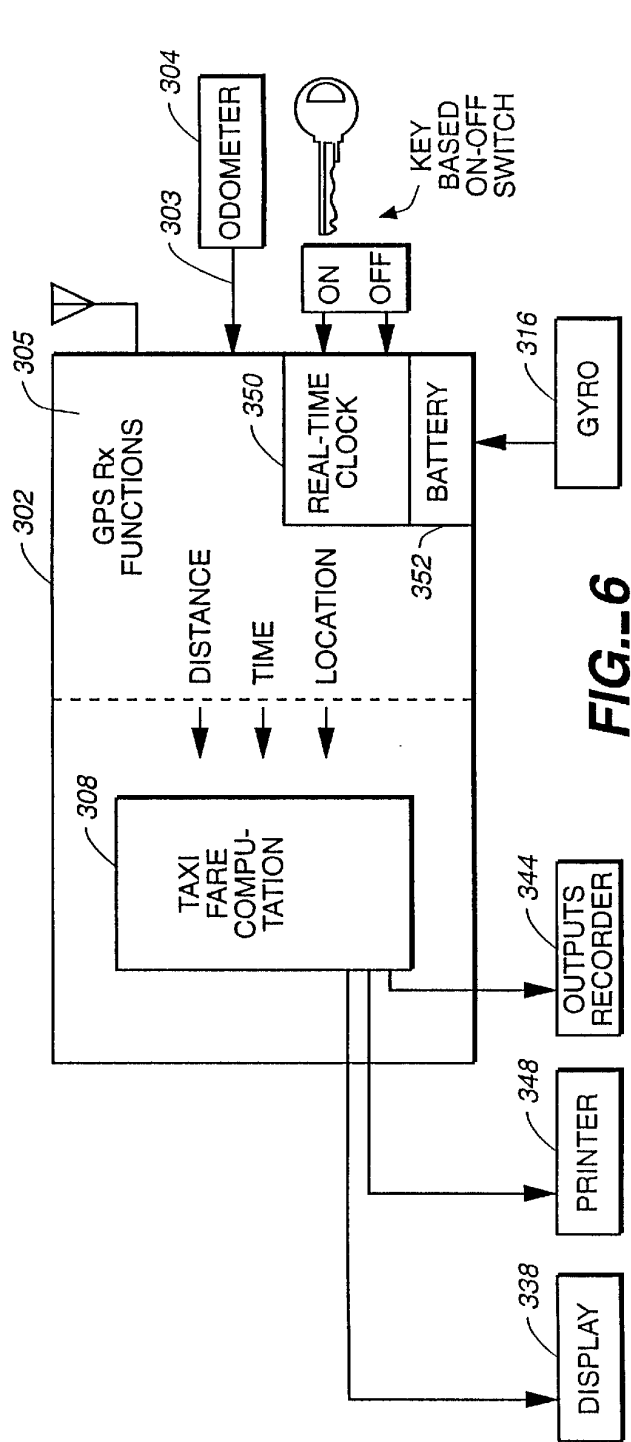


FIG. 6

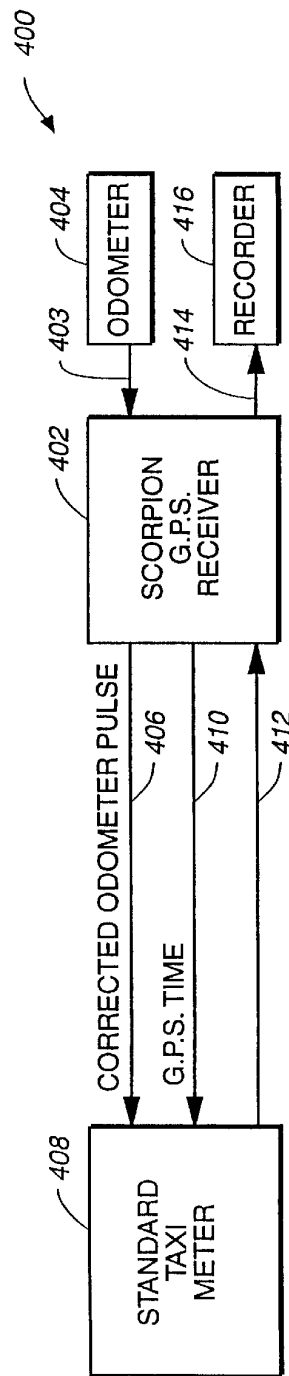


FIG. 7

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**INTEGRATED TAXIMETER/GPS POSITION
TRACKING SYSTEM****TECHNICAL FIELD**

The present invention relates generally to measurement of the movement of a vehicle, and, more particularly, to accurately measuring the distance moved by a vehicle with rotating wheels.

BACKGROUND OF THE INVENTION

Mileage meters for commercial vehicles such as taxicabs and long-haul trucks are calibrated and certified by governmental agencies for a specific tire pressure and a certain rim size. When the tire pressure and rim size of a vehicle are changed, distance errors of 3 percent can be obtained. For consumers, increased mileage readings by a taximeter increase their costs. For a state governmental agency which taxes a long-haul truck based on the number of miles driven by the long-haul truck within the state, shortened mileage readings result in significant revenue shortfall for the state.

Consequently, a need exists for a technique of calibrating mileage meters, such as taximeters and long-haul truck mileage meters.

A taximeter or mileage meter system which is based exclusively on GPS techniques could theoretically provide accurate distance information and could be continuously calibrated. However, a taximeter or mileage meter using only a GPS system is limited because of outages caused by passage of a vehicle with such a system through tunnels, canyons, dense urban areas, etc.

A taximeter or mileage meter is used to provide distance measurements. U.S. Pat. No. 5,014,206 granted to Scribner et al. on May 7, 1991, and entitled "Tracking System" discloses a system used for determining and recording the geographic location of a vehicle during predetermined events using a GPS system. The Scribner et al. system is adapted to a particular application by configuring a switch or sensor to record the occurrence of a desired event, such as the opening of a garbage truck tailgate at a waste dump site. Passive RF tags are used to identify a vehicle as being at a particular site at a particular time.

SUMMARY OF THE INVENTION

It is, therefore, an object of the present invention to provide a technique for calibrating a taximeter or mileage meter.

It is another object of the invention to provide a calibrated system which can function during outages of a calibration signal. The invention provides incontestably accurate taximeters and trip meters with accurate elapsed time measurements and total distance traveled based on GPS time measurements and "calibrated" odometer pulses. GPS outages are compensated for with dead-reckoning equipment. Thus, the present invention is able to accurately measure the distance moved by a vehicle with rotating wheels by calibrating, correcting, and/or verifying odometer readings.

In accordance with these and other objects of the invention, a combined taximeter or mileage meter and a GPS system is provided for calibration of the taximeter or mileage meter. Means are provided for calibrating the taximeter with the GPS information. For purposes of the present invention, GPS information includes position, velocity, and time information.

A taximeter system according to the invention includes a taximeter integrated with an integral GPS receive/computer

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for providing GPS position, velocity, and time information. The odometer input pulses to the taximeter are accurately calibrated by using GPS position, velocity, and time information to generate corrected odometer pulses which are provided to the odometer input terminal of the taximeter. The GPS system is integrated into the taximeter for calibrating and cross checking of input odometer pulses to provide reliable, consistent distance measurements by the taximeter. The integrated taximeter and GPS system provided according to the invention uses GPS position, velocity, and time information to produce incontrovertibly accurate corrected, odometer input pulses and GPS time signals for the taximeter to precisely compute elapsed time and distance traveled. Dead reckoning operation of the system is available when the GPS receiver has service outages. A calibrated mileage meter for trucks also includes an integral GPS receive/computer for providing accurately calibrated odometer pulses to the mileage meter. Certain locations can be tagged and recorded for documentation of trip information such as when a vehicle enters or leaves a state, proof of a path followed by a vehicle, delivery of good at a certain site, operation within speed limits, certification of operation within a certain geographic area.

A system for calibrating a taximeter according to the invention includes a GPS receiver/computer system having means for receiving input odometer pulses from an odometer where the GPS receiver/computer system providing GPS position, velocity, and time information as output signals. Interface means are provided for receiving the GPS position, velocity, and time information from the GPS receiver/computer system and for providing calibrated odometer output pulses as a function of the received GPS position, velocity, and time information. A taximeter is provided having means for receiving calibrated odometer output pulses from the interface means and for receiving the GPS position, velocity, and time information. The taximeter has means for computing a fare from the calibrated odometer output pulses and GPS position, velocity, and time information provided by the GPS receiver/computer system.

The GPS receiver/computer system includes dead reckoning means for providing location information to the GPS computer system during GPS receiver system service outages. In one embodiment of the present invention, the GPS receiver/computer system includes differential GPS means for improving the accuracy of the GPS receiver/system.

A system is also provided for calibrating a mileage meter for vehicles such as local delivery trucks or long-haul trucks. The system is similar to the taximeter and includes a GPS receiver/computer system providing GPS position, velocity, and time information, where the GPS receiver/computer system includes means for receiving the GPS position, velocity, and time information from the GPS receiver/computer system and for providing calibrated odometer output pulses as a function of the received GPS position, velocity, and time information. The system includes dead reckoning means for providing location information to the GPS computer system during GPS receiver system service outages. The system also includes a mileage meter having an input terminal for receiving the calibrated odometer pulses where the mileage meter includes means for computing mileage from the calibrated odometer pulses. In one embodiment, differential GPS means are provided for improving the accuracy of the GPS receiver/system.

Means are included for providing trip information and for recording trip information. The trip information includes various types of information, such as, for example, information: about when a vehicle enters and leaves predeter-

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mined zones, establishing proof of a path followed by a vehicle, about delivery of goods by a vehicle at a certain site, about operation of a vehicle within speed limits, and about certification of operation of a vehicle within a certain geographic area.

A method of calibrating a taximeter installed in a taxi vehicle is provided according to the invention. The method includes the steps of providing GPS position, velocity, and time information as output signals from a GPS receiver/computer system, receiving input odometer pulses from an odometer, providing calibrated odometer output pulses as a function of the received GPS position, velocity, and time information and computing a fare in a taximeter from the calibrated odometer output pulses provided by said GPS receiver/computer system. The method also includes the step of using a dead reckoning navigation system for providing location information to the GPS computer system during GPS receiver system service outages. In one embodiment, differential GPS means are used for improving the accuracy of the GPS receiver/system. The method includes the steps of providing trip information and of displaying trip information. The step of providing trip information includes providing information about several items, including proof of a path followed by a taxi vehicle, operation of a vehicle within speed limits, and certification of operation within a certain geographic area.

The invention includes a method of calibrating odometer pulses received by a mileage meter for a vehicle such as a local delivery truck or a long haul truck. The steps of this method include receiving raw odometer pulses from an odometer, providing GPS position, velocity, and time information from a GPS receiver/computer system, receiving the GPS position, velocity, and time information from the GPS receiver/computer system, providing calibrated odometer output pulses as a function of the received GPS position, velocity, and time information, and computing mileage from the calibrated odometer pulses. The method also includes the steps of providing trip information and recording such trip information. The step of providing trip information includes the step of providing information about when a vehicle enters and leaves a predetermined zone, about proof of a path followed by a vehicle, about delivery of goods at a certain site, about operation within speed limits, and about certification of operation within a certain geographic area. Differential GPS is used to improve the accuracy of the GPS receiver/system.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings which are incorporated in and form a part of this specification, illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention:

FIG. 1A is a block diagram of a prior art taximeter system which receives odometer pulses and which provides measurement elapsed time, distance, real time, and a fare to be charged, based only on the odometer pulses.

FIG. 1B is a view of a typical taximeter package which includes a customer display with computed fare and distance traveled readouts.

FIG. 2 is a block diagram of a taximeter system which uses a GPS system for independent calibration of the odometer pulses delivered to the taximeter, where the GPS system includes a dead-reckoning capability.

FIG. 3 is a block diagram of a taximeter system which uses a GPS system having a direct output terminal which provides corrected odometer pulses to a taximeter computer.

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FIG. 4 is a block diagram of a fully integrated taximeter/GPS system in accordance with the present invention.

FIG. 5 is a block diagram of a fully integrated taximeter/GPS system including a gyro module in accordance with the present invention.

FIG. 6 is a block diagram of a fully integrated taximeter/GPS system including a key-activated recording system in accordance with the present invention.

FIG. 7 is a block diagram of a mileage measurement and logging system which uses a GPS system having a direct output terminal at which are provided corrected odometer pulses.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference will now be made in detail to the preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings. While the invention will be described in conjunction with the preferred embodiments, it will be understood that they are not intended to limit the invention to these embodiments. On the contrary, the invention is intended to cover alternatives, modifications and equivalents, which may be included within the spirit and scope of the invention as defined by the appended claims.

FIG. 1A is a block diagram of an electronic taximeter 100 which receives input odometer pulses on a signal line 102 from a vehicle speed sensor. The taximeter and vehicle speed sensor are calibrated and certified to be accurate under standard conditions, such as a specified tire pressure and a specified rim size. The pulse rate of the input odometer pulses is supposed to be accurately proportionate to the speed of the taxi, with no compensation being provided for changes such as tire pressure and/or rim size, etc. When the tire pressure and rim size of a vehicle, such as a taxi, are changed from the standards, errors of up to 3 percent can result, resulting in increased costs to taxi riders.

At the start of a trip, a taxi driver initiates a start-of-trip signal on an input signal line 104 to activate operation of the taximeter and to start an elapsed time measurement. At the end of the trip, the taxi driver initiates an end-of-trip signal on an input signal line 106 to stop the elapsed time measurement and operation of the taximeter.

The electronic taximeter 100 includes a module 110 which produces a distance measurement, or trip distance, as a function of the number of input odometer pulses received on the signal line 102 during an elapsed time period. Elapsed time is measured in an elapsed-time module 112 which is turned on and off respectively by the start-of-trip signal and the end-of-trip signal. Elapsed time information is provided from the elapsed-time module 112 as an input to the trip distance module 110 on a signal line 114. Real time-of-day information is provided by a real-time module 116 to the elapsed time module 112 on a signal line 118.

A fare computation module 120 receives input signals from the various other modules. Specifically, as shown in FIG. 1A, fare computation module 120 receives input from the trip distance module 110 on a signal line 122, from the elapsed-time module 112 on a signal line 124, and from the real-time module 116 on a signal line 126. The fare computation module 120 computes a fare in accordance with a fare computation tariff as a function, for example, of an initial fare charge, trip distance, elapsed time, real time, and various "extras", such as additional passengers and baggage. A display module 128 displays the computed fare and distance traveled.

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FIG. 1B shows a typical taximeter package which includes a customer display **130** for a taximeter system having a LED, or similar, display panel **132**. Computed Fare is displayed on one line **134** of the LED display panel **132**. Another line **136** of the LED display panel **132** displays Trip Distance. A start-of-trip button **138** is operated to provide an input signal on input signal line **104** of FIG. 1A to activate operation of the taximeter and to start an elapsed time measurement. An end-of-trip button **140** is operated to provide an end-of-trip signal on the input signal line **106** to stop the elapsed time measurement and operation of the taximeter. Buttons **142**, **144** are used to input Extra information such as additional passengers and luggage.

FIG. 2 is a block diagram of one embodiment of a taximeter system **200**, according to the invention. A GPS system is integrated into the taximeter for calibrating and cross checking of input odometer pulses to provide reliable, consistent distance measurements by the taximeter. This taximeter system **200** combines a GPS receiver/computer module **202** with a taximeter computer module **204** through an interface circuit **206**. The GPS receiver/computer module **202** and the interface circuit **206** are integrated with the taximeter functions in the taximeter housing.

The GPS receiver/computer system **202** includes a GPS receiver/computer circuit **208** and a suitable GPS antenna **209**. For differential GPS (DGPS) operation, an optional DGPS antenna **210** and DGPS receiver **212** are provided for receipt of correction information, which is, for example, transmitted locally from a fixed GPS reference-receiver site.

The GPS receiver/computer **208** measures its velocity with respect to that of a satellite by measuring the Doppler shift of the signals received from the satellite. Using an ephemeris and almanac, the position of the satellites are precisely known. Some of the Doppler shift measured by the GPS system is due to the satellite and the balance of the Doppler shift is due to the velocity of the GPS receiver. The GPS system processes this velocity information and distance is calculated as the product of velocity and time.

One embodiment of the receiver/computer **208** is implemented using, for example, a commercially available GPS receiver system provided by Trimble Navigation of Sunnyvale, Calif. and called the Trimble Placer GPS/DR system. The Trimble Placer GPS/DR system is a mobile GPS system which also includes a dead reckoning (DR) capability incorporated into an I/O processor circuit board. The Placer DR system uses GPS signals as its primary means of determining position and velocity. Because of its dead reckoning capability, the Placer DR system provides for accurate, reliable, vehicle location in areas where GPS signals are temporarily blocked.

The receiver/computer **208** as implemented by a Placer DR system circuit board is packaged in a standard taximeter housing with the taximeter circuits. The Placer DR system uses dead reckoning when the GPS satellite signals are blocked by features such as tall buildings, tunnels, multi-deck bridges, etc. Input signals to the GPS system for dead reckoning operation are provided on a signal bus **214** from a heading sensor **216**, such as a gyroscopic system provided, for example, as a piezoelectric vibrating-beam gyro. The Placer DR system continuously calibrates its DR sensors with GPS signals.

Accuracy of the combined GPS and dead-reckoning system is improved with a U.S. patent application, Ser. No. 08/068,983, filed May 28, 1993 by Geier et al. for a "Navigation System for Adaptive Weighting of GPS and Dead-Reckoning Information". The Geier et al. Patent is

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incorporated herein by reference as background material. Geier et al. provides improved navigational data to a vehicle user by blending GPS solutions and dead-reckoning (DR) solutions using modified Kalman filters.

A signal line **218** provides connections for signals from a vehicle's digital pulse odometer **220** to the GPS receiver/computer **208**. The GPS module **202** uses the heading sensor information from the heading sensor **216** and the odometer pulses to generate DR position and velocity. Information provided by the GPS receiver/computer module **208** includes latitude, longitude, velocity, time, and direction of travel.

The interface circuit **206** receives GPS time information on a signal line **224** from the GPS receiver/computer module **202**. The interface circuit **206** receives GPS position, velocity, and time information on a signal line **226** from the GPS receiver/computer module **202**. The interface circuit uses the GPS position, velocity, and time information to provide corrected odometer pulses on a signal line **228** to a trip distance module **232**. The corrected odometer pulses are provided from a pulse stuffer/subtractor module included in the interface circuit **206**. GPS time signals are provided from the interface circuit **206** on a signal line **234** to a real time module **234**.

A taxi driver provides a start-of-trip signal on an input signal line **240** to activate operation of the taximeter system **200** and to start an elapsed time measurement. Elapsed time is counted in an elapsed-time circuit **242** which is turned on by the start-of-trip signal. At the end of the trip, the taxi driver provides an end-of-trip signal on an input signal line **244** to stop the elapsed time measurement.

The trip distance module **230** receives the corrected odometer pulses on line **228** and elapsed time information on a signal line **246** from the elapsed time module **242**.

The corrected odometer pulses on signal line **228** are calibrated by the GPS system, which verifies and corrects for errors in the odometer pulses received by the GPS receiver/computer module **202** from the odometer **220**.

A fare computation module **250** receives an output signal from the trip distance module **230** on a signal line **252**. The fare computation module **250** receives an output signal from the elapsed-time module **242** on a signal line **254**. The fare computation module **250** receives an output signal from the real-time module **234** on a signal line **256**. The fare computation module **250** computes a fare as a function of an initial fare charge, corrected trip distance, elapsed time, real time, and any "extras" in accordance with a fare computation tariff. A display module **258** displays, for example, the computed fare and the trip distance.

Information is sent on a signal line **260** from the fare computation module **236** to the interface circuit **206** and then on a signal line **262** to the GPS receiver/computer module **202**.

Information relevant to particular trips is sent from the GPS receiver/computer on a signal line **264** to a data recorder **266** which records, for example, what path was traversed for a trip. Information is also sent on a signal line **268** to a printer **270**, which provides, for example, a trip ticket providing appropriate documentation of a trip, for example, to a taxi rider or to a state agency.

The recorded trip information can include a number of items, depending upon the application. For an interstate truck, the information is about when and where a vehicle enters and leaves a predetermined zone, such as a state or municipality. For both taxis and trucks, the trip information includes information showing proof of a path followed by a

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vehicle. The trip information may include information about delivery of a passenger or goods at a certain site. The trip information can include information about operation of a vehicle, particularly a truck, within safe speed limits. The trip information can also include information about certification of operation within a certain geographic area.

The integrated taximeter and GPS system provided according to the invention uses GPS position, velocity, and time information to produce incontrovertibly accurate corrected odometer input pulses and time signals for the taximeter to precisely compute elapsed time and distance traveled. The integrated taximeter and GPS system taximeter system provided according to the invention also provides for dead reckoning operation of the system when the GPS receiver has service outages.

FIG. 3 is a block diagram of an embodiment of a taximeter system 300, which uses a Scorpion GPS receiver/computer integrated circuit 302 by Trimble Navigation of Sunnyvale, California. The Scorpion integrated circuit 302 is a Trimble Navigation ASIC chip which includes a 68332 microprocessor, A/D circuits, DUARTs. A U.S. patent application, Ser. No. 08/165,972, filed Dec. 10, 1993, by Lau et al. for a "Single-Chip GPS Receiver Digital Signal Processing and Microcomputer" and incorporated herein by reference as background material, provides an integrated GPS receiver/computer integrated circuit. The integrated circuit is a Trimble Navigation ASIC chip which includes a 68332 microprocessor, A/D circuits, DUARTs. The integrated circuit also includes integral circuitry for taking a raw odometer input pulses on a signal line 304 from an odometer 304 and internally processing the raw odometer pulses to obtain corrected, calibrated odometer output pulses. The GPS system verifies and corrects for errors in the raw odometer pulses received by the integrated circuit 302 from an odometer.

The Scorpion integrated circuit 302 also includes integral circuitry for taking a raw odometer input pulses on a signal line 304 from an odometer 304 and internally processing the raw odometer pulses to obtain corrected, calibrated odometer output pulses, which are provided as output signals on a signal line 306. The GPS system verifies and corrects for errors in the raw odometer pulses received by the Scorpion integrated circuit 302 from the odometer 304.

The corrected, calibrated odometer output pulses on signal line 306 are fed into the odometer input terminal of a standard taximeter 308. The taximeter 308 is similar to the taximeter of FIG. 2, discussed herein above. GPS time signals are also fed on a signal line 310 to a real time module 312 of the standard taximeter 308.

As discussed in connection with FIG. 2, a taxi driver provides a start-of-trip signal on an input signal line 320 to activate operation of the taximeter system 308 and to start an elapsed time measurement. Elapsed time is counted in an elapsed-time circuit 322 which is turned on by the start-of-trip signal. At the end of the trip, the taxi driver provides an end-of-trip signal on an input signal line 324 to stop the elapsed time measurement.

A trip distance module 326 receives the corrected odometer pulses on line 306 and elapsed time information on a signal line 328 from the elapsed time module 322.

A fare computation module 330 receives an output signal from the trip distance module 326 on a signal line 332. The fare computation module 330 receives an output signal from the elapsed-time module 322 on a signal line 334. The fare computation module 330 receives an output signal from the real-time module 312 on a signal line 336. The fare com-

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putation module 330 computes a fare as a function of an initial fare charge, corrected trip distance, elapsed time, real time, and any "extras" in accordance with a fare computation tariff. A display module 338 displays, for example, the computed fare and the trip distance.

Information is sent on a signal line 340 from the fare computation module 330 to the GPS receiver/computer module 302. Information relevant to particular trips is sent from the GPS receiver/computer on a signal line 342 to a data recorder 344 which records, for example, what path was traversed for a trip. Information is also sent on a signal line 346 to a printer 348, which provides a trip ticket providing appropriate documentation of a trip.

The integrated taximeter and GPS system provided according to the invention uses GPS position, velocity, and time information to produce incontrovertibly accurate corrected tachometer input pulses and GPS time signals for the taximeter to precisely compute elapsed time and distance traveled. As mentioned in connection with the description of FIG. 3, the recorded trip information can include a number of items, depending upon the application. For an interstate truck, the information is about when and where a vehicle enters and leaves a predetermined zone, such as a state or municipality. For both taxis and trucks, the trip information includes information showing proof of a path followed by a vehicle. The trip information may include information about delivery of a passenger or goods at a certain site. The trip information can include information about operation of a vehicle, particularly a truck, within safe speed limits. The trip information can also include information about certification of operation within a certain geographic area.

With reference next to FIG. 4, a block diagram of an integrated taximeter system 308 and a GPS receiver/computer 305 which are integrated in a single ASIC chip 302. In the present embodiment, all taximeter firmware is embedded within, for example, the Scorpion ASIC chip 302 by Trimble Navigation of Sunnyvale, California. In a manner similar to the embodiment of FIG. 3, in the present embodiment, GPS system 305 verifies and corrects for errors in the raw odometer readings. Hence the present embodiment integrates both the GPS software and the taximeter software onto, for example, the Scorpion ASIC chip 302. Thus, all taximeter calculations are performed by the Scorpion integrated circuit 302. By integrating both GPS system 305 and taximeter system 308, the present embodiment eliminates the potential for fraud or intentional altering of taximeter calculations.

As in the embodiment of FIG. 3, the embodiment of FIG. 4 includes integral circuitry for taking a raw odometer input pulses on a signal line 303 from an odometer 304 and internally processing the raw odometer pulses to obtain corrected, calibrated, odometer output pulses. The corrected odometer output pulses are used by taximeter system 308 of Scorpion chip 302 for calculation of an accurate, incontrovertible, fare.

As discussed above, in operation, a taxi driver provides a start-of-trip signal on an input signal line 320 to activate operation of the taximeter system 308 and to start an elapsed time measurement. At the end of the trip, the taxi driver provides an end-of-trip signal on an input signal line 324 to stop the elapsed time measurement.

The trip fare is calculated as described above in detail in conjunction with the embodiment of FIG. 3. The present embodiment also includes a display module 338, a printer module 348, and an outputs recorder 344.

Hence, the present embodiment provides an incontrovertibly accurate fare. Additionally, by integrating taximeter

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system **308** and GPS system **305** onto a common ASIC chip, the present embodiment is not susceptible to fraud or intentional altering of fare-related data.

Referring now to FIG. 5, another embodiment of the present invention is shown in which a gyro module **316** is coupled to ASIC chip **302**. In the present embodiment, gyro module **316** is used to generate dead reckoning position signals. The dead reckoning position signals are input to ASIC chip **302** as a substitute or in addition to GPS generated position signals.

With reference next to FIG. 6, yet another embodiment of the present invention is shown including a key-activated recording system. As shown in FIG. 6, the present embodiment includes additional features such as a real-time clock **350**, a battery **352**, and a key-based on/off switch **354**. The present embodiment is well suited for logging the miles traveled by a vehicle through, for example a given state. Thus, the present invention is extremely useful for determining state taxes assessed according to the quantity of miles traveled by a vehicle through a given state. In operation, once a vehicle enters a given state or geographic region, key-activated on/off switch **354** is turned on. When the vehicle leaves the state or geographic region, key-activated on/off switch **354** is turned off. The state or geographic region is then able to receive an accurate incontrovertible record of the miles traveled by the vehicle while in the state or geographic region. Real-time clock **350** powered by battery **352** provides a time-stamp which indicates when key-activated switch **354** is turned on and/or off. Therefore, the present embodiment provides a record of the times at which key-activated switch is turned on and/or off. By providing such a record, the present embodiment prevents the intentional or unintentional turning off of key-activated switch while the vehicle travels through the state or geographic region. Thus, the state or geographic region is able to accurately assess taxes upon vehicles moving through the state or geographic region.

Furthermore, the present embodiment is also well suited to having key-activated switch **354** turned on or off by, for example, a state official posted at the border of the state. By having key-activated switch **354** turned on or off by a state official the state is able to precisely monitor and tax vehicles moving therethrough.

Additionally, the embodiments of FIGS. 3-6 are also well suited to having a communication link, not shown, between the integrated GPS/taximeter system and, for example, a tracking station. The communication link is used to transfer information such as, for example, position, fare amount, status, receipts, and the like from a vehicle to a tracking station. The communication link is established using any one of numerous communication link techniques well known in the art.

FIG. 7 is a block diagram of a mileage measurement and logging system **400** which uses a GPS system having a direct output terminal at which are provided corrected odometer pulses. The mileage measurement and logging system **400** is used, for example, with vehicles such as trucks, which have mileage meters which are calibrated and certified by governmental agencies for a specific tire pressure and a certain rim size. When the tire pressure and rim size of a vehicle are changed, distance errors of 3 percent can be obtained. For a state governmental agency which taxes a long-haul truck based on the number of miles driven by the long-haul truck within the state, shortened mileage readings result in significant revenue shortfall for the state.

The mileage measurement and logging system **400** uses a Scorpion GPS receiver/computer integrated circuit **402**

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which includes a 68332 microprocessor, AID circuits, DUARTs. The Scorpion integrated circuit **402** also includes integral circuitry for taking a raw odometer input pulses on a signal line **403** from an odometer **404** and internally processing the raw odometer pulses to obtain corrected, calibrated odometer output pulses which are provided as output signals on a signal line **406**. The GPS system verifies and corrects for errors in the raw odometer pulses received by the Scorpion integrated circuit **302** from the odometer **404**.

The corrected, calibrated odometer output pulses on signal line **406** are fed into the odometer input terminal of a standard mileage meter **408**. GPS time signals are also fed on a signal line **410** to the mileage meter **408**.

Information is sent on a signal line **412** from the fare computation module **330** to the GPS receiver/computer module **402**. Information relevant to particular trips is sent from the GPS receiver/computer on a signal line **414** to a data recorder **416**. This information includes trip information such as when a vehicle enters or leaves a state, proof of a path followed by a vehicle, delivery of good at a certain site, operation within speed limits, certification of operation within a certain geographic area.

The integrated taximeter and GPS system provided according to the invention uses GPS position, velocity, and time information to produce incontrovertibly accurate corrected odometer input pulses and GPS time signals for the taximeter to precisely compute elapsed time and distance traveled. Also, as mentioned in connection with the description of FIG. 3, the recorded trip information can include a number of items, depending upon the application. For an interstate truck, the information is about when and where a vehicle enters and leaves a predetermined zone, such as a state or municipality. For both taxis and trucks, the trip information includes information showing proof of a path followed by a vehicle. The trip information may include information about delivery of a passenger or goods at a certain site. The trip information can include information about operation of a vehicle, particularly a truck, within safe speed limits. The trip information can also include information about certification of operation within a certain geographic area.

The foregoing descriptions of specific embodiments of the present invention have been presented for the purposes of illustration and description. They are not intended to be exhaustive or to limit the invention to the precise forms disclosed, and obviously many modifications and variations are possible in light of the above teaching. The embodiments were chosen and described in order to best explain the principles of the invention and its practical application, to thereby enable others skilled in the art to best utilize the invention and various embodiments with various modifications as are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the claims appended hereto and their equivalents.

I claim:

1. A calibrated electronic taximeter system for a taxi, comprising:

a GPS receiver/computer system having means for receiving input odometer pulses from an odometer, said GPS receiver/computer system providing GPS information as output signals;

interface means for receiving the GPS information from the GPS receiver/computer system and for providing continuously calibrated odometer output pulses as a function of the received GPS information, when the GPS information is available;

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a taximeter having means for receiving calibrated odometer output pulses from the interface means and for receiving the GPS information, said taximeter having means for computing and displaying a taxi fare from the calibrated odometer output pulses and GPS information provided by said GPS receiver/computer system;

wherein the GPS receiver/computer system includes dead reckoning means for providing location information to the GPS computer system during GPS receiver system service outages;

means for providing trip information;

means for recording the trip information; and

wherein the trip information includes information selected from the group consisting of information about when and where a vehicle enters and leaves a predetermined zone, information establishing proof of a path followed by a taxi, information about operation within speed limits, and information verifying operation within a certain geographic area.

2. The system of claim **1** wherein the GPS receiver/computer system includes differential GPS means for improving the accuracy of the GPS receiver/system.

3. A method of calibrating a taximeter installed in a taxi vehicle, comprising the steps of:

providing GPS position information and GPS time information as output signals from a GPS receiver/computer system;

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receiving input odometer pulses from an odometer;

providing calibrated odometer output pulses as a function of the received GPS velocity information and GPS time information;

computing a taxi fare in a taximeter from the calibrated odometer output pulses provided by said GPS receiver/computer system;

displaying the taxi fare;

using a dead reckoning navigation system for providing location information to the GPS computer system during GPS receiver system service outages;

providing the trip information;

displaying the trip information;

recording the trip information; and

wherein the step of providing the trip information includes information selected from the group consisting of the step of providing information about proof of a path followed by a taxi vehicle, providing information about operation of a vehicle within speed limits; and providing information about certification of operation within a certain geographic area.

4. The method of claim **3** including the step of using differential GPS means for improving the accuracy of the GPS receiver/system.

* * * * *

Exhibit 13



The New York City **Taxicab Fact Book**

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March 2006

Introduction

New York City's 12,779 yellow medallion taxicabs comprise a \$1.8 billion industry serving about 240 million passengers a year. Taxis are a vital part of New York City's transportation network, transporting 25% of all fare-paying bus, subway, taxi and for-hire vehicle passengers traveling within Manhattan and collecting 45% of fares paid for these trips. Cabs are also the primary ground carrier between Manhattan and LaGuardia Airport and provide a substantial number of trips to and from John F. Kennedy International Airport.

Because of their central transportation role, their prominence in Manhattan traffic, and the fact that taxicabs are privately operated as well as closely regulated, information on New York's cabs attracts a broad audience. This *New York City Taxicab Fact Book* traces the history of the industry and profiles the taxi industry's three constituent elements: passengers, drivers and owners.

The *Fact Book* was prepared by Bruce Schaller, Principal of Schaller Consulting, which serves government, business and non-profit organizations seeking to meet customer needs in all forms of urban transportation including taxi, bus, subway and auto. Schaller Consulting specializes in taxicab regulatory and operational issues. Mr. Schaller has worked extensively on taxi issues in New York City and other cities across the U.S., including Chicago, San Francisco, Los Angeles, San Diego and the Washington DC and Dallas-Fort Worth areas.

Three versions of the *Fact Book* were published by the Taxi and Limousine Commission in the early 1990s while Bruce Schaller was Director of Policy Development and Evaluation. Schaller Consulting released a new, extensively expanded and updated *Fact Book* in September 2003. This is the second update to the *Fact Book* since 2003. This edition contains new and updated information on taxi ridership and revenues, cab availability, driver nationalities and driver incomes. Fare information is also updated to reflect the November 2006 increase in wait time.

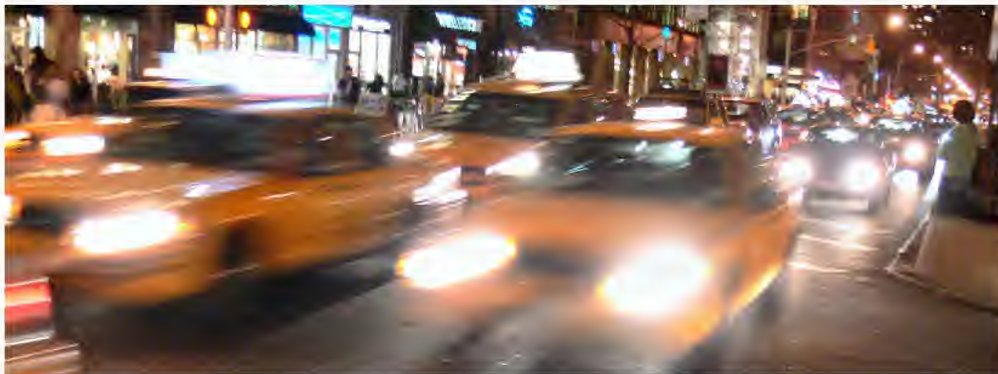


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This document is available in electronic form at www.schallerconsult.com/taxi

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New to the 2006 Fact Book

Ridership, revenue and fares

- Taxi ridership increased to 241 million in 2005, up from 233 million in 2001 but below the 1999 peak of 246 million. *(Details on page 3)*
- Industry revenue totaled a record \$1.82 billion in 2005. Revenue increased 29% from 2003 to 2005. Revenue growth was primarily due to the May 2004 fare increase, with economic growth and issuance of additional medallion licenses also contributing to revenue growth. *(Details on page 34)*
- Cabs transport 11% of fare-paying passengers traveling by taxi, bus, subway, car service or black car in New York City, and 25% of those traveling within Manhattan.
- Taxi fares now account for an estimated 30% of all fares paid by passengers for taxi, bus, subway, and car service and black car trips in New York City, and 45% of fares paid for trips within Manhattan.
- The average fare is \$9.61 for a 2.8 mile trip, or \$11.44 when surcharges and tips are included (taking into account the November 2006 increase in wait time).
- New York's fare is eleventh highest among the 14 U.S. cities with 1,300 or more metered taxicabs. *(Details on page 17)*

Driver incomes

- As a result of the 2004 fare increase, driver incomes increased to \$158 per shift in 2005 – a 37% increase since 2003 in nominal dollars and a 27% increase in inflation-adjusted dollars. *(Details on page 36)*
- As a result of the fare increase, drivers' inflation-adjusted cash incomes now exceed the cash incomes of cab drivers in 1929 – for the first time since the Stock Market Crash of that year. *(Details on page 37)*

Driver licensing, experience and national origin

- 3,800 new drivers were issued licenses in fiscal year 2005, up from a low of 2,127 in fiscal year 2000 but well below the 3,800 to 4,700 licenses issued annually in the mid 1990s. *(Details on page 51)*
- Driver experience levels have grown dramatically. In 2005, 42% of drivers had been licensed for at least 11 years, compared with only 29% in 1998 and 10% in 1993. *(Details on page 52)*
- Annual driver attrition has fallen from 8.8% in the mid-1990s to 6.2% in 2005. The attrition rate among newly licensed drivers has declined by 50%.

- 91% of drivers are immigrants and 9% were born in the United States. The most common countries of origin are Pakistan (14.4%), Bangladesh (13.6%) and India (10.2%). *(Details on pages 53-57)*

Quality of service

- New Yorkers give cab service a rating of 6.2 on a 0-10 scale for overall quality of service. The satisfaction level for taxi service is below the satisfaction level for private autos, subways, car services and buses. *(Details on pages 11-12)*
- Taxi riders give the highest ratings for personal security in cabs, comfort, vehicle cleanliness, being a fast mode of travel and being charged the correct fare. *(Details on page 11)*
- Taxis receive relatively low ratings for being able to get a cab when you want one, value for the money, safety from accidents, driver understanding of directions and driver courtesy.
- Passengers filed 17,350 complaints with TLC in fiscal year 2005. Traffic violations, service refusals and rudeness head the list of complaints. *(Details on pages 13-14)*
- 72% of the taxicabs are model year 2003 or later cars (as of April 2005). *(Details on page 42)*

Medallion prices

- Medallion prices reached record-high levels in 2005: \$336,000 for individual medallions and \$379,000 for corporate medallions. *(Details on pages 38-41)*
- While previous auctions had set record prices, the average sales price for medallions auctioned in October 2005 – \$339,000 for individual licenses and \$393,000 for corporate licenses – were in line with the market prices. Medallion licenses for accessible and alternative fuel cabs were auctioned at below-market prices as part of the October 2005 auctions. *(Details on pages 28)*

Other highlights of the Fact Book

- Manhattan residents frequently rely on cabs for work and personal trips. Manhattan adults hail a cab an average of 100 times a year. Two-thirds of Manhattan residents use cabs for at least some work and/or personal trips.
- 45% of taxicabs are leased to drivers on a long-term basis, primarily by large leasing agents or taxi fleets, up from 19% in 1992.
- 29% of taxicabs are owner-driven, an all-time low and down from 37% in 1992.
- 26% of cabs are leased on a shift basis, down from 40% in 1992. *(Details on pages 31-33)*

Part I. Taxis as a Mode of Transportation

A Critical Link

Taxis provide ready mobility for millions of New Yorkers . . .

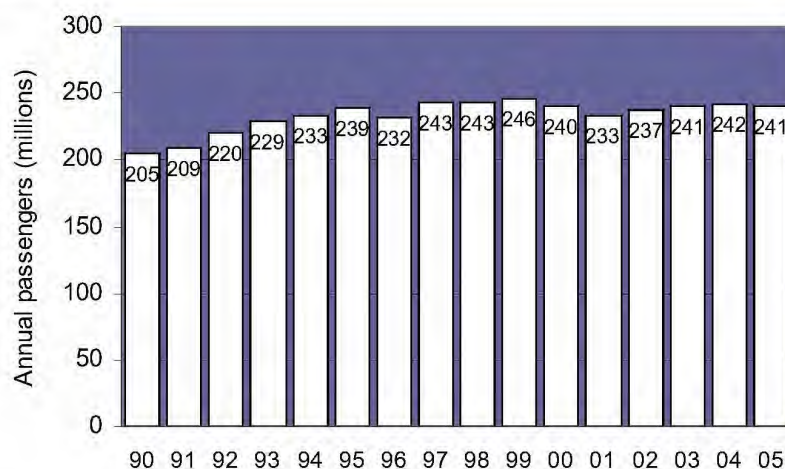
- 241 million people rode in New York City yellow medallion taxicabs in 2005.
- With an average of 1.4 passengers per trip, there were 172 million taxi trips in 2005, or about 470,000 taxi trips per day.
- After falling by 3% in 2001 due to the recession and the Sept. 11 terrorist attacks, ridership in 2005 matched the 2000 level. (See Figure 1.)

. . . and play a major transportation role . . .

- Taxis carried 11% of fare-paying riders using taxis, for-hire vehicles, subways or buses in New York City in 2005. Taxi trips accounted for 30% of all fares paid on these transport modes.
- Taxis play a particularly prominent role in travel within Manhattan. Cabs transported 25% of all paying passengers traveling by taxi, bus, subway or for-hire vehicle within Manhattan in 2005. Taxis accounted for 45% of all fares paid on these modes.
- Cabs are the number-one means of travel from Manhattan to New York airports, carrying 39% of all airport-bound passengers from Manhattan. *[TLC 1993b]*¹

Figure 1.
Taxi ridership,
annually,
1990-2005.

Source: Schaller Consulting analysis of taximeter and odometer readings taken during taxi inspections.



¹ See Appendix for source references.

... far larger than in most U.S. cities

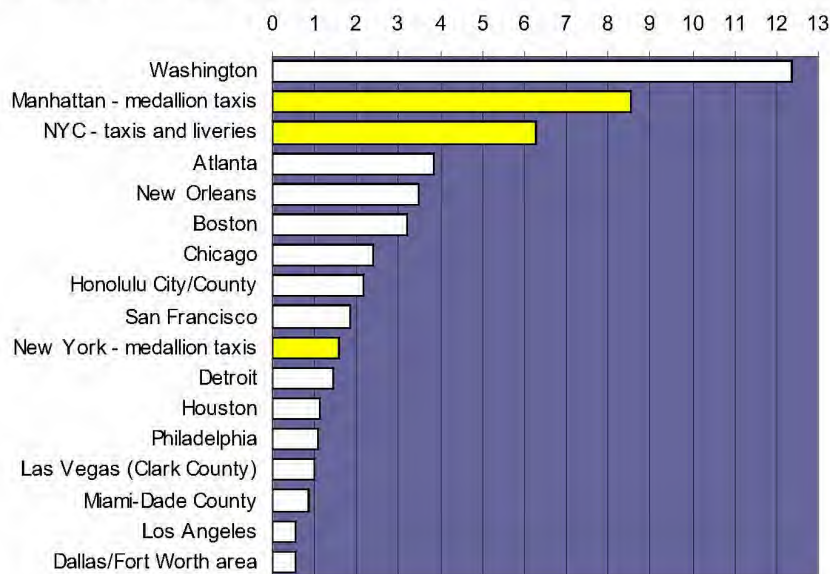
- Combining taxis, black cars and car services, there were 6.3 taxis/liveries per 1,000 New York City residents in 2005. This figure is greater in New York City than in any other major U.S. city except Washington DC, which does not limit the number of taxicabs. (See Figure 2.)
- Focusing on Manhattan, which accounts for over 90% of taxi trip origins, there were 8.5 yellow medallion taxis per 1,000 Manhattan residents in 2005.
- Other cities with at least 2.4 taxis per 1,000 residents are Chicago, New Orleans and Boston. These cities have high-density downtowns and many visitors.
- Auto-oriented cities such as Los Angeles, Dallas and Houston, have fewer than 1.2 taxis per 1,000 population.
- These ratios are highly affected by the land area of the regulatory jurisdiction. For example, cabs in downtown Miami and Las Vegas are highly visible, but the large size of the regulating jurisdictions (Miami-Dade County and Clark County, respectively) produce relatively low population ratios.
- A statistical model of 118 cities and counties found that the number of taxicabs in U.S. cities is related to the number of zero-vehicle households in the city, subway ridership and airport taxi passenger volumes. These factors better explain the number of taxicabs than does population. [Schaller 2005]

Figure 2.

Ratio of taxicabs to population in cities with 1,300 or more cabs.

Taxis per 1,000 residents, 2005.

Source: U.S. Census 2004 population estimates



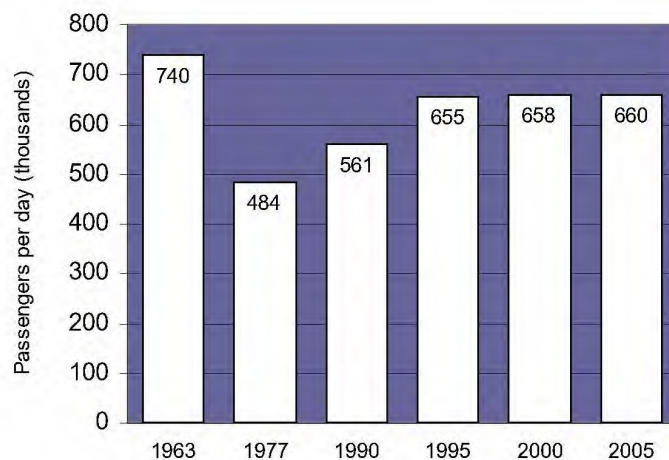
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Taxi ridership has followed changes in the economy

- Taxicab ridership has been fairly stable since 1995 at about 660,000 passengers per day.
- Ridership increased by 35% from the mid-1970s to 1995, spurred by rising demand and increases in cab mileage as single-shifted cabs were moved to double-shift operation.
- Taxicab ridership fell sharply between 1963 and 1977 as New York City went through a deep economic contraction in the 1970s and many fleet cabs were sold to minifleet owners who operated one shift instead of two shifts per day. (See Figure 3.)

Figure 3.
Taxi ridership,
average per day,
1963-2005.

Sources: Tri-State Transportation Commission (1963 and 1977), Schaller Consulting analysis of taximeter and odometer readings taken during taxi inspections.



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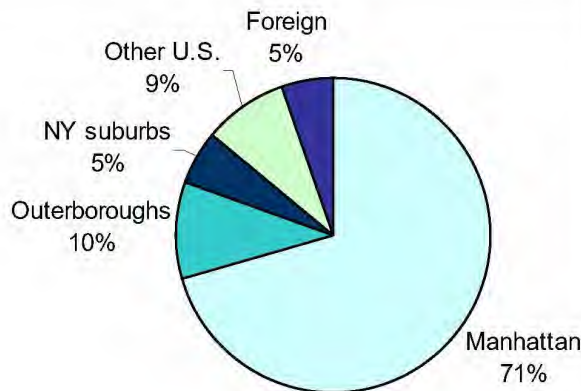
Who Takes Cabs and Why

The primary riders are Manhattan residents who are frequent riders . . .¹

- 71% of all taxi trips transport Manhattan residents. (See Figure 4.)
- Outer-borough residents, suburbanites, U.S. residents from outside the New York area, and foreign visitors each account for between 5% and 10% of all trips.
- 6% of Manhattan residents “always” or “usually” use taxicabs for work trips and 20% “always” or “usually” take cabs for personal trips. [*Schaller Consulting 2002b*]
- An additional 38% of Manhattan residents “sometimes” use taxicabs for work trips and 48% “sometimes” take cabs for personal trips. Thus, two-thirds of Manhattan residents use cabs for work and/or personal trips at least some of the time. [*Schaller Consulting 2002b*]
- Manhattan adults hail a cab an average of 100 times a year.
- 66% of Manhattanites’ taxi trips are between home, work and/or recreational pursuits (i.e., restaurants, entertainment and shopping). Providing quick, convenient, door-to-door service, taxis function as the equivalent of the suburban family car – not surprising given that 77% of Manhattan households do not own a car. [*TLC 1993b and 2000 U.S. Census*]

**Figure 4.
Place of
residence of
taxi riders,
1993.**

Source: *TLC 1993b*.



¹ Except as otherwise noted, data in this chapter are from *TLC 1993b*.

... though cabs are equally important to visitors

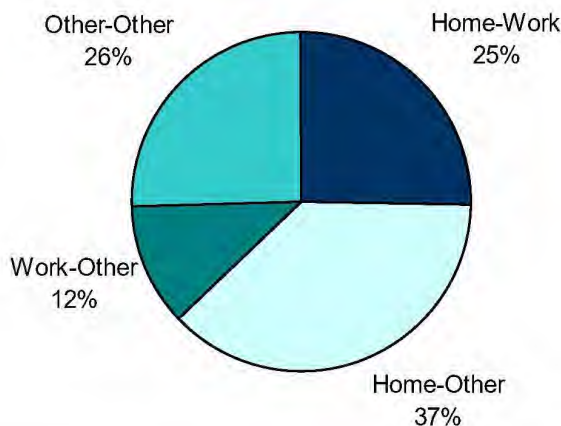
- There are about 38 million passenger-trips by visitors annually, representing an average of 2.5 passenger trips per overnight visitor.
- Hotel guests average one taxi trip to or from the hotel each day.
- Visitors use cabs primarily to go between hotels, business appointments, entertainment spots, restaurants, bus and train stations and the airports. Trips that are both to and from these places account for 50% of all visitor taxi trips, compared with 15% of all taxi trips.
- The majority of U.S. visitors who ride cabs are in New York on business, while most foreign visitors are tourists.

Trips involving home or work place predominate

- 32% of all taxi trips are destined for the passenger's home while 19% are going to the passenger's place of work. Other destinations are entertainment (13%), business appointments (10%), train and bus terminals (5%), shopping (4%), hotels (4%) and medical appointments (2%).
- 25% of trips are between home and work and 37% are between home and non-work locations. (See Figure 5.)
- After 8 p.m., over 50% of all trips are bound for the passenger's home, generally originating at entertainment attractions or work places.
- 15% of all fares are reimbursed by the passenger's employer.

Figure 5.
Trip purposes
of taxi riders,
1993.

Source: TLC 1993b.



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Speed and access are primary reasons to use cabs instead of the subway

- Among New York City residents, the main reasons to take a cab instead of the subway are “how long the trip will take,” cited by 38% of respondents to a survey, and “not being able to get there by subway,” cited by 29%. *[Schaller 2000]*
- The main reasons to take the subway instead of a cab are cost, cited by 53%, and how long the trip will take, cited by 32%. *[Schaller 2000]*

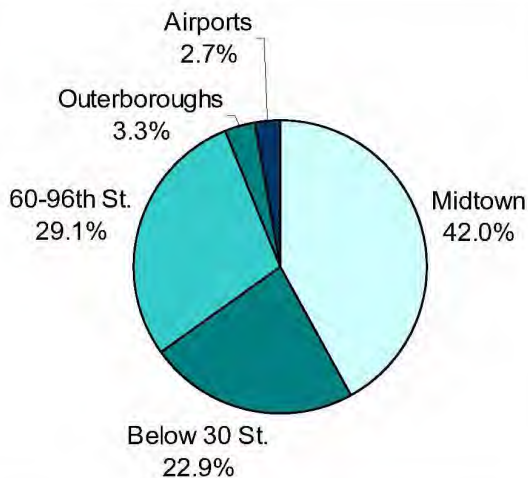
Trips center on Manhattan, especially Midtown

- 80% of all taxi trips began and/or ended in the Manhattan business district (60th Street to the Battery, river to river) in 1988. (See Figure 6.)
- 42% of all trips started in Midtown Manhattan (30th to 60th Streets, river to river) in 1988.
- This trip profile was essentially unchanged morning, midday, afternoon and evening in 1988.
- 8% of all taxi trips served the “outer-boroughs” (Brooklyn, the Bronx, Queens, Staten Island or northern Manhattan) in 1988. More than one-half of the outer-borough trips began in Manhattan south of 96th Street. Only 1% of all trips both began and ended in the outer-boroughs.
- 4% of all trips began and/or ended at LaGuardia or Kennedy airports in 1990. (The number of trips to Newark airport was negligible.) *[TLC 1991]*
- Airport taxi trips have grown significantly since 1990. Although comprehensive data are not available, the number of taxis dispatched from JFK increased 68% from 1996 to 2005. *[Unpublished Port Authority of New York and New Jersey data]*

Figure 6.
Taxi trip origins, 1988.

Outer-boroughs are defined as Brooklyn, Bronx, Queens, Staten Island and Manhattan above 96 Street.

Source: Trip sheet sample.



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Journey to work by taxicab, 2000

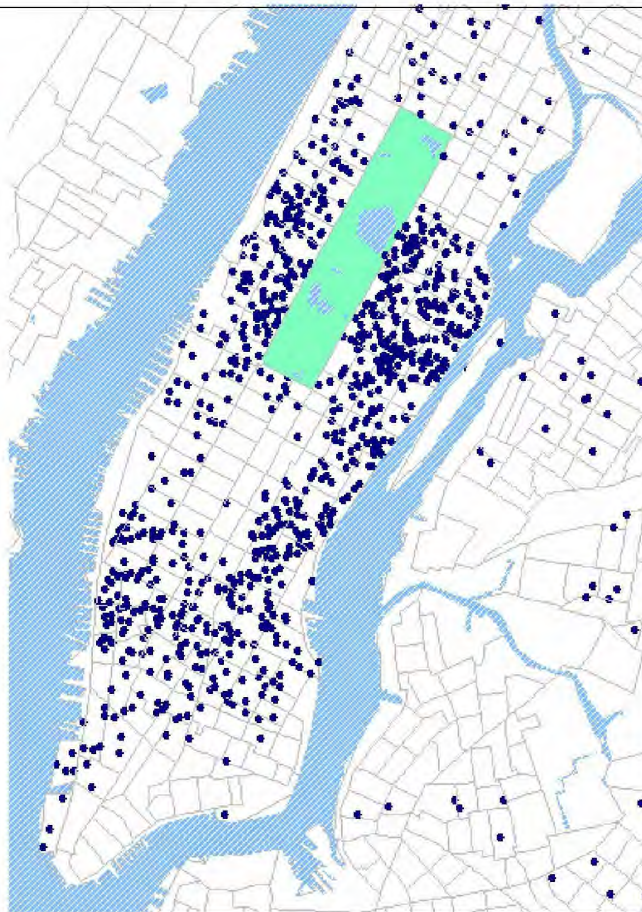
- Commuting to work is the predominant taxi trip purpose during the morning rush hour, accounting for 61% of trip destinations from 7-9 a.m. [TLC 1993b]
- Taxi commuters were concentrated among residents of the Upper East Side and Upper West Side in 2000. (See Figure 7.)
- A substantial number of taxi commuters also live in East Midtown and the Valley (between Midtown and Downtown business districts) as well.

Figure 7.
Place of residence of
workers using taxis
for journey to work,
2000.

One dot = 40 commuters.

Note that the Census does not include (a) non-work trips, (b) commute trips for workers who only sometimes use cabs to get to work, or (c) trips where main mode to work is other than taxi, e.g., rail or ferry.

Source: 2000 U.S. Census.



Taxis are a primary way to go to the airports

- 35% of air passengers traveling to LaGuardia Airport came by cab in 2002, as did 23% traveling to John F. Kennedy International Airport. *[Port Authority of New York and New Jersey 2002 Terminal by Terminal Survey]*
- By contrast, 24% of air passengers traveling to LaGuardia used a “limo, executive car or town car” and 22% came by private vehicle. Figures for JFK were 21% by limo, executive car or town car and 27% by private vehicle.
- Taxi ridership departing the airports is much higher – by 50% – than ridership to the airports. Presumably, many people who use other modes to the airport such as for-hire vehicle or private car, take advantage of the convenience of the taxi dispatch lines when leaving the airport. *[The 50% figure is based on a sample of 1990 taxicab trip sheets.]*

Taxi Service Quality

How satisfactory is taxicab service? This chapter reports on service quality based on customer opinion surveys and customer complaints. Results show that taxi service is viewed somewhat less favorably than subway and bus service and much less favorably than the private auto. The data also identify specific service problems with cab availability, safety from accidents, driver courtesy and geographic knowledge and value for the money.

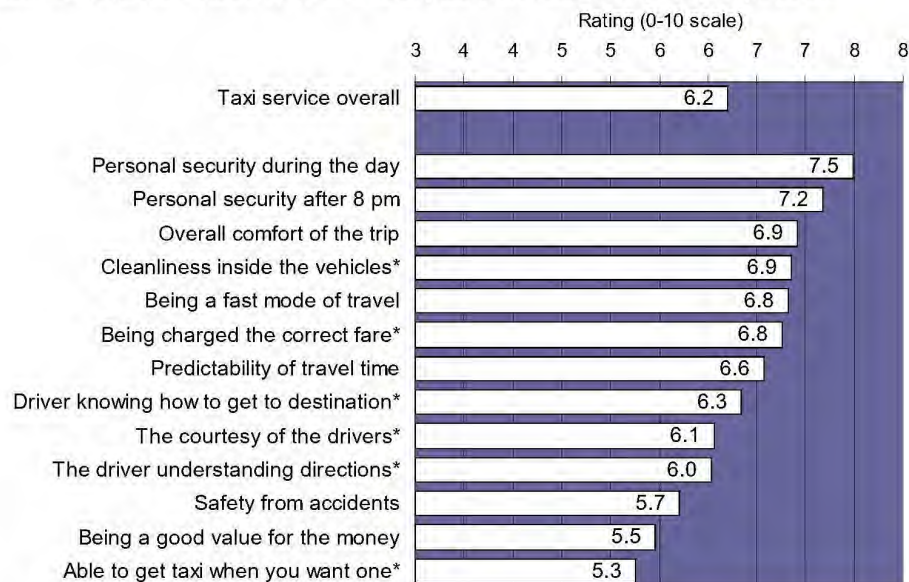
Best aspect of cab service is personal security; worst is cab availability

- New Yorkers gave cab service a 6.2 rating for overall quality of service in 2004, on a scale of 0 (worst possible service) to 10 (best possible service).
- Asked about different aspects of taxi service, taxi riders give the highest ratings to personal security, comfort, vehicle cleanliness, being a fast mode of travel, and being charged the correct fare. (See Figure 8.)
- Taxis receive relatively low ratings for being able to get a cab when you want one, value for the money, safety from accidents, driver understanding of directions and driver courtesy.
- Mid-range ratings are given for predictability of travel time.

Figure 8.

Customer Satisfaction Ratings, 2004.

Overall rating by all respondents; attribute ratings by respondents who had used cabs in past 3 months. Source: New York City Transit Transportation Panel Survey, July-Sept. 2004.



* Rating is from Oct.-Dec. 2000 (these attributes were not asked after early 2001).

Satisfaction with taxi service trails other modes

- Taxis (6.2 rating) were rated below private autos (8.5), subway (7.0), car service (6.9) and local buses (6.7).

Cabs rank fourth or fifth in all major service attributes

- Taxis receive lower ratings than autos on each of seven service attributes and lower than subway, car service and bus on most of the seven attributes. (See Table 1.)
- Taxis are perceived as being a faster mode of travel, with more predictable travel times, than the bus.
- Taxis receive a higher rating than the subway for personal security at night.
- Ratings are much lower for taxis than for other modes for safety from accidents and being a good value for the money.

Table 1.**Customer satisfaction ratings, 2004.**

Source: New York City Transit Transportation Panel Survey, July-Sept. 2004.

	Over all	Being fast mode of travel	Predict- ability of travel time	Overall comfort of trip	Safety from acci- dents	Good value for the money	Per- sonal security during the day	Per- sonal security after 8 p.m.
Private cars	8.5	8.1	7.7	8.9	7.6	7.8	8.8	8.4
Subway	7.0	7.9	7.0	6.9	7.7	7.1	7.6	6.5
Car service	6.9	7.5	7.2	7.7	6.7	6.5	7.9	7.4
Local bus	6.7	6.4	6.4	7.2	7.6	7.1	8.1	7.4
Taxi	6.2	6.8	6.6	6.9	5.7	5.5	7.5	7.2

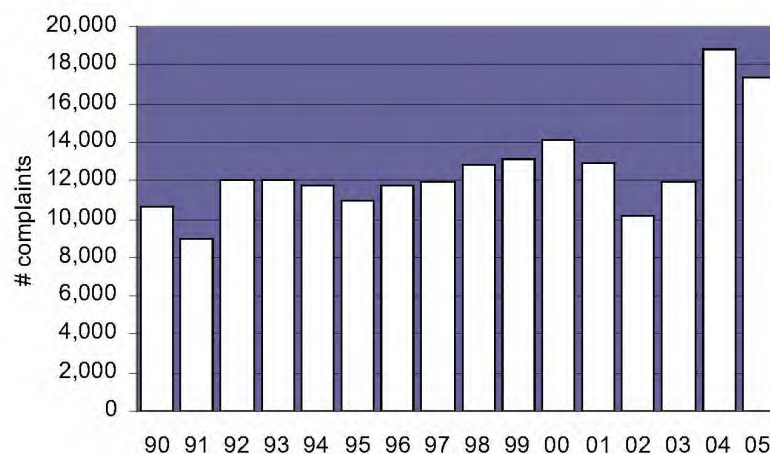
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Over 17,000 passenger complaints to TLC in 2005

- Passengers filed 17,350 complaints with TLC in fiscal year 2005.
- The total number of complaints declined by 8% from fiscal year 2004 to 2005.
- Complaint trends should be interpreted with caution because the number of complaints is subject to changes in the ease of contacting TLC to file complaints as well as changes in the quality of service. Most notably, the number of complaints increased 58% from fiscal year 2003 to 2004 as the city's 311 system began processing taxi passenger complaints.

Figure 9.
Passenger
complaints
filed with TLC,
1990-2005.

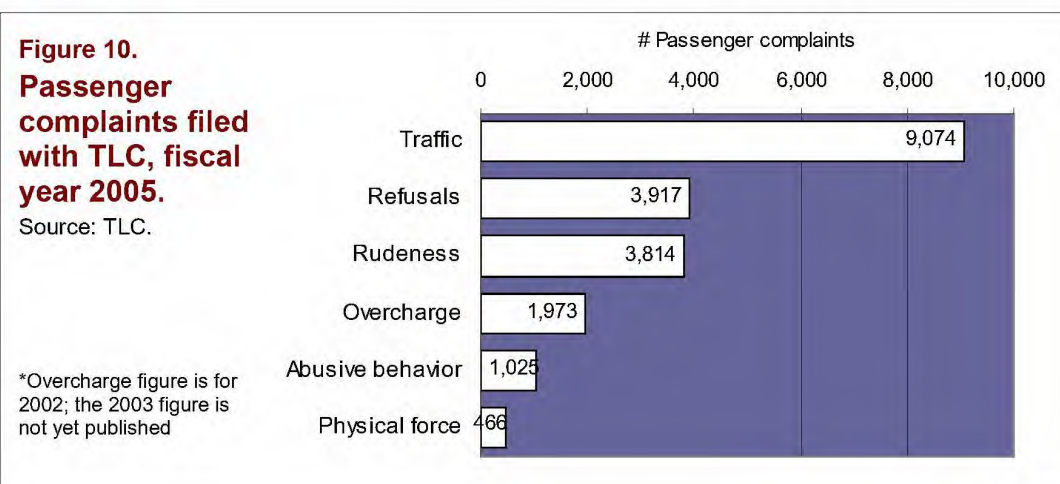
Source: New York
City Mayor's
Management
Reports



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Driver rudeness and traffic violations lead the list of passenger complaints

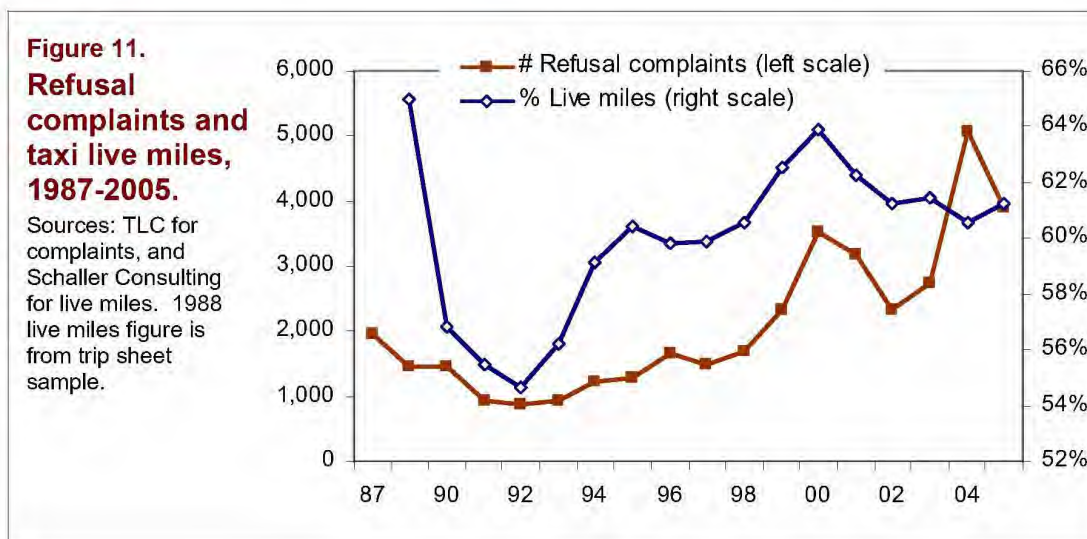
- In fiscal year 2005, of the 17,350 customer complaints filed, 9,074 complaints were for traffic violations, up 35% from fiscal year 2004. (Note that many complaints involve more than one rule violation.)
- 3,917 complaints were for service refusals, a 23% decline from the previous year.
- 3,814 complaints were for driver rudeness, a 26% decline from the previous year.
- 1,025 complaints were for abusive behavior by the driver.



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Service refusal complaints rise and fall with cab availability

- Both service refusal complaints and live miles (miles with a passenger) declined during the recession in the early 1990s and from 2000 to 2003, also recession years. (See Figure 11.)
- Conversely, during the 1990s economic expansion, service refusal complaints and live miles increased.
- While live time remained stable, refusal complaints increased sharply in 2004; this is in part likely due to the advent of the 311 City information system.
- In a 1993 survey of passengers who had filed a refusal complaint with TLC, complainants thought that financial motivations were the most common reason that they had been refused. Passengers said that drivers do not want to dead-head back from an outer-borough destination, they want to avoid becoming stuck in rush hour bridge or tunnel traffic, or they believe that a trip uptown will be more profitable than a passenger's desired trip downtown. Although race is often seen as the major cause of service refusals of non-whites, nonwhite complainants pointed to these financial motivations as the reason for drivers' refusal more often than they cited racial bias.
- The implication of this information is that the ease (or difficulty) of finding passengers is a main reason that some drivers choose to refuse or accept fares. When times are tough, drivers will transport virtually anyone they see hailing a cab. When passengers are plentiful, drivers (or at least some drivers) decide to be more choosy about which trips to take, and as a result, a larger number of passengers are refused service.



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Fares

This section has been updated to reflect the increase in the wait time that took effect on November 30, 2006.

How the fare is calculated: The cab fare is \$2.50 for the first 1/5 of a mile and 40 cents per additional unit. A unit is composed of distance (one unit equals 1/5 mile) and/or wait time (one unit equals 60 seconds). As a cab moves at more than 12 mph, the meter clocks distance. When a cab is stopped or is moving at less than 12 mph, the meter clocks time. This method of calculating fares is uniform throughout the U.S. and conforms to federal standards for taximeters.

TAXI FARE	
\$2.50	INITIAL CHARGE
40¢	Per 1/5 Mile
40¢	Per 1 Minutes Stopped/Slow Traffic
\$1.00	Weekday Surcharge 4pm - 8pm
50¢	Night Surcharge 8pm - 6am

There is also a \$1 surcharge for trips beginning from 4 p.m. to 8 p.m. and a 50-cent surcharge for trips starting between 8 p.m. and 6 a.m. Trips between John F. Kennedy International Airport and Manhattan are charged at a flat rate of \$45 plus any tolls. There is a \$15 surcharge for trips to Newark Liberty International Airport.

Short, quick trips are most common

- The average fare (without any surcharges) increased from \$6.85 to \$8.65 as a result of the May 2004 fare increase and to \$9.61 with the increase in wait time in November 2006. Including surcharges and a 15% tip, the average fare is \$11.44 for a 2.8 mile trip with 4.77 minutes wait time.
- The average trip traveled 2.47 miles and took 11 minutes, including 4.6 minutes charged as wait time, in 1993. Trip length increased to 2.8 miles in 2001.
- A typical short trip that stays within Midtown Manhattan averages 1.13 miles with 6.1 minutes waiting time and costs \$6.80.
- A medium length trip, for example from Grand Central Station to Union Square or Greenwich Village, averages 2.19 miles with 5.9 minutes of waiting time, and costs \$8.84.
- A longer trip in medium to light traffic, for example from Tribeca to the Upper East Side, costs \$11.20 for 3.75 miles and 4 minutes of waiting time.
- Airport fares are sensitive to the amount of congestion, which varies widely for different airport trips, and the route chosen (i.e., taking the Triboro Bridge versus the Midtown Tunnel from LaGuardia to Manhattan). Using geographically direct routes, in moderate traffic, fares from Midtown Manhattan to LaGuardia average \$26. Including different traffic conditions and routes, fares between Midtown and LaGuardia are \$23 to \$34. (A flat fare applies for trips between Manhattan and Kennedy Airport.)

Taxi fare has fluctuated in a \$2 range since 1980, adjusted for inflation

- The fare for today's average trip grew from 83 cents in the early 1950s to \$2.30 in the early 1970s to \$9.61 in 2006. (See Table 2 and Figure 13 on the next page.)
- Adjusted for inflation, the fare has varied between \$7.40 and \$11.63 over the past half century.
- The fare has fluctuated between \$7.65 and \$9.61 over the past 20 years, using today's dollars.
- Compared with the public transit fare, the taxi fare is at a 25-year high, at 5.8 times the transit fare. (See Figure 12. The 5.2 multiple is based on the \$9.61 average taxi fare and the widely used six-for-five MetroCard bonus. Note that since the two fares are charged on different bases, the ratio varies for actual trips depending on the length of the trip, number of passengers, surcharges and traffic conditions.)

New York's taxi fare is inexpensive relative to most major U.S. cities

- New York City's taxi fare for a 2.8 mile trip was eleventh among the 14 U.S. cities with 1,300 or more metered taxicabs, as of early 2006.
- Honolulu (\$12.89 average fare for a 2.8 mile trip), San Francisco (\$10.85), and Miami (\$10.73) led this list. Average fares were \$10.07 in Los Angeles, \$8.66 in Chicago and \$8.07 in Detroit, which had the lowest taxi fare among cities with 1,300 or more metered cabs, as of early 2006.

Figure 12.
Ratio of taxi to
transit fare since
1951.

Ratio of average taxi fare to transit fare. Cost of discounted transit fare is used for 1995 and later (currently \$1.67 with six-for-five bonus fare).

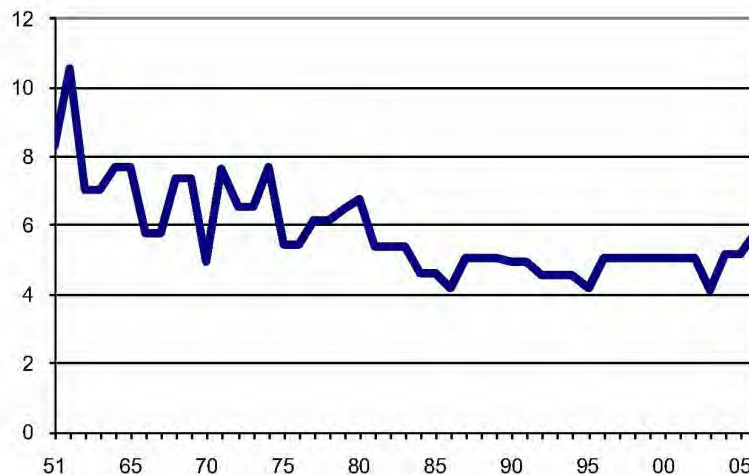


Table 2. Taxi fares since 1952.

	Initial Charge	Mileage Charge	Wait Time	Charge per		Avg. fare
				Mile	Minute	
Before 1952	\$0.20 first 1/4 mi.	\$0.05 per 1/4 mi.	\$0.05 per 2 min.	\$0.20	\$0.03	\$0.83
July 1952	\$0.25 first 1/5 mi.	\$0.05 per 1/5 mi.	\$0.05 per 90 sec.	\$0.25	\$0.03	\$1.06
Dec. 1964	\$0.35 first 1/5 mi.	\$0.05 per 1/5 mi.	\$0.05 per 90 sec.	\$0.25	\$0.03	\$1.16
Jan. 1968	\$0.45 first 1/6 mi.	\$0.10 per 1/3 mi.	\$0.10 per 2 min.	\$0.30	\$0.05	\$1.48
March 1971	\$0.60 first 1/5 mi.	\$0.10 per 1/5 mi.	\$0.10 per 72 sec.	\$0.50	\$0.08	\$2.30
Nov. 1974	\$0.65 first 1/6 mi.	\$0.10 per 1/6 mi.	\$0.10 per 60 sec.	\$0.60	\$0.10	\$2.71
March 1977	\$0.75 first 1/7 mi.	\$0.10 per 1/7 mi.	\$0.10 per 60 sec.	\$0.70	\$0.10	\$3.09
July 1979	\$0.90 first 1/7 mi.	\$0.10 per 1/7 mi.	\$0.10 per 60 sec.	\$0.70	\$0.10	\$3.24
April 1980	\$1.00 first 1/9 mi.	\$0.10 per 1/9 mi.	\$0.10 per 45 sec.	\$0.90	\$0.13	\$4.06
July 1984	\$1.10 first 1/9 mi.	\$0.10 per 1/9 mi.	\$0.10 per 45 sec.	\$0.90	\$0.13	\$4.16
May 1987	\$1.15 first 1/8 mi.	\$0.15 per 1/8 mi.	\$0.15 per 60 sec.	\$1.20	\$0.15	\$5.08
Jan. 1990	\$1.50 first 1/5 mi.	\$0.25 per 1/5 mi.	\$0.25 per 75 sec.	\$1.25	\$0.20	\$5.70
March 1996	\$2.00 first 1/5 mi.	\$0.30 per 1/5 mi.	\$0.30 per 90 sec.	\$1.50	\$0.20	\$6.85
May 2004	\$2.50 first 1/5 mi.	\$0.40 per 1/5 mi.	\$0.40 per 120 sec.	\$2.00	\$0.20	\$8.65
Nov. 2006	\$2.50 first 1/5 mi.	\$0.40 per 1/5 mi.	\$0.40 per 60 sec.	\$2.00	\$0.40	\$9.61

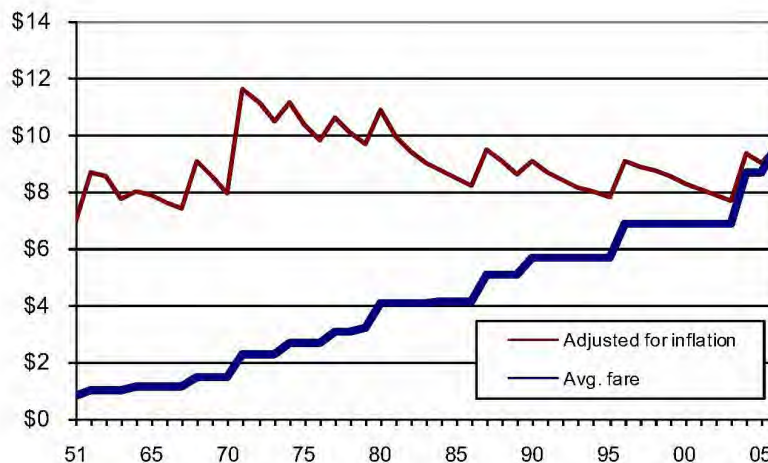
Surcharges and flat fares:

- A night surcharge, applying to trips beginning between 8 p.m. and 6 a.m., was added in May 1981. The surcharge was rescinded in January 1982 for all but the 2,300 fleet cabs. The 50-cent night surcharge was extended to the entire industry in May 1987.
- \$1 surcharge for trips beginning between 4 p.m. and 8 p.m. was added in May 2004.
- A \$30 flat fare from JFK airport to Manhattan was adopted in January 1996 and increased to \$35 in 2001 and \$45 in 2004. The flat fare was extended to trips from Manhattan to JFK airport in 2006.
- Surcharge for trips to Newark Airport was increased from \$10 to \$15 in 2004.

Average fare based on 2.8 mile trip with 4.77 minutes of wait time.

Figure 13.
Taxi fares since 1951.

Average fare in current and inflation-adjusted dollars.



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Taxi Service Availability

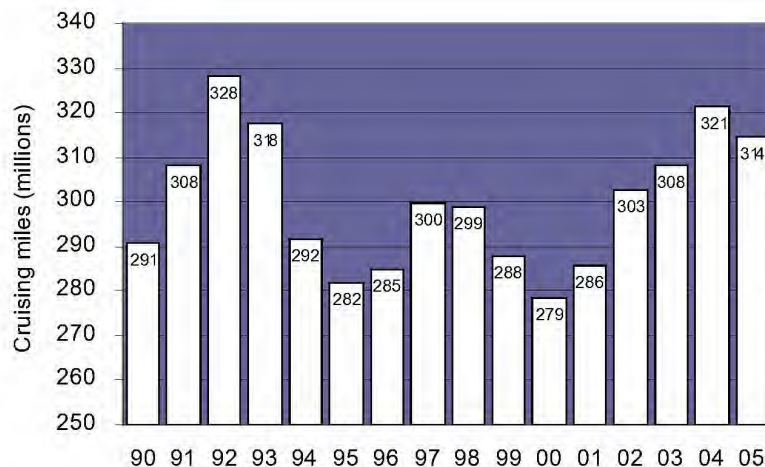
Cab availability has fluctuated with the economic cycle

One measure of taxi service availability is “cruising miles,” or mileage operated without passengers. An increase in cruising miles means that a person standing on a street corner is more likely to encounter an available cab. Similarly, a decrease in cruising miles signals a decrease in service availability.

- 39% of total cab mileage, a total of 314 million miles, was spent cruising for passengers in 2005. (See Figure 14.)
- Cruising miles increased 15% from 2000 to 2004, due to lesser demand for taxi service during the recession as well as after the 2004 fare increase, and increases in the number of cabs and in mileage per cab.
- Cruising miles declined in 2005 primarily because of increased demand for service and slightly lower mileage per cab after the May 2004 fare increase.
- Taxi service availability, measured by taxi cruising mileage, fell by 15% from 1992 to 2000 as an expanding economy fueled greater demand for taxi service, leaving fewer cabs available for street hail.
- Cruising miles increased 13% in the recession from 1990 to 1992.

Figure 14.
Taxi service
availability,
1990-2005.

Source: Schaller Consulting analysis of taximeter and odometer readings taken during taxi inspections.



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Cabs were scarce even in November 2001

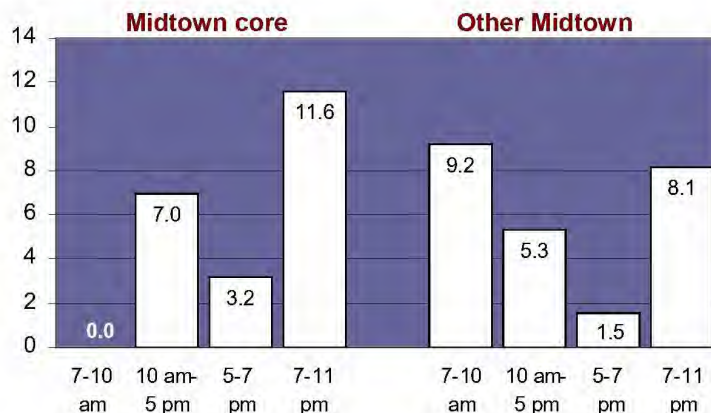
A second method of measuring taxi availability is to try hailing a cab at a representative sample of locations. The following data are based on how many cabs stopped for testers attempting to hail a cab at randomly selected locations in Midtown Manhattan in November 2001. Results are expressed as the number of cabs stopping for each one-half hour of testing.

- 5.6 cabs stopped per one-half hour of testing, or one cab every 5.4 minutes, in Midtown Manhattan.
- In the Midtown core (40 St. to 60 St., Park Ave. to Sixth Ave.), no cabs stopped during the morning rush hour and only 3.2 cabs stopped per one-half hour during the evening rush hour. (See Figure 15.)
- Cabs were more readily found during midday hours (7.0 cabs stopped per half hour) and in the evening (11.6 cabs stopped per half hour of testing).
- In other parts of Midtown, cabs were scarce in the evening rush hour and relatively easy to hail the rest of the day.
- 4.7 cabs stopped for hailers on the Upper East and Upper West Sides during the morning rush hour (7-10 a.m.)
- 3.3 cabs stopped per half hour on Saturday nights in the Theatre District.

Figure 15.
Taxi
availability in
Midtown
Manhattan,
Nov. 2001.

Number of cabs
stopping per one-half
hour of testing.

Source: Schaller
Consulting 2002a.



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Availability is product of demand and supply changes

- Service availability changes at virtually the same rate as industry-wide mileage, meaning that a 10% increase in mileage produces a 10% increase in available miles. *[Schaller 1999]*
- Economic activity also strongly affects availability; a 10% increase in economic activity, measured by employment at Manhattan eating and drinking places, produces a 10% decline in available miles. (Changes in eating and drinking place employment reflect changes in social, recreational and business activity in Manhattan.)
- Availability increases when the taxi fare increases; a 10% increase in the fare (in real dollars) produces a 2.7% increase in available miles.

Part II. Development of the NYC Taxi Industry

Early years¹

- New York City's gasoline-powered taxi industry originated in 1907 when Harry N. Allen fielded 65 French-imported automobiles. Providing faster service and using mechanical meters to more accurately compute the fare, the new service quickly replaced horse-drawn hansom cabs. With cab stands at major hotels, Allen quickly expanded to 700 cabs.
- Allen left the taxi business in 1908 in the wake of a bloody seven-week drivers strike. His innovations caught on, however, as did a new word he coined – *taxicab*. Allen derived this word from the French “taxi-mètre,” which referred to mechanical devices for measuring a fare or tax.
- Even without Harry Allen, the taxi industry grew quickly to 15,000 vehicles in 1923, led by several large fleets such as Checker (3,750 taxis), Yellow (3,000 taxis) and the National Transportation Company (1,500 cabs).
- Many of the companies operating taxi fleets in New York City also operated fleets in other cities, often as a way for vehicle manufacturers to sell their automobiles in a highly competitive market. Morris Markin's Checker Cab Manufacturing Company, for example, established fleets in New York, Chicago, Pittsburgh and Minneapolis. John D. Hertz, who started out as a car salesman and is best remembered for his auto rental agency, formed Yellow Cab Company to manufacture cabs and operate fleets in Chicago, Kansas City and Philadelphia as well as New York. Hertz painted his cabs yellow after he read a University of Chicago study that found yellow to be the most visible color at greater distances.
- During the 1920s and 1930s, easy entry into this all-cash business led to an oversupply of taxis, resulting in traffic congestion, fare-cutting wars, low driver wages, inadequately insured vehicles, and other unsafe and sometimes illegal activities. The Great Depression created an influx of unemployed workers which worsened these problems, with the number of cabs spiraling to 21,000 in 1931.
- To deal with illegal activities such as cheating, hustling, false advertising, stealing and extortion, the taxi industry was placed under police control in 1925.
- To address problems of oversupply, in 1937 the City Board of Aldermen enacted an ordinance sponsored by Alderman Lew Haas that froze the number of taxi licenses at 13,595, the number then outstanding. New York thus joined Chicago, Boston, Philadelphia, Baltimore and other cities in placing a cap on the number of taxicabs. Most of these cities did not issue new taxi licenses for 50 years or more.

¹ Source for this section is *Gilbert and Samuels 1982*.

- Also in 1937, the Transport Workers Union won recognition and negotiated contracts with 28 fleets. TWU representation only lasted two years, however, and attempts by others, including John L. Lewis' United Mine Workers, also collapsed. *[Gilbert and Samuels 1982; Rogoff 1980]*
- Initially, the Haas Act had no impact on the industry's size. Taxi companies continued to let permits lapse until, by the late 1940s, there were fewer than 12,000 active licenses. The outstanding licenses included 6,800 fleet-operated cabs and about 5,000 individually owned and driven cabs.

Post-World War II boom and controversy

- The Haas Act cap remained in place throughout the post-World War II era with one exception. In 1945, following provisions of an ordinance adopted by the City Council, 183 additional medallion licenses were issued to returning veterans who had given up their medallions during the war. These licenses were nontransferable and reverted to the City when the driver retired. As late as 1962, 141 of these veteran's medallions were still in use. *[New York Times, May 16, 1962]*
- Until 1954, New York City required that taxicabs seat five passengers behind the driver and have a trunk-mounted luggage rack. Also required was a grill in the trunk to prevent carriage of dead bodies. Only Checker, Desoto and Packard had models that fulfilled the "jumbo" vehicle requirements. New York City allowed smaller vehicles in 1954, eventually leading to the demise of large vehicles. *[Gilbert and Samuels 1982]*
- Throughout the 1950s and 1960s, demand for taxicab service grew even though the number of cabs was still below its Depression-era level. As demand grew, "live time" on a 10-hour shift, which had fallen from 3.2 hours in 1930 to 1.7 hours during the 1930s, rose to 4.8 hours in 1949, 5.7 hours in 1961 and 5.9 hours in 1967. *[Rogoff 1980]*
- The cap on licenses became an impediment to the taxi industry's ability to meet New York's growing transportation needs. With the post-war boom, taxi drivers increasingly serviced Manhattan's growing demand, with Manhattan-originating trips accounting for 77.7% of all trips in 1963. *[Tri-State Transportation Commission, 1963 Taxi Trip Survey]* In Brooklyn, Queens and the Bronx, cab service became scarce.
- The Haas Act authorized the City to issue additional licenses based on an evaluation of the need for more cabs. Through the 1960s, the Police Department's Hack Bureau periodically conducted these evaluations. Each time, however, the police concluded that no additional cabs were needed. The provision for issuing additional licenses was removed from City law in 1971.

Concentration of taxis in Manhattan led to creation of neighborhood car services

- To fill the need for cab service in the boroughs outside Manhattan, neighborhood car services, or liveries, began to operate in New York City's lower-income neighborhoods. Though not regulated by the City government, these operations were legal provided they operated only by prearrangement.
- Liveries were a source of contention from their birth. While many elected officials defended them as community businesses providing needed transportation, the taxi industry attacked them as unregulated, unsafe, and encroaching on taxis' rights.
- Despite controversy, the new car service industry grew rapidly. The number of car service vehicles increased from 2,500 in 1964 to 9,300 in 1971. Thus, in 1971 the number of taxis and liveries combined (21,000) matched the previous high tide of the industry exactly four decades earlier. (See Table 3 at the end of this chapter.)
- In part to address livery issues, the City Council in 1971 created the Taxi and Limousine Commission, although the TLC did not finally gain clear jurisdiction over "for-hire vehicles" until 1987.

The Taxi and Limousine Commission

The Taxi and Limousine Commission was created in 1971 by City Council legislation to regulate and improve taxi and livery service in New York City and establish overall transportation policy governing these services.

As a city agency regulating a private industry, TLC licenses 42,900 taxicab drivers and the owners of the 12,779 taxicabs. TLC also licenses 37,000 for-hire vehicles and the 750 base stations from which they operate and smaller numbers of paratransit (wheelchair-accessible) vehicles and commuter vans, as well as the drivers of these other classes of vehicles. (For additional information about the livery industry see www.schallerconsult.com/taxi/taxifb.htm)

TLC has four basic duties: to enact regulations (including setting the taxi fare), issue licenses, inspect vehicles used as taxicabs and enforce local laws and regulations. TLC establishes licensing standards for drivers and owners and driver training requirements, inspects each taxicab three times a year; investigates passenger complaints; adjudicates summonses for rule violations; and imposes fines, suspensions and revocations where appropriate. The agency has 450 employees to carry out these duties.

Taxicab rules and other regulatory information can be found on TLC's web site: www.nyc.gov/taxi.

Street enforcement of taxicab rules and laws is assigned to the NYC Police Department's Taxi Unit.

TLC regulations are set by nine commissioners: a salaried chairman and eight unsalaried members. Five members are appointed at the recommendation of the City Council and represent the boroughs of the city, thus maintaining a role for the City Council in taxi regulation. The other four members are appointed by the Mayor, who also designates the Chairman. The Chairman is the full-time executive head of the agency.

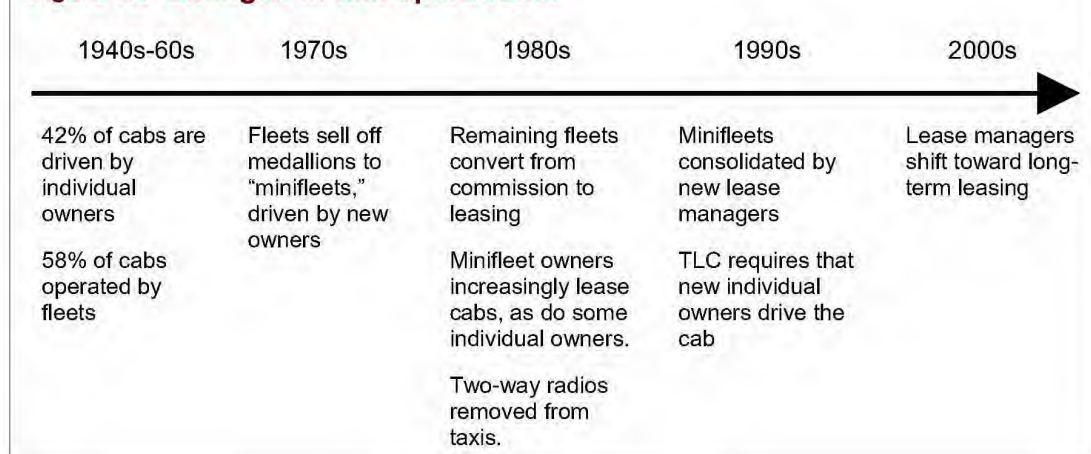
Economic forces and the rise of leasing shaped fragmentation and reconsolidation of taxi operations

- Economic recession in the 1970s led to sharp declines in demand for taxi service. About 75% of the taxi fleets, which overall owned 6,800 of the city's taxis, sold their medallion licenses to individual, non-unionized drivers. The number of fleets declined from more than 75 in the mid-1960s to 19 fleets in the 1980s that operated only 1,900 cabs.
- Liquidation of the fleets drove medallion prices to bargain-basement levels. In the midst of the sell-off and a sagging local economy, fleet medallion prices hit a low of \$10,000 in 1971 compared with a peak of more than \$30,000 in the mid-1960s.
- The fleet medallion licenses were sold to small operators, dubbed "minifleets." Minifleets consisted of two taxicabs and two partners, each of whom drove one of the cabs. Operationally, minifleets looked and acted like individual owner-drivers. This meant that by the late 1970s medallion licensees drove close to 9,400 cabs. The surviving fleets operated the remaining 2,400 of the 11,787 cabs in 1979. *[Rogoff 1980]*
- In 1979, TLC rescinded the prohibition on "horse-hire" and permitted taxi owners to lease cabs to drivers. Under leasing, drivers pay a flat per-shift fee and keep fares and tips above the lease fee and cost of gasoline. Leasing was phased in, applying only to newly hired fleet drivers. But by the mid-1980s, nearly all drivers (except owner-drivers) were lessees.
- Minifleet as well as fleet owners began to lease their cabs to drivers in the early to mid-1980s. Leasing offered minifleet owners the opportunity to realize income not only from their own driving but from the labor of other drivers. Some minifleet owners plowed their profits back into the industry, steadily buying up minifleet medallions. Eventually, some of these original minifleet owners formed fleets. Others, seeing the financial opportunities afforded by long-term leasing, steadily increased the size of their operations and became today's leasing agents. The minifleet as it was known in the 1970s and early 1980s had significantly shrunk by the late 1980s. Today, the original minifleet form of operation is virtually extinct.
- In the early 1980s, individual owner-drivers also began to lease out their cabs. Owner-driving of individual cabs declined from 100% in the 1970s to 76% in 1992 and 63% in 1998. This figure rebounded to 66% in 2005 as a growing number of cabs came under the TLC rule that the owner must drive individually owned medallions transferred since January 1990. Even with this rule, however, leasing has grown among individually owned medallions; 39% of individual owner-driven cabs were also leased for a second shift in 2005, up from about 10% in 1992.

Taxi radio services lead to creation of the black car industry

- Starting in the mid-1960s, some taxi owners (mostly owner-drivers) formed radio associations and began serving customers by telephone prearrangement as well as by traditional street hail. The number of radio cabs grew steadily, reaching 1,700 cabs in 1973 and 3,200 cabs in 13 radio associations in 1982. [*New York Times*, June 17, 1973; *Mayor's Committee* 1982]
- Radio service was provided to passengers who simply telephoned in a service request and paid the meter fare in cash and to businesses who had accounts with the radio group. Business-account trips were concentrated in the evening, as businesses provided workers with free transportation home. [*Hale Russell* 1979] As of 1979, 25% of radio cabs' overall time was devoted to serving business accounts and 12% to cash-paid radio calls. [*Cambridge Systematics* 1979] Radio work proved popular with drivers because it provided a regular flow of business and, in the drivers' view, prearranged trips posed less of a safety risk than street hails.
- The growth in radio work created a problem for passengers trying to hail cabs from the curb. Since the number of taxis was capped, hailers grew increasingly frustrated at lines of cabs passing by with their roof lights indicating "on radio call." To address this problem, TLC first allowed and then mandated that radios be moved from medallion to nonmedallion cars. The first radios were transferred in March 1982 in two companies, Intaboro and Dial. The transition of radios out of yellow cabs was completed by March 1987.
- In converting to nonmedallion radio cars, taxi owner-drivers generally bought and drove luxury black cars. They either leased their medallion cabs to other drivers or sold the taxicab license.
- To serve the booming business community in the 1980s, the original black car companies grew and additional companies were formed as offshoots of existing companies or from scratch. By the early 1990s, about 8,000 cars were licensed to 45 black car companies. In 2005, there were 10,400 black cars operated out of 72 bases.

Figure 16. Changes in taxi operations.



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For drivers, first unionization, then greater independence and responsibility but lower earnings

- In the 1950s and 1960s taxi drivers sought to benefit from the industry's rising profitability. They were aided by City officials who tied each fare increase during these decades to increases in driver commissions. In the early 1950s, fleets increased the commission percentages paid to drivers from 42.5% to 44% and then to 45% to gain support for a fare increase finally adopted in 1952. *[Rogoff 1980]*
- In the 1960s, further increases in commissions and driver benefits were linked to fare increases. Between 1965 and 1976, labor costs rose from about 45% to nearly 58% of bookings. *[Rogoff 1980]*
- With Mayor Robert F. Wagner's support, Electrical Workers Union and Central Labor Council head Harry Van Arsdale led a unionization drive, and in 1965, won the right to organize 82 fleet garages. *[Rogoff 1980]*
- The sell-off of fleet medallions to non-unionized minifleet drivers combined with the later advent of leasing among fleets to dramatically weaken the union in the 1970s and 1980s. The union held on as a remnant of its former self until 1997.
- Leasing assured fleets of a pre-determined income for each shift worked. Leasing also allowed fleets to drop employee benefits which drivers had previously enjoyed, including health and pension benefits, employer contributions to Social Security, scholarships, legal services, unemployment insurance and disability insurance. (Under State law, drivers must be covered by workers compensation.)
- Accounting for both cash income and the value of these benefits, lease drivers earned less in 1986 than did commission drivers in 1981, after adjusting for inflation.
- With incomes falling and then stagnant, taxi driving became a transient job filled by an ever-changing mix of immigrants from over 80 countries.
- Many drivers are attracted to the industry by the greater independence of leasing versus the old commission system. But their incomes also vary more as passenger demand changes from day to day.

New licenses issued in the 1990s

- In 1987, at the urging of Mayor Edward I. Koch, the City Council approved legislation permitting the Taxi and Limousine Commission to issue up to 1,800 additional taxi medallion licenses. The Council required that TLC first study the effects of issuing more medallions through an environmental impact statement (EIS). The EIS, completed in 1989, concluded that only 400 additional cabs could be put on the road without violating clean air rules. The Taxi and Limousine Commission, however, voted down a proposed regulation to issue 400 medallion licenses, which would have been nontransferable and issued by lottery to drivers with good records.

- The issue was revived during the City's fiscal crunch in the early 1990s. Drawing on the 1989 EIS, the City gained State Legislative approval to auction 400 new medallions as a money-raising measure.
- The 400 new medallions were issued through three sets of auctions in 1996 and 1997. The auctions set record-high prices and raised about \$85 million for City coffers. Bidders were attracted to the "clean" medallions – there being no chance that a claim from past accidents would come forward after the sale.
- A second set of auctions were authorized in early 2004 after the TLC completed a new EIS. A total of 900 new medallions will be issued from 2004 to 2006. Auctions in April 2004 set record prices. In October 2005 the average price was \$392,900 for corporate and \$339,200 for individual medallions – in line with the market price of existing licenses. Separate groups of medallions for use on accessible vehicles and alternative fuel vehicles were also auctioned. Both groups fetched lower prices: \$275,300 for accessible medallions and \$222,700 for alternative fuel medallions.

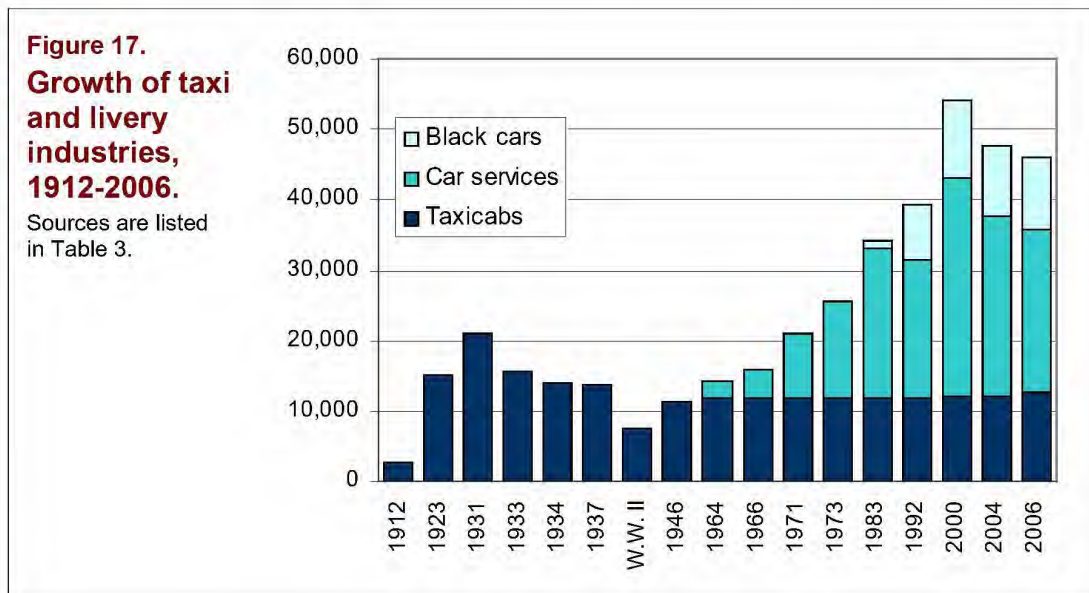
Regulatory changes aimed to upgrade service

- Under a succession of TLC chairmen (and one chairwoman) since the mid-1980s, TLC adopted regulatory initiatives and reforms to address numerous problems in the industry.
- Initiatives raised the level of insurance coverage; required that only new cars be placed into service as cabs; set a vehicle replacement cycle of three to five years; implemented strict thrice-annual inspections on each vehicle at a centralized inspection facility in Queens; expanded driver training and added an English as a Second Language component; adopted rules to suspend or revoke licenses of drivers who persistently violate TLC rules or traffic laws; required that newly transferred individually owned cabs be driven by the owner; capped lease fees charged by owners; and required safety partitions or cameras inside cabs and trouble (alert) lights on the exterior to enhance driver safety.
- Some initiatives were later retracted. "Talking taxi" announcements, in which various celebrity voices reminded passengers to buckle up at the start of the trip and take their luggage and a receipt at end of the trip, were removed in 2002 after analysis showed no change in seat belt usage, and many customers and drivers objected to the grating voices. A one-year pilot program for in-taxi TVs featuring programming and advertising was ended in August 2003.

Taxicabs in the early 21st Century

- Taxicabs and liveries continue to be a vital source of transportation for New Yorkers. Together, the taxi and livery industries operated 46,000 vehicles in New York City in 2006, up from 39,000 in 1992 and 21,000 in 1971. (See Figure 17 and Table 3 on following pages.)

- Newer vehicles, increased driver experience and higher driver earnings form a foundation for providing taxi customers with a high quality riding experience. Yet satisfaction with taxicab service lags behind satisfaction with other forms of transportation, providing a continuing challenge for both the industry and its regulators.
- An emerging issue concerns use of technology in cabs. TLC has mandated that all taxis accept credit and debit cards, install monitors that will show passengers their current location and install location tracking devices that will aid in recovery of lost property. While promising new service features for passengers, these initiatives pose considerable implementation challenges. *[See Schaller Consulting, 2005]*
- Addressing both vehicle issues and the “taxi system,” a non-profit group, Design Trust for Public Space, is convening auto designers, auto manufacturers and taxi industry representatives to redesign the New York City taxicab. Prototypes will be shown at the 2007 New York Auto Show as part of a celebration of the 100th anniversary of the first gasoline-powered taxicabs in New York City.



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Table 3. Growth of taxi and livery industries, 1907-2006

	Total Taxi and Livery*	Taxicabs	Car services	Black cars	Limousines	"Gypsy cabs"
1907	65	65				
1912	2,800	2,800				
1923	15,000	15,000				
1931	21,000	21,000				
1933	15,500	15,500				
1934	14,000	14,000				
1937	13,595	13,595				
During WW II	7,500	7,500				
1947	11,414	11,414				
1964	14,300	11,787	2,500			
1966	15,800	11,787	4,000			
1971	21,100	11,787	9,300			4,400
1973	25,500	11,787	13,700			
1983	34,200	11,787	21,300	1,080		14,000
1992	39,400	11,787	19,600	8,000	1,600	
May 1996		11,920				
Oct. 1996		12,053				
Sept. 1997		12,187				
2000	54,000	12,187	30,800	11,000	3,100	
2002	50,900	12,187	27,400	11,300	4,500	
2004	47,900	12,487	25,500	9,900	3,600	
2006	46,000	12,779	22,900	10,400	4,200	

*Includes medallion taxicab, car services and black cars. Does not include "gypsy cabs" or limousines.

Car services refers to for-hire vehicles serving neighborhoods around the city, primarily on a cash basis. Black cars refers to executive sedans primarily charging corporate accounts. Limousines charge by the hour and seat up to nine passengers. "Gypsy cabs" refers to vehicles not licensed to work for-hire and picking up street hails.

Car service and "gypsy cab" figures are estimates for 1964-83.

Car service, black car and limousine figures in 1992 and since 2000 reflect the number of licensed vehicles. The shift to biannual licensing has somewhat inflated the number of licensed FHV's since 2000 as compared with earlier years, as a larger number of licenses are no longer used but had not yet officially expired.

Sources: Gilbert 1980, Rogoff 1982; Mayor's Study Panel 1966; Urbitran Associates 1984; New York Times, March 20, 1949; TLC licensing records.

Part III. The Taxi Industry

Who Owns and Runs Cabs

Diversity in operations developed over 30 years

While all 12,487 taxis serve passengers in basically the same way, cabs are operated in a wide variety of ways. The diversity of operations has grown and evolved over the past three decades.

Prior to the early 1970s, cabs were operated in one of two ways. Taxis with individually owned licenses were driven by the medallion owner. Fleet cabs were dispatched each shift out of central garages that operated anywhere from 25 to several hundred cabs.

Today, taxis are operated in three basic ways:

- **Owner-operators**, where the taxi license holder (medallion owner) also drives the taxicab. Four in ten owner-drivers lease their cabs to other driver(s) for a second shift.
- **Fleet-type operators** that dispatch cabs from a central garage, leasing to drivers by the shift. Drivers pay a lease fee for each shift they work and return the cab to the garage at the end of the shift. Some of these operators are officially recognized by TLC as fleets, others are recognized as “agents” and operate in essentially the same way.
- **Long-term leasing**, run by companies that lease cabs to drivers for periods of months. Drivers pay a weekly lease fee and retain day-to-day control of the car. Typically, the cab is leased to two drivers who arrange to pass the vehicle back and forth at the end of each 12-hour shift.

In practice, many fleet and fleet-type operators lease cabs both by the shift and long-term. It is also notable that many long-term lessors and even fleets are not actually the medallion owner. In these cases, the medallion owner contracts with a leasing company or fleet to operate the cab on the owner’s behalf.

TLC requires that individually owned cabs be driven 210 shifts per year by the medallion owner, for licenses transferred since 1990.

TLC requires that owners (or agents) who lease long-term submit drivers’ names to TLC. These drivers are called “named drivers.” Generally speaking, lower insurance rates apply to these drivers since the insurance company can check the drivers’ accident records. (Named drivers had been listed on the rate card, or vehicle license, in the cab for enforcement purposes, but this practice was recently discontinued.)

Fleets and agents who dispatch on a shift basis operate with “unspecified drivers.” Any licensed driver may drive the cab, affording the fleet latitude in dispatching drivers.

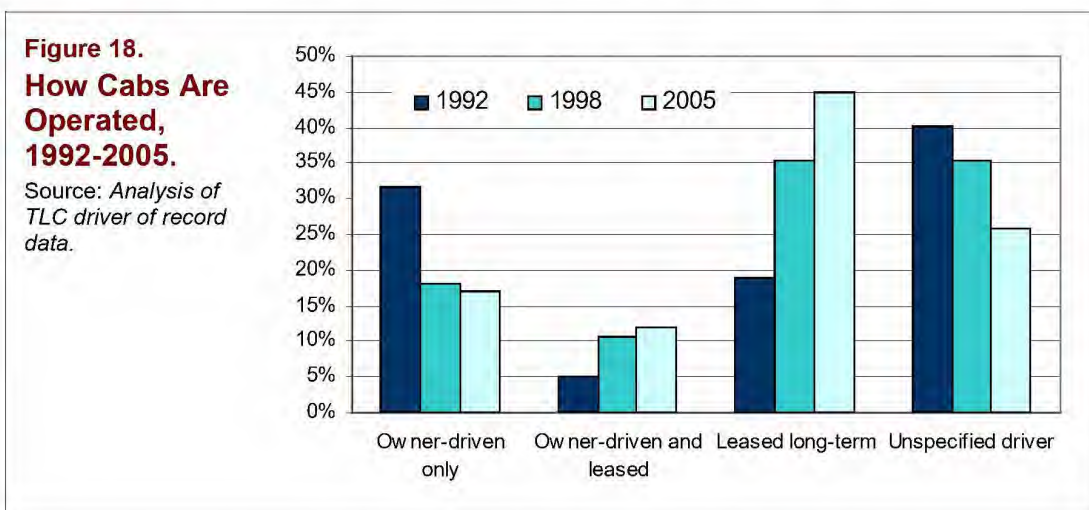
Owners or agents may and sometimes do elect “unspecified driver” status but lease the cab on a long-term basis.

Two-thirds of cabs are exclusively leased; one-third are owner-driven

- In 2005, 3,730 taxicabs (29%) were driven by the medallion owner. Forty-one percent of these cabs were also leased for a second shift to other driver(s).
- 2,116 cabs (17%) were operated by 15 TLC-recognized fleets; 70% of these cabs were operated on an “unspecified driver” basis, meaning they could be leased by the shift or long-term.
- 5,740 cabs (45%) were operated by 46 TLC-registered “agents.” Of these, 25% were operated on an “unspecified driver” basis and 75% through long-term leases.
- 1,210 cabs (9%) were leased by owners who were not registered as agents.

As taxi operations are consolidated, large agents/fleets now operate 6,400 cabs

- 25 agents or fleets operate 100 or more taxicabs and together operate a total of 6,400 cabs. By contrast, large agents and fleets operated 5,730 cabs in 2003.
- The largest fleets are Team Systems Corp., which operates 391 taxicabs, and Ronart Leasing Corp., which operates 325 cabs.
- The largest agents are All Taxi Management Inc. (which operates 812 cabs), S&R Medallion Corp. (397 cabs), Transit Systems Ltd. (390 cabs), Woodside Management Inc. (353 cabs), Queens Medallion Leasing Inc. (343 cabs), Mystic Leasing Service Corp. (267 cabs), Green Apple Management (231 cabs) and Yellow Cab SLS Jet Management (231 cabs).
- Most fleets and agents are located in Queens (primarily Long Island City), with some in Manhattan and Brooklyn and a few in the Bronx.



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Most leased cabs are leased long-term, not by the shift

- A total of 5,760 cabs (45%) were leased long-term and 3,290 cabs (26%) were operated on an “unspecified driver” basis in 2005.
- Long-term leasing doubled from 19% of all cabs in 1992 to 45% in 2005.
- Cabs using “unspecified drivers” shrank from 40% in 1992 to 26% in 2005.
- The shift from fleet-type “unspecified driver” operations to long-term leasing was predictable based on financial analyses of the industry in the early 1990s. These financial analyses showed that the expenses of long-term lessors was significantly less than expenses of the fleet operators. Long-term lessors avoid the administrative and oversight costs borne by fleet operators that lease by the shift. With a lower cost structure, owners who leased on a long-term basis earned substantially higher profits than owners leasing by the shift – about \$21,000 annually for long-term lessors versus \$16,000 for shift lessors in 1993. *[TLC 1994b]*
- The number of owner-driven cabs has shrunk over the past decade from 37% of all taxicabs in 1992 to 29% in 2005. Most of this decline is accounted for by reduced owner-driving of corporate medallions; only 186 corporately owned cabs were driven by a stockholder of the corporation in 2005, down from 565 in 1992.
- Owner-driving among individually owned cabs declined steadily until the late 1990s but has increased since about 1998 as a growing number of cabs have come under the TLC rule that the owner must drive individually owned medallions transferred since January 1990. In 2005, just over 3,500 individually owned cabs were driven by the owner as compared with 3,250 in 1998 and 3,750 in 1992.
- Even among individually owned cabs, the financial attractiveness of leasing is evident. Of the 5,377 individually owned cabs, about 1,850 were leased to drivers (not owner-driven at all) in 2005, 1,400 were driven by both the owner and lessee, and 2,150 were owner-driven only.
- Another factor in the decline in owner-driving is that TLC has allowed over 175 of the post-1990 individual medallions to be operated by leasing agents or fleets; these cabs are unlikely to be owner-driven.

Finances

\$1.8 billion a year in revenues

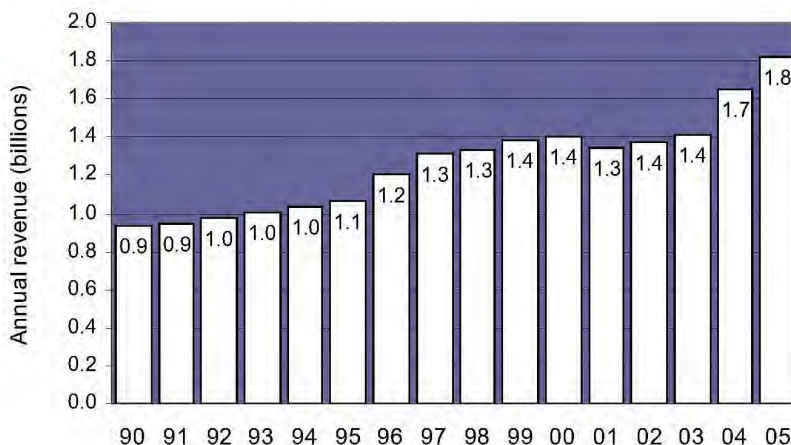
- Taxicabs generated \$1.82 billion in fare revenue in 2005. (Revenue figures include the rush hour and night surcharges and tips, which are assumed to be 15% of the fare.)
- Revenues averaged \$2.25 per operating mile in 2005, generating \$317 for an average shift that covers 141 miles and \$145,200 per taxicab annually.
- Total industry revenue increased by 29% between 2003 and 2005 (years before and after the 2004 fare increase). This increase was primarily due to the fare increase though the recovering economy and issuance of new cab licenses also played a role. (See Figure 19.)
- Total fare revenue increased by 45% in the 1990s, spurred by the 20% fare increase in 1996, increased demand for cabs and the industry's shift toward predominantly double-shift operations.

Fare revenue fluctuates with fares and demand for service

- Fare revenue fluctuates with changes in the Manhattan economy. Taxi fare revenue per mile increases 6.4% for every 10% increase in employment at Manhattan eating and drinking places, which reflect changes in social, recreational and business activity in Manhattan. *[Schaller 1999]*
- Absent changes in economic conditions, fare revenue per mile increases by 7% to 7.5% for every 10% increase in the fare (in real dollars), as higher fares reduce demand for service by 2.5% to 3%.
- Conversely, as inflation erodes the fare in real dollars, a 10% decline in the inflation-adjusted fare, representing about three years worth of inflation, produces about a 2.5% to 3% increase in revenue per mile.

Figure 19.
Taxi industry
revenue, 1990-
2005.

Includes surcharges and estimated 15% tips
Source: Schaller Consulting analysis of taximeter and odometer readings taken during taxi inspections.



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- Fare revenue per mile falls by about 3% in the summer (July and August) over and above the falloff accounted for by changes in employment.
- Cab revenue growth was slowed in 1998 by transit fare incentives which attracted local travelers from taxis to buses and subways. The transit fare incentives introduced from mid-'97 to mid-'98 reduced taxi industry revenue by 2% from what it would have been otherwise. Thus, without the fare incentives, cab revenues would have grown by about 3% in 1998 instead of 1%. (The fare incentives were free transfers between bus and subway; a 10% bonus on fare purchases of \$15 or more; and 30-day and 7-day unlimited ride passes.)

61% of cab mileage is with passengers

- Paid mileage – the percentage of odometer miles with a passenger – is a key indicator of both the taxi industry's financial health and demand for taxi service. Over the last four decades, paid mileage has ranged from a low of 55-57% during recessions in 1977 and 1991-92, to a high of 64% in the boom year of 2000. Paid mileage comprised 61% of total mileage in each year 2002 to 2005.

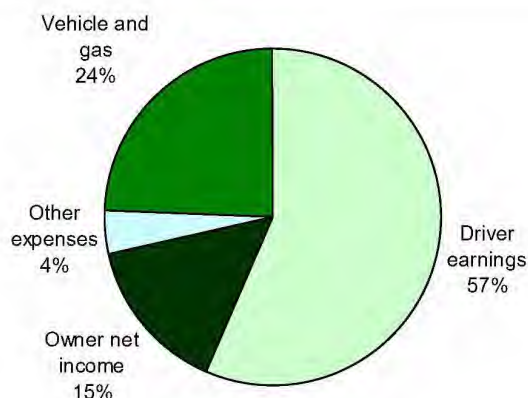
Where the fare dollar goes

- Each dollar of revenue generated by fares and tips was divided for cabs leased to drivers as follows in 2005: 57 cents to drivers' earnings, 24 cents to vehicle costs (car purchase, maintenance, gasoline and auto insurance), 4 cents to other expenses and 15 cents to owners' net income. (See Figure 20.)

Figure 20.
Where the fare dollar goes, 2005.

For cabs leased to drivers.
"Fare dollar" includes surcharges and estimated 15% tips.

Source: Schaller Consulting unpublished analysis.



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Driver incomes dropped with adoption of leasing

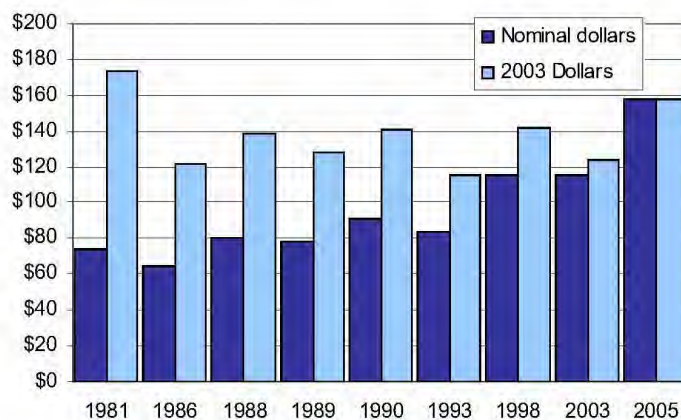
- Fleet drivers in New York City averaged \$158 in take-home income per shift in 2005, after paying lease fee and gasoline costs. (Based on shifts of 130 miles for fleet drivers. Take-home income includes tips.)
- The \$158 in average 2005 take-home income represents a 37% increase since 2003, primarily due to the 2004 fare increase. In inflation-adjusted dollars, driver incomes have increased 27% since 2003 and 12% since 1998. (See Figure 21.)
- Despite recent gains, drivers' total compensation has declined 9% since 1981, after accounting for inflation.
- Drivers' total compensation declined in the early 1980s as taxicab fleets converted from paying drivers on a commission basis to leasing. Although drivers' cash incomes stayed about the same after leasing was introduced, their total compensation dropped due to the loss of benefits such as health and pension benefits, employer contributions to Social Security, scholarships, legal services, unemployment insurance and disability insurance. (As mandated by New York State law, both commission and lease drivers are covered by workers compensation.)
- Because lease drivers work about 15 percent more hours than did commission drivers in the early 1980s, the decline in hourly driver earnings since 1981 is greater than the decline in per-shift earnings.
- Since 1996, TLC has set caps on lease fees. The caps were increased by 8% with the May 2004 fare increase. Current caps are \$105 for day shifts, \$115 for Sunday to Tuesday night shifts, \$120 for Wednesday night shifts and \$129 for Thursday to Saturday night shifts. The cap for weekly leases to two drivers is \$666 per driver. The cap for medallion-only leases (driver supplies the vehicle) is \$800.

Figure 21.
Taxi driver
incomes, 1981-
2005.

Take-home income per shift.

1981 figures are for commission drivers and include the value of fringe benefits.

Sources: Schaller and Gilbert 1996 and analysis of taxi income and lease fee data.



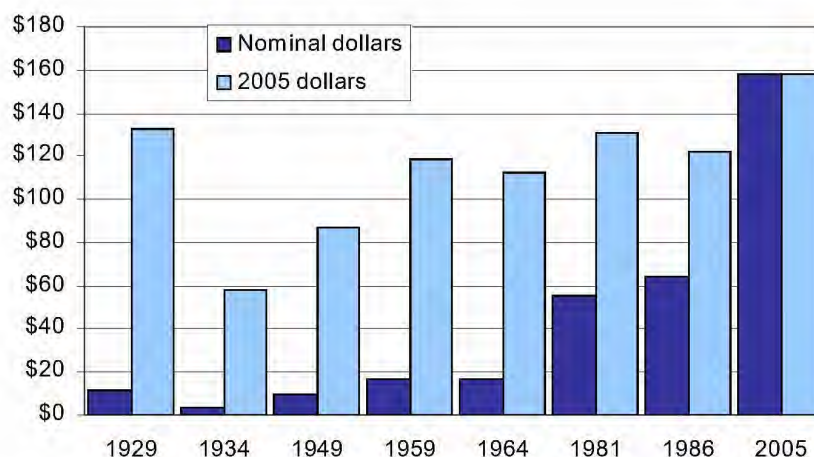
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After the 2004 fare increase, driver cash incomes exceed incomes in 1929

- According to newspaper reports, in 1929 drivers averaged about \$8.40 per day in net income from commissions and \$2.75 in tips, for a take-home income of just over \$11 a shift. Adjusting for inflation, that income is equivalent to \$132 in inflation-adjusted 2005 dollars. (See Figure 22.)
- At \$158 per shift in 2005, driver cash incomes now exceed driver incomes in 1929 for the first time since the Crash.
- With the Great Depression reducing demand for cab service but increasing the number of cabs on the street, driver income plummeted to under \$4 a shift in 1934 (\$58 a shift in inflation-adjusted dollars).
- The combination of a booming post-war economy, the limit on the number of medallion licenses, and unionization of fleet drivers produced gains in driver incomes, reaching \$130 cash income per shift for commission drivers in 1981, using inflation-adjusted dollars. (As shown on the previous page, the value of fringe benefits brought driver incomes to \$173 in 1981, using inflation-adjusted dollars.)

Figure 22.
Taxi driver
cash
incomes,
1929-2005.

Average cash income per shift of taxi drivers, in nominal and inflation-adjusted dollars, including tips. Excludes value of fringe benefits.



Sources: *New York Times*, "Taxi War a Result of Lower Profits," February 11, 1934; *New York Times*, "As 35,000 Cabbie Commentators See New York," March 20, 1949; *New York Times*, "Drivers' Income Cut 6% By Taxi Tax, Report Finds," October 22, 1959; *New York Times*, "Cabbies Squabble Over Rise in Fare," April 13, 1964; Bruce Schaller and Gorman Gilbert, "Villain or Bogeyman? New York's Taxi Medallion System," *Transportation Quarterly*, Winter 1996; Parsons Brinckerhoff Quade & Douglas, Inc., *Additional Taxicab Licenses Final Environmental Impact Statement*, June 1989; Taxi and Limousine Commission, "Taxicab Fare Review," October 12, 1989; Taxi and Limousine Commission, "The Taxi Industry, 1991," October 29, 1991; analysis of TLC meter readings taken at vehicle inspection.

Medallion Prices

Why a value to a license?

Taxicab licenses first gained value after World War II as demand for taxi service grew while the number of cabs was capped. The continuing limit has produced values of over \$350,000, paid by a buyer when the license is transferred from one owner to another. These license transfers are often called “medallion” transfers, referring to the painted aluminum medallion, signifying a taxi license, which is affixed to the hood of every yellow medallion cab. (See photo at right.)



Medallion systems in other cities have also generated large medallion values in the range of \$50,000 to over \$200,000 in Boston, Chicago and Philadelphia.

Medallion values are established on the open market between buyers and sellers, although the Taxi and Limousine Commission must approve the new owner’s qualifications. In economic terms, the value of medallion licenses is the “monopoly profit” produced by the limitation on the number of taxicabs, or in other words, the profit that owners can earn in the taxi industry that is greater than profits in comparable industries.

Medallion prices thus reflect net revenues derived from taxi operations. Changes in prices reflect, fundamentally, changes in the demand for taxicab service relative to supply. But medallion prices are also affected by a variety of other factors. For example, falling interest rates and longer amortization schedules for loans used to finance buyers’ purchases have contributed to the escalation of medallion values because purchasers are more sensitive to their monthly “nut” or loan payments than to the size of the loan. Fares can also affect medallion values, as can the availability of drivers. Driver shortages were one reason for the decline in medallion prices in 1998-2001. Other factors affecting medallion prices include the number of potential buyers, expectations of future revenue and lease fee caps.

Medallion values are computed separately for individually owned and fleet-owned (or “corporate”) cabs. Licenses are permanently assigned to one of these categories.

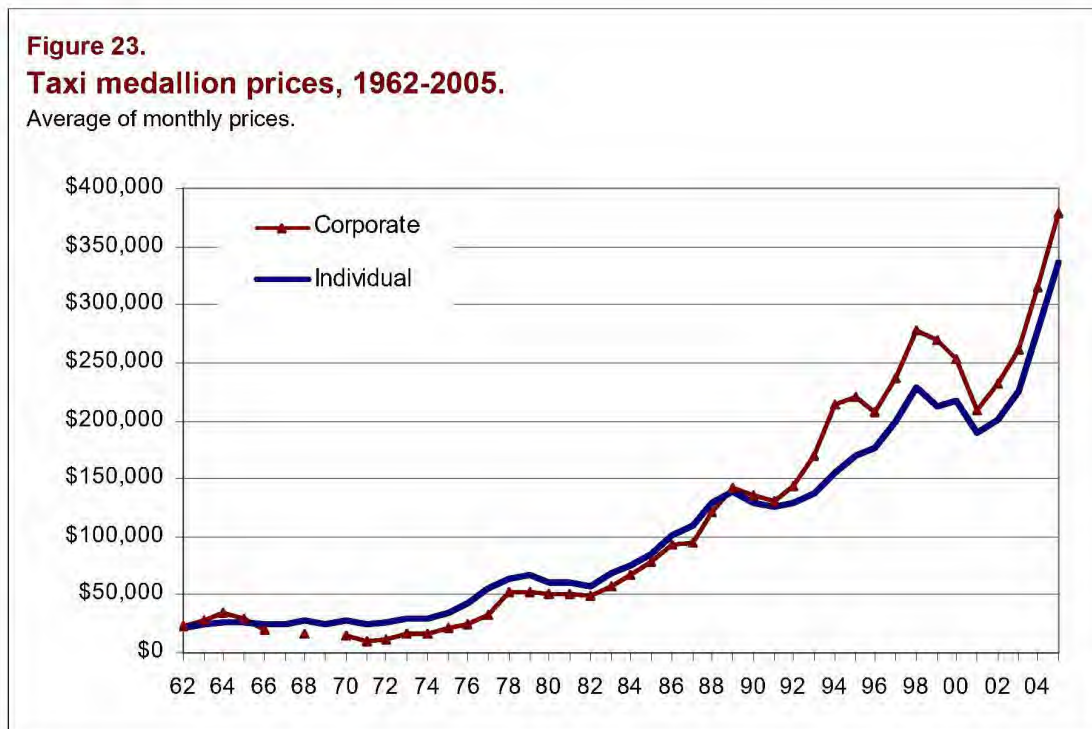
Trends in medallion prices

- Medallion values show a very strong upward trend over the past half-century, fueled by growing demand for taxicab services and other factors such as longer loan terms and the introduction of leasing. Medallion values reached \$25,000 in 1963, \$50,000 in 1977, \$100,000 in 1986 and \$200,000 in 1994 and \$300,000 in 2004. (See Figure 23.)
- Medallion prices increased to \$379,000 for corporate and \$336,000 for individual licenses in 2005.

- Values have also experienced significant declines. Taxicab ridership fell sharply in the early 1970s as New York City went through a deep economic contraction. Medallion prices fell again during recessions in the early 1980s and early 1990s.
- Medallion prices also declined between the spring of 1998 and mid-2001. This decline, which preceded the economic slowdown in New York City, appeared to stem from factors internal to the taxi industry such as shortages of drivers. As unemployment rose during the recession that began a few months before the Sept. 2001 terrorist attacks, the number of drivers coming into the taxi industry increased. This was one factor in the increase in medallion values that began in the fall of 2001.
- Another factor was lower interest rates, which much like a home mortgage increases the price that buyers can afford to pay for medallion licenses. Interest rates on typical loans dropped to 5-6% in mid-2003, amortized over 15 years or more (albeit with a balloon payment due after 3-5 years).
- Declining interest rates and longer loan terms have meant that monthly loan payments stayed constant despite large increases in medallion prices. Since the early 1990s, interest rates declined from 10% or more to about 5% and loan amortization schedules stretched from 10 years to 15 years. As a result, monthly payments on medallion loans were the same or slightly less in mid-2003 as in 1993 despite a 50% increase in the price of individual medallions and 43% increase in the corporate price. (Monthly payments were typically about \$1,500 for individual medallions and \$3,500 for two corporate medallions as of mid-2003, for buyers who borrow 80% of the combined medallion price and transaction fees, including the 5% City transfer tax.)

Figure 23.
Taxi medallion prices, 1962-2005.

Average of monthly prices.



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- The volume of medallion sales has fallen sharply. In the 1980s transfer volumes exceeded 600 annually for both individual and corporate medallions. Transfers dropped to an average of 250 for both individual and corporate medallions in the 1990s, and declined to 199 individual sales and 64 corporate sales in 2005 (not including stock transfers).

Corporate versus individual prices

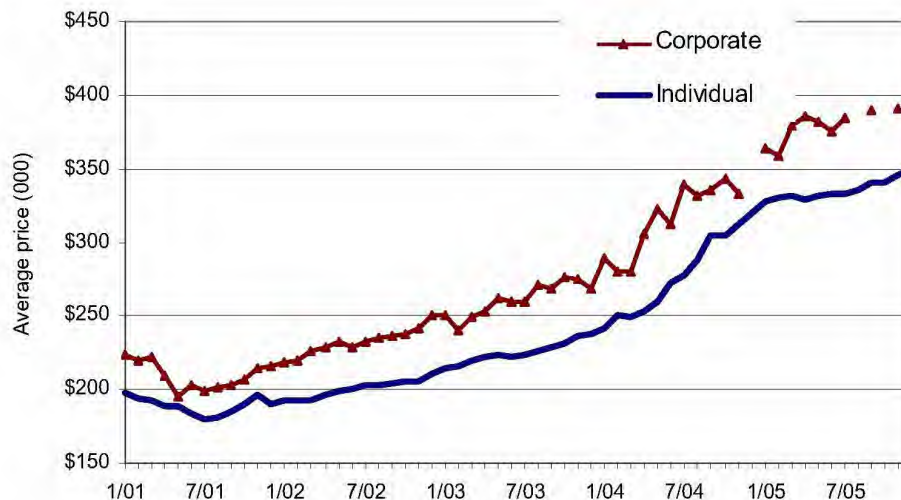
- In the 1970s and early 1980s, individual owner-driving was a more attractive method of taxi operation, dominating the industry and reflected in higher medallion prices for individual licenses.
- Since the late 1980s, however, an increasing number of taxicabs have been leased out of large fleets, and the fleet or “corporate” price overtook the individual price.
- The substantial difference in price between corporate and individual narrowed sharply in 2001 as the industry experienced a driver shortage, the effects of the Sept. 2001 terrorist attacks and the city’s overall economic downturn. The gap has widened somewhat since 2001, however.

(See *Schaller and Gilbert 1996* for further discussion of the medallion system and its effects on the taxi industry. See 1994 Taxicab Fact Book, also online at www.schallerconsult.com/taxi/taxifb.htm, for a description of the finances of typical medallion buyers in 1993.)

Figure 24.

Monthly taxi medallion prices since January 2001.

Average of monthly prices. Average price not available for some months due to lack of transfers.



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Table 4. Medallion prices and transfer volumes, 1947-2005

Year	Average Price		# Transfers	
	Individual	Corporate	Individual	Corporate
1947	\$ 2,500	\$ 2,500		
1950	5,000	5,000		
1952	7,500	7,500		
1959	19,500	20,000		
1960	20,825	19,450		
1962	22,000	23,400		
1964	26,000	34,145	290	
1965	26,000	30,000	610	
1966	25,000	19,000	390	
1968	27,000	16,000	490	
1969	24,500	n/a	650	
1970	28,000	14,000	670	
1971	25,000	10,000	430	
1972	26,000	12,000	580	
1973	30,000	17,000	600	
1974	30,000	17,000	590	
1975	35,000	22,000	570	
1976	42,000	24,000	800	
1977	55,000	33,000	680	
1978	63,000	52,000	810	
1979	67,000	53,000	830	
1980	60,000	50,000	700	
1981	60,000	50,000	n/a	
1982	57,500	49,300	697	637
1983	68,600	57,900	723	648
1984	75,900	66,200	795	796
1985	84,900	79,000	641	703
1986	101,600	92,900	660	778
1987	108,700	94,600	527	567
1988	129,700	121,500	532	646
1989	139,100	141,400	418	408
1990	128,400	135,700	374	272
1991	126,067	130,360	357	443
1992	128,577	143,199	281	407
1993	137,196	170,200	256	248
1994	155,633	214,221	232	164
1995	169,750	219,958	194	187
1996	176,333	207,292	264	267
1997	199,875	236,500	205	203
1998	229,000	277,318	155	215
1999	212,917	269,500	178	111
2000	217,125	253,864	208	119
2001	188,958	209,458	210	158
2002	200,333	232,250	262	267
2003	224,958	260,917	266	345
2004	277,583	315,636	191	249
2005	335,583	378,556	199	64

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Cars

Why cabs are the definition of high-mileage cars

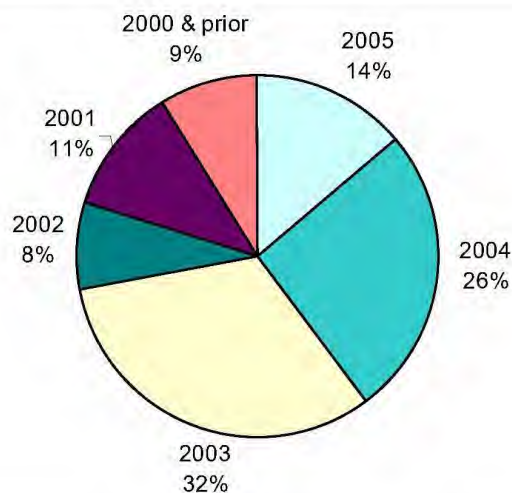
- New York City taxicabs traveled a total of 811 million miles in 2005, or an average of 64,600 miles per cab.
- Total industry mileage grew by 14% from 1995 to 2005. The growth resulted from increases in the number of double-shifted cabs and issuance of additional medallion licenses.
- Mileage varies considerably among operators. Cabs run by fleets and other shift lessors, in service two shifts per day and 7 days per week, average 72,000 miles. Cabs leased long-term (usually to two drivers) average 68,000 miles. Owner-drivers, generally driving one shift a day, 5 or 6 days a week, averaged 42,000 miles.

Rules for new cabs have made the vehicles relatively new

- As of April 2005, 72% of cabs were model year 2003 or later vehicles; 19% were model year 2001 or 2002 vehicles and 9% were model year 2000 or earlier cars. (See Figure 25.)
- Cars brought into service as taxicabs must be brand new vehicles and generally must be replaced five years after being placed into service. This is one of the strictest vehicle policies in the U.S.; most major cities allow vehicles to be used for 5 to 9 years and allow used vehicles to be put into service.
- Taxis driven exclusively by “unspecified drivers” who change day to day, must be retired after three years.

Figure 25.
Vehicle model year, 2005

Source: Analysis of TLC data. Data are a snapshot as of April 2005.

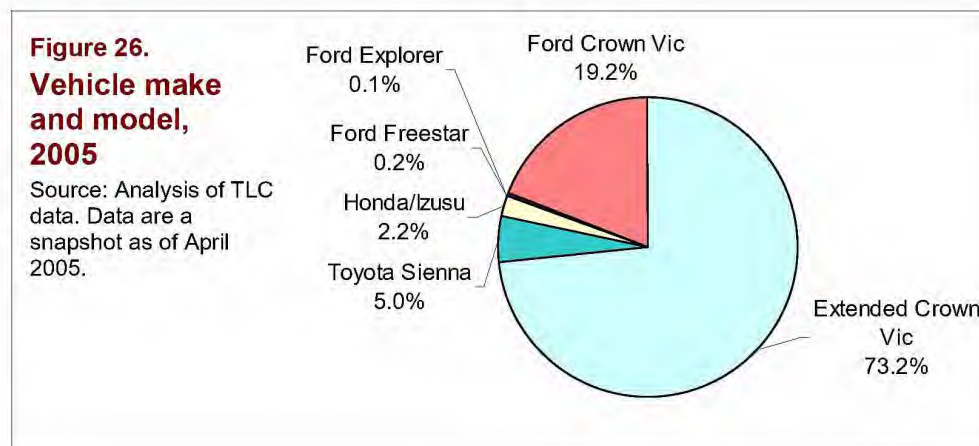


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- Exceptions for minivans and financial hardship have meant that, in practice, some cabs exceed the five-year retirement age.
- Adoption of the vehicle retirement regulations by TLC in 1996 came on the heels of cabs becoming older and on increased reliance on used cars. A 1993 survey of owners replacing their vehicles found that the two main dispositions for old cars were “use for parts” and “junked.”

Taxi owners rely on the Ford Crown Victoria

- Taxi owners use cars with body-on-frame construction to endure the city’s streets. Heavy duty suspensions and brakes and larger radiators further fortify the cars for taxi duty. Unibody cars have not been durable when tested by taxi fleets, although some owner-drivers have had success with minivans.
- As a result of the industry’s need for body-on-frame vehicles, when Chevrolet discontinued the Caprice in the mid-1990s, most owners switched to the Ford Crown Victoria.
- The Ford Crown Victoria accounted for 92% of all taxicabs in 2005. The extended Crown Vic, featuring an additional 6 inches of leg room for rear seat passengers, accounted for 73% of all taxis and the older models for 19% of all cabs. (See Figure 26.)
- Other vehicles in use as taxicabs include minivans manufactured by Toyota, Honda and Ford, and the Ford Explorer SUV.
- The last Checker Cab, a vintage 1978 model, was retired in 1999 by co-owner/driver Earl Johnson. Checker Motors ceased production of the Checker Cab in 1982.



Most cabs now pass their thrice-annual inspection

- Cabs undergo an exacting safety and emissions inspection every four months at TLC's centralized inspection center in Woodside, Queens. The center opened in August 1989 and represented a major commitment by the City for vehicle safety and low emissions. (Previously, cabs were inspected at decentralized service stations using much less sophisticated equipment.) Two hundred items are checked at each inspection.
- 52% passed the initial inspection in fiscal year 2005.
- Older cars fail much more frequently than newer models. During inspections in Sept. to Dec. 2005, 75% of model year 2005 cars passed the initial inspection compared with 51% of model year 2004 cars and 27% of model year 2002 and prior year cars. *[Analysis of TLC inspection data]*

Innovations in color and license plates

- The ubiquitous yellow cabs were once many colors. In 1968 the City Council mandated that all cabs be painted yellow by January 1, 1970, thus standardizing their appearance and differentiating them from the rising number of illegal "gypsy" cabs. Before 1968 each taxi fleet adopted its own color scheme, as did individual owners. Only one fleet was painted yellow.
- The format for cabs' license plates changed in 1990. To ease identification, the plate is now the same as the medallion number, e.g., 8Y19. A small A, B, etc. is placed after the medallion number when new plates are issued. Previously, the plate number began and ended with the letter T, with numerals in between. Some "TT" plates continue to be used when license plates need to be replaced.

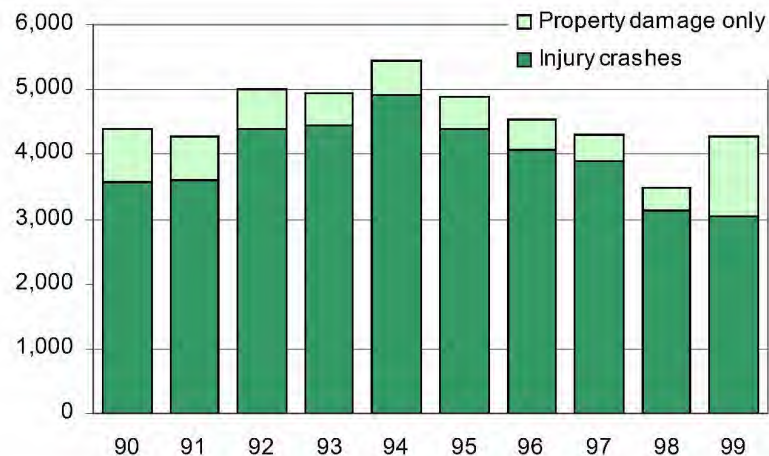


Accidents

- Medallion taxicabs were involved in 4,270 crashes (accidents) reported to the New York State Department of Motor Vehicles in 1999.
- 3,041 of these crashes involved personal injury and 10 involved a fatality.
- A 37% increase in personal injury taxi crashes from 1990 to 1994 was followed by a 38% decline from 1994 to 1999. (See Figure 27.)
- The increase in total crashes (injury and non-injury) from 1998 to 1999, shown below, was due to the increase in reported non-injury (property damage only) crashes. This increase is the product of a change in Department of Motor Vehicle (DMV) reporting requirements. DMV now requires crash reports when “apparent” property damage is over \$1,000 rather than where the damage is known to be over \$1,000.
- 538 pedestrians were injured and four were killed in crashes involving taxicabs in 1999. This was the lowest number of pedestrian injuries in over a decade.
- 282 bicyclists were injured (none were killed) in crashes involving taxicabs in 1999. This was the lowest figure since 1991.
- Liveries were involved in 13,134 crashes in 1999, for a total of 17,127 taxi/livery crashes in New York City in 1999. Livery crashes involving injury increased from 8,179 in 1994 to 10,290 in 1999.

Figure 27.
Taxi crashes,
1990-99.

Source: Schaller
Consulting 2001.



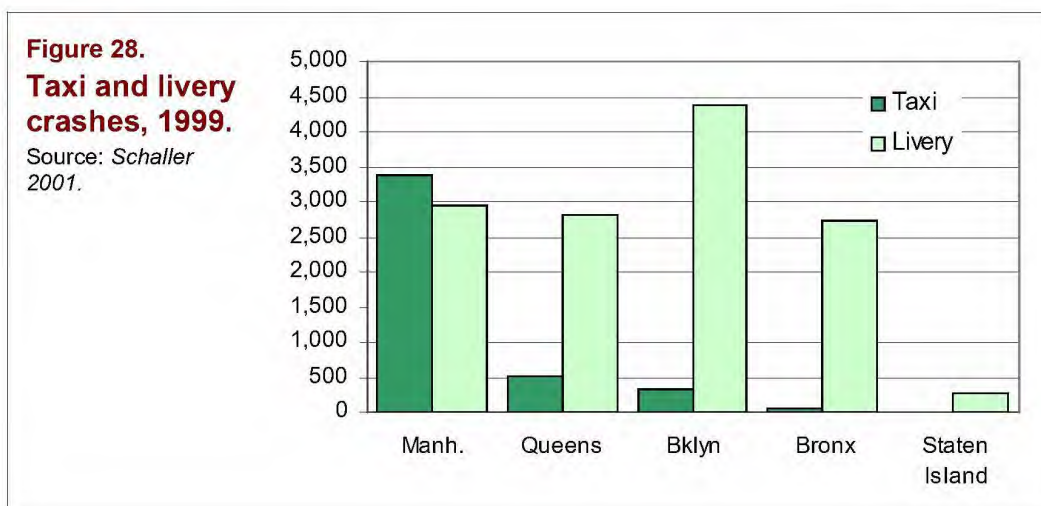
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Taxi crashes are concentrated in Manhattan

- The large majority of taxi crashes occurred in Manhattan in 1999 – 3,368 in Manhattan versus 902 in the other four boroughs combined. (See Figure 28.)
- 17% of all injury crashes in Manhattan in 1999 involved taxis. (An additional 13% involved liveries.)
- The number of livery crashes in Manhattan (2,951) is approaching the number of taxi crashes in Manhattan.

Better-paid drivers tend to be safer drivers

- There appears to be a strong relationship between taxicab crash rates and driver incomes. Higher driver incomes are associated with lower crash rates. When driver incomes declined between 1990 and 1993, crash rates increased. Conversely, when driver incomes increased from 1993 to 1998, crash rates decreased. [Schaller Consulting 2004a]



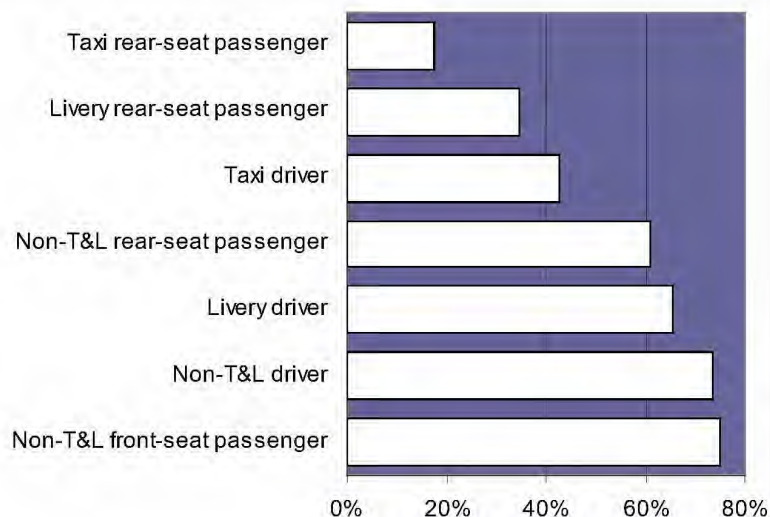
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Few taxi passengers wear seat belts, increasing injury rates

- 11.5% of rear-seat taxi passengers involved in crashes sustained Class A or B injuries such as fractures, concussions, internal injuries, bleeding, burns, contusions and abrasions in 1999. *[Schaller Consulting 2001]*
- This figure is three times higher than for passengers in other vehicles. The injury rate (Class A or B injuries) is 3.0% for rear-seat livery passengers and 3.1% for rear-seat passengers in other vehicles involved in taxi/livery crashes.
- 17% of rear-seat taxi passengers involved in crashes in 1999 were wearing seat belts. This is a far lower rate of restraint use than for other occupants of taxis and other vehicles involved in these same crashes. (See Figure 29.) Taxi passengers' reluctance to wear seat belts clearly contributes to their elevated rate of serious injury.
- Taxi passengers not wearing a restraint are nearly twice as likely to sustain relatively severe injuries as those wearing a restraint (15.6% vs. 8.6% for the years 1997-99).
- Seat belt usage is only one facet of this story, however. Even when wearing restraints, taxi passengers experience high injury rates. Looking just at seat belt users, 8.6% of taxi passengers are relatively seriously injured, a substantially higher rate than for livery passengers (3.3%) or passengers in other vehicles involved in taxi/livery crashes (3.9%).
- The higher incidence of injury to taxi passengers may also be linked to the presence of partitions in most medallion cabs, which introduce a very hard surface in an otherwise cushioned environment. This is the one clear difference in the passenger environment in taxis versus other vehicles.

Figure 29.
Restraint use by
passengers in
accidents
involving taxis or
liveries, 1999.

Percentage of passengers known to be using restraint at time of crash, based on police reports.
"T&L" = taxi and livery (for-hire vehicles)
Source: *Schaller Consulting 2001.*



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Drivers' Work Days

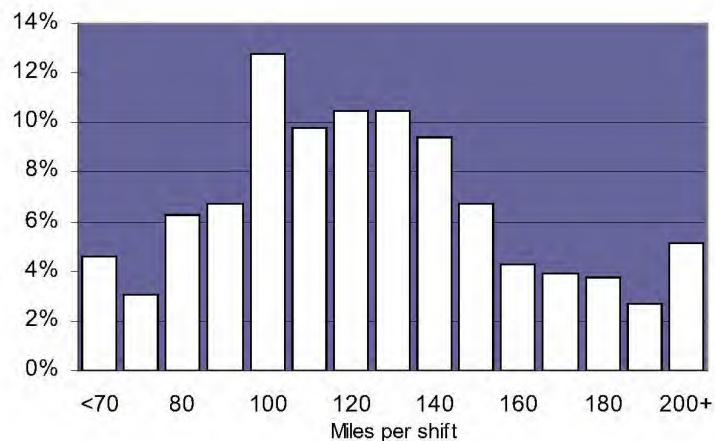
10 hours, 30 trips, 141 miles a day ...

- Shifts averaged 10 hours in 1990. Most drivers worked between 8 and 12 hours a day, counting from when they pick up their first fare until they drop off their last fare of the day. *[TLC 1991]*
- The average driver spent 50 minutes a day on one or two breaks.
- Drivers averaged 30 trips per shift, serving a total of 42 passengers each shift, in 1990.
- The average cab traveled 141 miles per shift in 1990.
- Live miles increased from 55% of total mileage in 1991 to 64% in 2000, then fell to 61% in 2002 through 2005. (See Figure 11 earlier in the report.)
- In 1990, live time was well over 80% during times of peak demand for taxicabs. *[TLC 1991]*
- Between 80 and 150 miles are traveled on most shifts, though some shifts cover over 200 miles. (See Figure 30.)

Figure 30.
Mileage driven per shift, 1990.

Total mileage traveled includes going to and from fleet garages, home, etc.

Source: *TLC 1991*.
Based on trip sheet sample.



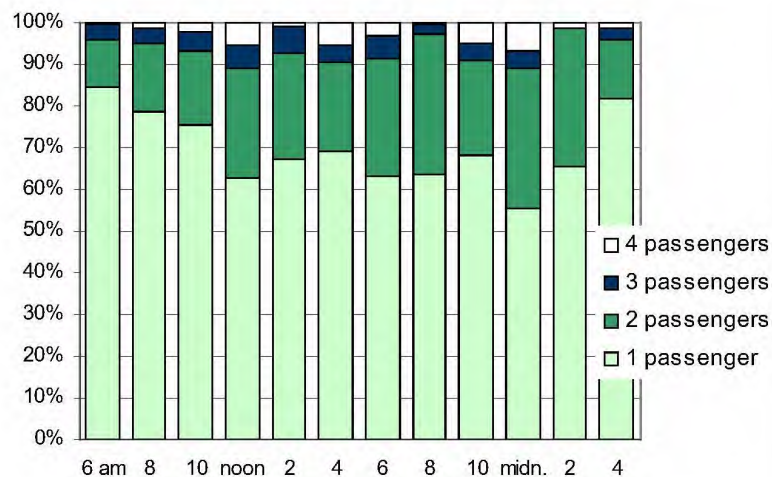
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... and usually just one passenger.

- 69% of all trips carried only one passenger, compared to 24% with 2 passengers, 4% with three passengers and 3% with four passengers. This works out to an average of 1.4 passengers per trip. *[Sample of 1993 trip sheets.]*
- Multi-passenger trips nearly doubled in the evening compared to the morning – 20% of all weekday trips between 7 a.m. and 11 a.m. compared with 36% between 10 p.m. and 1 a.m. (See Figure 31.)

Figure 31.
Passengers
per trip, 1993.

Source: Sample of
1993 driver trip
records.



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Driver Quality

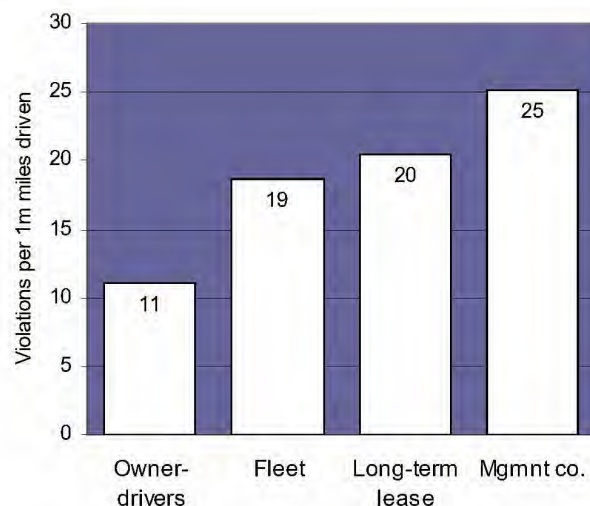
Experience makes for good drivers

- A 1988 study found that “good” drivers generally worked full-time and had several years of experience driving a cab. These experienced, full-time drivers were the subject of far fewer complaints for service problems such as refusing passengers, overcharging, treating passengers rudely or abusively or driving unsafely. Part-time, relatively novice drivers had the worst records, with violation rates 5½ times greater than full-time, experienced drivers. [*TLC 1988*]
- A 1993 study found that the most experienced drivers violated TLC rules 4 to 5 times less often than drivers in their first year. [*Summons records for October 1990-March 1992*]
- Drivers with better-than-average complaint records have driven 5 or more years.
- Owner-drivers, who drive full-time and are generally more experienced than lessees, violated TLC rules less than half as often as drivers leasing from taxi management companies. (See Figure 32.)
- Yet high turnover among drivers means that most taxi service is provided by drivers with less experience, many of whom work part-time. Figures compiled in the early 1990s showed that 53% of all taxi service is provided by drivers with fewer than 5 years of experience, and only 34% of all taxi service is provided by full-time drivers with at least 5 years experience.

**Figure 32.
Driver rule
infractions, by
how cab is
operated,
1990-92.**

Number of TLC rule violations per 1 million miles operated in the 18 month period between Oct. 1990 and March 1992.

Source: *TLC 1994a*.



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Who Drives Cabs

Drivers greatly outnumber cabs . . .

- There were 42,900 licensed taxi drivers eligible to drive the 12,779 licensed taxicabs in 2005.
- The number of licensed taxi drivers declined from about 40,000 in the late 1990s to 35,200 in 2000 before climbing to 42,900 in 2005. *[NYC Mayor's Management Reports]*

. . . but only a fraction work full-time

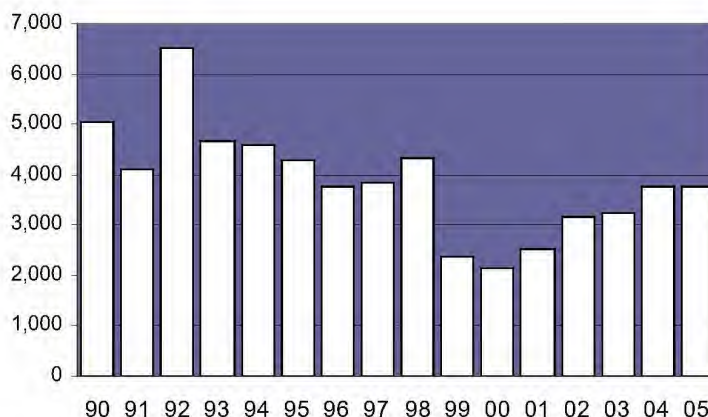
- 40% of all licensed drivers report having driven a cab 5 or more days in the preceding week. *[Survey of drivers renewing their license in December 1993]*
- 29% of all drivers report not having driven at all in the previous week.

Flow of new drivers tends to be counter-cyclical to the economic cycle

- 3,800 new drivers were issued licenses in both fiscal year 2004 and fiscal year 2005.
- The flow of incoming drivers tends to be counter-cyclical to the economy, with more drivers applying for a taxi driver license when other jobs are scarce. The inflow of new drivers reached a low of 2,100 in fiscal year 2000 during the peak of the economic cycle but then rebounded to 2,500 in fiscal year 2001 and 3,200 in fiscal year 2002.

Figure 33.
New drivers
licensed by
TLC, 1990-
2005.

Source: NYC
Mayor's
Management
Reports



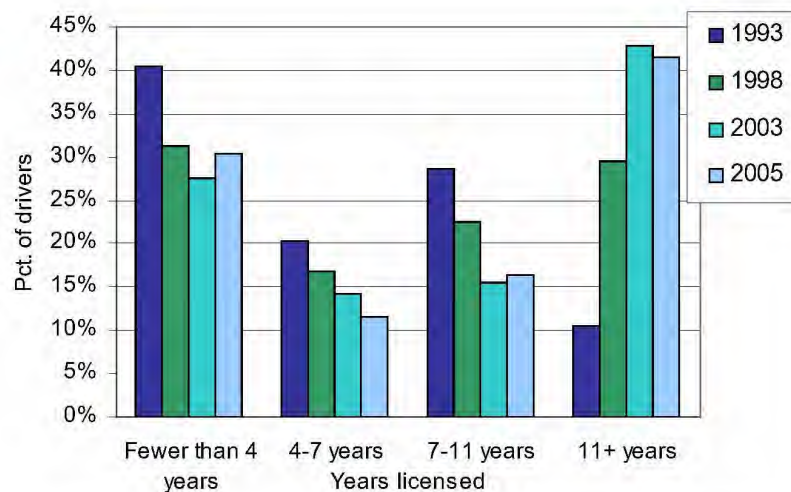
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Driver experience levels increased sharply from the early 1990s to 2003

- In 2005, drivers were licensed an average (median) of 9.2 years, up from 5.7 years in 1993 and 7.8 years in 1998.
- Both owner-drivers and lease drivers have gained in years of experience. Owner-drivers were licensed an average of 17 years in 2005 compared with 10 years in 1994. Drivers with long-term leases were licensed an average of 8 years in 2005 compared with 4.5 years in 1994. (Data for shift or fleet drivers is not available.)
- Drivers have gained in years of experience because driver attrition has slowed. Attrition rates (percentage of drivers not renewing their licenses upon expiration) declined from 8.8% per year in the mid-1990s to 6.2% in 2005.
- Attrition has slowed particularly for drivers coming up for renewal for the first time. In 2005, 18% of drivers who were initially licensed in 2003 failed to renew when their licenses expired two years later, compared with 37% of drivers in 1995 who were initially licensed two years earlier.
- Among the most dramatic change is the increase in the number of drivers who have been in the industry for over a decade. In 2005, 42% of drivers had been licensed for at least 11 years compared with 10% in 1993. (See Figure 33a.)
- Concurrently, the number of relatively new drivers has declined. The proportion of drivers with fewer than 4 years in the industry dropped from 40% in 1993 to 31% in 1998 and has remained at about that level.

Figure 33a.
Number of years
licensed, New
York City taxi
drivers, 1993-
2005.

Source: Schaller
 Consulting analysis of
 TLC licensing records



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It's an immigrant industry coming from all over the world

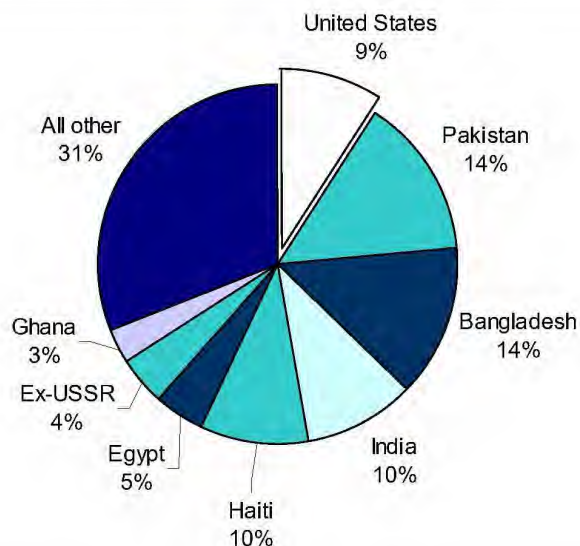
- 9% of taxi drivers were born in the United States while 91% are immigrants.
- 39% of taxi drivers emigrated from South Asia: 14% from Pakistan, 14% from Bangladesh, 10% from India and 1% from Afghanistan. (See Figure 34 below and Table 5 at end of this chapter.)
- 4% or more of drivers are from each of the following countries: Haiti, Egypt and former Soviet republics.

The countries of origin of new drivers shifted in the 1980s and has been fairly stable since the early 1990s

- Among drivers who were newly licensed between mid-2002 and mid-2004, 18% were born in Bangladesh, up from 10% in 1991 and 1% in 1984. This growth reflects increases in Bangladeshi emigration to New York City from 400 per year in the 1980s to 3,900 per year in the mid-1990s.
- 15% of new drivers are from Pakistan and 10% from India.
- Increased African immigration to New York City is evident in the increase in medallion cab drivers from Egypt, Morocco, Ghana and Nigeria. Eleven percent of new drivers are from one of these four countries.
- The national origins of driver applicants has shifted dramatically since the mid-1980s. The proportion from the Indian subcontinent rose from 10% in 1984 to 43% in 1991.
- The proportion of applicants born in the U.S. dropped sharply from 26% in 1984 to 10.5% in 1991. The fraction from the Caribbean fell from 27% to 8%.

Figure 34.
Country of birth of
taxi drivers, 2004.

Source: Schaller
Consulting 2004b



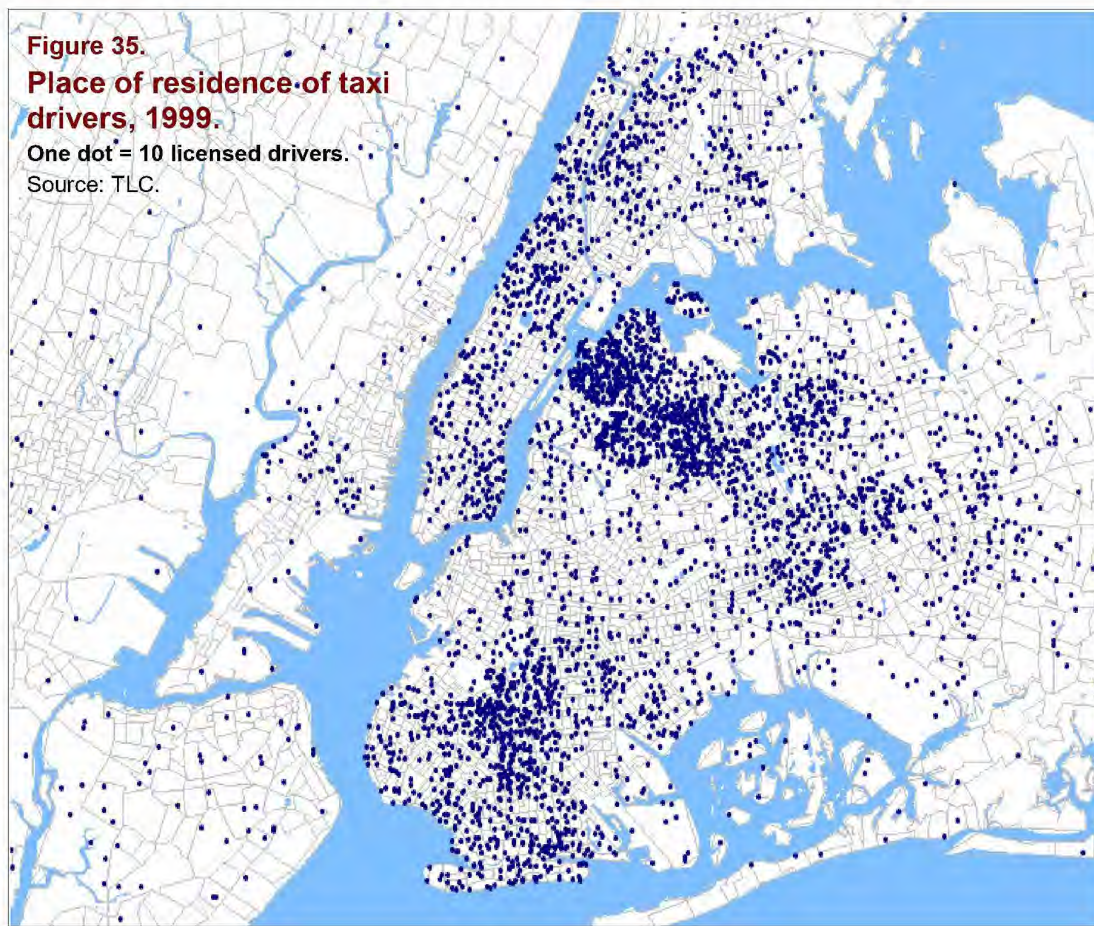
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Languages spoken reflect the diversity

- 60 languages were spoken among driver applicants in 1991. (See Table 7.)
- 24% of all applicants reported having learned English as a child. Of immigrant applicants, 16.1% reported learning English as a child, closely followed by languages from the Indian subcontinent and Africa: Urdu (15.7%), Punjabi (12.7%), Arabic (11.1%) and Bengali (10.6%).
- Though most immigrant applicants learned English before or soon after arriving in the U.S., less than half (43%) said they speak English at home (even in addition to their native language), in 1991.

Most drivers live in Queens or Brooklyn

- Drivers' homes are concentrated in northwest Queens neighborhoods of Astoria, Elmhurst, Woodside and Jackson Hts. and central Brooklyn neighborhoods of Borough Park, Bensonhurst and Flatbush. (See Figure 35.)



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Diverse in race and age, but not by sex

- The taxi industry continues to be nearly all male. Only 1.0% of drivers were female in 2005.
- The proportion of new drivers who are female increased to 2.1% in 2005, up from 1.2% in 2001 and 0.4% in 1994.
- The median age of all drivers was 44 in 2005, compared with 42 in 1999 and 38 in 1994.
- The average age of newly licensed drivers was 34 in 2005, about the same as in 1999 (average age 35) and slightly older than in 1994 (average age 31 for new drivers).
- 48% of drivers classified themselves as Asian (including Indian), 25% as black, 18% as white and 7% as Hispanic in 2005.

Most applicants drove before or had retail jobs

- 44% of those applying for driver licenses in 1991 had driven passengers for-hire before, mainly car services in New York City and/or taxis in another country. Eleven percent said they were returning to drive a NYC taxi again, having let their original license lapse.
- The previous job of driver applicants was most often driving professionally (19.6%); restaurant cooks, cashiers, waiters or other jobs in food-related businesses (15.1%); store clerks, cashiers, bank tellers and other retail jobs (6.1%), or jobless (6.9%).

Why and how drivers come into the industry

- Word of mouth is critical; 73% knew someone who drove a cab and 58% found the owner of the cab they would drive through a friend, relative or neighbor.
- 58% of all applicants in 1991 wanted to drive a cab for two simple and basic reasons: to make money or because they needed a job. One in three named attractive aspects of the job – liking to drive or the flexibility, independence or excitement of driving.
- Most applicants saw driving a cab as an opportunity to make money and advance financially. They expected to earn more driving a cab than in their previous job.
- Most applicants also planned to drive “for many years” and hoped to buy a medallion license eventually. But these plans were not fulfilled for most applicants. Despite their plans, 40% were out of the industry by the end of 1993 and 64% by 1998.
- One in 10 of all prospective drivers in 1991 sought to drive a cab for short-term financial reasons, often reflecting setbacks in their working lives during the

early-90s recession. These applicants held professional, supervisory or managerial jobs requiring high educational achievement or held skilled crafts jobs (e.g., mechanics) or used creative skills (e.g., artists, musicians and photographers). Many of these applicants expected to earn less driving a taxi than in their previous job, and planned to drive a cab for only a short while.

Driver retention

Why do some drivers stay and become long-term drivers while others leave? What factors influence drivers' decisions? This is a complex question with perhaps as many answers as there are drivers. But some insight can be gleaned from looking at the background of drivers who stay in the industry versus those who move on.

- Drivers who came into the industry in 1991 saying they expected to earn more driving a cab than in their last job were more likely to still be licensed in 1998, as compared with drivers who expected to earn the same or less. (See Table 8.)
- Drivers who came into the industry saying they “like to drive” were somewhat more likely to still be licensed in 1998, as compared with drivers who came just for the money.
- Drivers from Bangladesh, the former Soviet Union, African countries, Pakistan and India showed higher retention rates than drivers from the Caribbean, central America and – especially – Europe and the U.S.

Table 5. Country of birth of taxi drivers, 2005

U.S. and Possessions	9.1%
Foreign-born	90.9%
Pakistan	14.4%
Bangladesh	13.6%
India	10.2%
Haiti	9.6%
Egypt	4.6%
Ex-USSR	4.4%
Ghana	3.0%
Dominican Republic	2.0%
Morocco	1.8%
China	1.6%
Ecuador	1.5%
Columbia	1.4%
Romania	1.4%
Nigeria	1.2%
Afghanistan	0.8%
Jamaica	0.7%
All other	18.7%
Total	100.0%
Total drivers with country of birth	30,240
Country of birth missing	11,384
Total licensed drivers	41,624

Source: *Schaller Consulting 2004b*

Table 6. Country of birth of taxi driver applicants, 1984 and 1991 and new drivers, 2002-04

	1984	1991	2002-04*	Change 1991 to 2002-04
United States	25.8%	10.5%	9.0%	-1.5%
Bangladesh	1.1%	10.2%	18.3%	8.1%
Pakistan	3.0%	21.3%	14.8%	-6.5%
India	3.0%	10.0%	9.5%	-0.5%
Egypt	3.8%	4.8%	6.1%	1.3%
Haiti	18.5%	4.1%	3.9%	-0.2%
Morocco	0.1%	1.7%	3.8%	2.1%
Ghana	2.1%	1.6%	2.9%	1.4%
Ex-Soviet Republics	3.1%	6.8%	2.8%	-4.0%
Nigeria	0.5%	1.1%	1.7%	0.7%
Romania	2.8%	1.6%	1.1%	-0.5%
Dominican Republic	4.5%	1.9%	0.9%	-1.0%
China	1.2%	0.7%	0.9%	0.2%
Ecuador	1.7%	0.8%	0.7%	-0.1%
Afghanistan	2.9%	1.2%	0.6%	-0.6%
Colombia	2.7%	1.0%	0.4%	-0.6%
Jamaica	1.8%	0.9%	0.4%	-0.5%

* Licensed from mid-2002 to mid-2004. Licenses are issued for two-year terms; these drivers had first-time licenses as of June 2004.

Data for 1984 and 1991 are for applicants for a taxi driver license. Data for 2002-04 are for newly licensed drivers (does not include drivers who applied for but did not obtain a driver license).

Sources: *Morris 1985; TLC 1992, Schaller Consulting 2004b*

Table 7. Native languages of driver applicants born outside the U.S., 1991

Language	Pct.	Where spoken
English	16.08%	Pakistan, India, Bangladesh
Urdu	15.72%	Pakistan
Punjabi	12.71%	Pakistan, India
Arabic	11.06%	Egypt, Morocco, Sudan
Bengali	10.57%	Bangladesh
Russian	7.44%	former Soviet republics
French	5.63%	Haiti, Ivory Coast, Senegal
Spanish	5.59%	Dominican Republic, Colombia
Creole	3.70%	Haiti
Hindi	3.38%	India
Akan	1.77%	Ghana
Romanian	1.73%	Romania
Pushtu	1.33%	Pakistan, Afghanistan
Amharic	1.09%	Ethiopia
Polish	1.05%	Poland
Chinese	1.05%	China
Korean	.97%	Korea
Turkish	.88%	Turkey
Bambara	.84%	Ivory Coast, Mali
Portuguese	.80%	Brazil
Farsi	.76%	Afghanistan, Iran
Wolof	.72%	Senegal
Mandingo	.60%	Ivory Coast
Greek	.56%	Greece
Hebrew	.52%	Israel
Dari	.48%	Afghanistan
Yoruba	.40%	Nigeria
Malayalam	.36%	India
Serbo-Croatian	.36%	Yugoslavia
Cantonese	.28%	Hong Kong, China
Armenian	.28%	scattered
Ga	.28%	Ghana
Fulani	.28%	Guinea
Tamil	.28%	India

Languages spoken by fewer than 0.25% of all applicants are Kwa (Ibo), Hungarian, Italian, Gujarati, Bulgarian, Berber, Tagalog, Thai, Albanian, Vietnamese, Japanese, Indonesian, Telugu, Hausa, Fante, German, Czech, Uzbek, Estonian, Twi, Bihari, Khmer, Ibibio, Mende, Marathi, Tigrinya

Source: *TLC 1992*.

Table 8. Taxi driver retention rates

Retention rates as of December 1998 for drivers who went through the TLC new driver training process in the summer and fall of 1991.

The figures below are the percentage of drivers licensed in 1991 who were still licensed seven years later, at the end of 1998. Note that these figures refer to licensing only and that many licensed drivers are actually behind the wheel only occasionally or not at all.

	Retention rate	# drivers surveyed
Whether expect to earn more driving a cab than in last job		
Earn more	39%	1,595
About the same	33%	772
Earn less	24%	285
Why do you want to drive a taxicab?		
Like to drive	42%	495
Need work	37%	465
Independence/flexibility	36%	223
Study	35%	98
Make money	34%	859
For extra money	33%	249
Other/no reason	3%	131
Previous job		
Food business	43%	442
Drove for-hire vehicle	41%	251
Retail	39%	180
Construction	38%	143
Jobless	36%	201
Salesperson	35%	133
Country/region of birth		
Bangladesh	45%	295
USSR	43%	196
Africa	43%	324
Pakistan	42%	615
India	41%	286
Caribbean/central America	29%	158
Europe	22%	161
U.S.	16%	301

Data Sources and Bibliography

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* indicates that publication is available at www.schallerconsult.com/taxi

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Exhibit 14



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CABS CHARGE NOT ONLY FOR MILEAGE BUT FOR THE TIME SPENT AT RED LIGHTS

By Deseret News

| May 27, 1990, 1:00am CDT

Gary Meyers



You're on a business trip to New York, Chicago, any city where taxis are the only way to go. You're in the cab, you're late, stuck in traffic and the meter is running. As the seconds tick away, your teeth begin to gnash. You see money slipping away with each tick of the box - and the cab isn't moving.

You wonder, is the meter right? How does it work anyway? We've all been there. Here are the answers to the questions about taxi meters and how taxicab fares work: Q. If you're stuck in traffic, are you billed when you are not moving? If so, how?

A. "If you are not moving your fare automatically goes on the clock," said Robert Collins, vice president at Checker Cab Co. in Chicago.

Once the cab is stopped, riders are charged by the second and not by the mile. The time rate is cumulative. For example, if the wait time is 20 cents per minute, and you are stopped for 30 seconds, the charge would be 10 cents. As soon as the cab begins moving again, the meter kicks in and the mileage rate then continues.

Q. Can it cost you more money if the cabby jackrabbits from red light to red light?



Q. Can you be charged waiting time if the cab is moving but very slowly?

A. No, unless you are in New York City. "Any speed under 9.6 mph starts the wait time rate, which in New York is 25 cents per 75 seconds, rather than the 25 cents per fifth of a mile moving rate," said Rebecca Bowser, with the New York City Taxi Cab Commission.

Q. Can you be billed for time, instead of distance when you are cabbng it? Do you ever have a choice?

A. Usually no. In most places, as long as the cab is moving, the customer is on the meter, and if the cab is not, the customer is on the clock.

However, in Washington, D.C., a customer may hire a cab by the hour, at the rate of \$12 for the first hour or part of an hour, and \$3 for each additional 15 minutes.

Q. Is it cheaper to take the shortest route, or the fastest route?

A. This can vary from city to city and during different times of the day. Even though customers have a hard time trusting cabbies, Mark Cohen, administrator of Boston's Hackney Carriage Unit, recommends allowing the cabbie to decide.

"A good cabdriver can make the call better than the general public," Cohen said. "In order to avoid traffic, most people are willing to pay an extra dollar or two in mileage fees in order to get to their destination faster anyway."

Q. What do you do if the cabby doesn't turn on the meter?

A. There is no charge until the flag falls. If the cabby forgets, he could be out of luck, unless his passenger is a nice guy.

Q. How often are customers cheated by tampered meters?

A. "Cab meters are not tampered with very often. It's a class-one offense that can lose a cabby his license. We do sting operations periodically checking for tampered meters," said Bowser.

A. The various city taxicab commissions check the accuracy of the meters.

Q. Do all taxi meters have seals? Where are they? How do you know if the seals are broken?

A. All meters have seals that are visible on the front. If the wire seal is cut or bent in any way, the seal should be assumed broken.

Q. If the seals are broken, what does it mean? What recourse do you have? Who should you call, a cop?

A. You can always call a cop. Otherwise, if the seal is broken, the passenger should take down the cabby's name and number, and also the number of the cab, and report it to the local taxicab commission.

Q. What do you do if a cabby refuses to take you where you want to go?

A. "By law, a cabby must accept all passengers and deliver them to their desired destination. Drivers must take passengers to where they want to go," said Collins. "If the driver refuses to do so, take his name and number, and the number of his cab, and report it to the Commissioner of Consumer Sales.

Q. Where do cabdrivers come from?

A. According to Pamela Haze, assistant dean of adult education at Chicago City-Wide College, cab drivers represent virtually all ethnic groups. Roughly 50 percent of drivers in Chicago are foreign-born, and during the last study conducted by the college, immigrants from Pakistan and India represented the majority of foreign-born cab drivers applying for licenses.

Q. Does any government agency (local or otherwise) require that the cabby know English? How about his way around the city?

A. In the city of Chicago, a cabby or chauffeur driver must pass a test showing a working knowledge of English. For a \$25 fee, the applicant may attend a two-day workshop at one of Chicago's city colleges. It is a 13.5 hour course, with five hours

Reader questions will be answered and may appear in this column, when mailed to Gary S. Meyers at 308 W. Erie, Suite 300, Chicago, IL 60610

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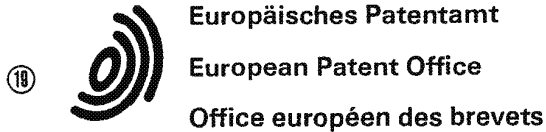
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Exhibit 15



11 Publication number: **0 032 607**
B1

12 **EUROPEAN PATENT SPECIFICATION**

- 45 Date of publication of patent specification: **16.07.86** 51 Int. Cl.⁴: **G 07 B 13/00, G 06 F 15/50**
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54 **Fare computation and dispatching method.**

- | | |
|---|--|
| <p>43 Date of publication of application:
29.07.81 Bulletin 81/30</p> <p>45 Publication of the grant of the patent:
16.07.86 Bulletin 86/29</p> <p>84 Designated Contracting States:
DE FR GB SE</p> <p>58 References cited:
 CA-A- 983 624
 FR-A-1 590 348
 US-A-3 736 408
 US-A-4 009 375</p> <p>AFCET, Traffic Control and Transportation Systems, 16-21 September 1974, pages 121-131 Monte Carlo, MC. Proceedings of the IFAC-IFIP-IFORS Symposium, Proc. 2 North Holland 1974, Amsterdam, NL. K.K. REBIBO: "A computer controlled Dial-a-ride system"</p> | <p>73 Proprietor: Baumann, Dwight M.
 4516 Henry Street
 Pittsburgh Pennsylvania (US)</p> <p>72 Inventor: Baumann, Dwight M.
 4516 Henry Street
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 Rowland Allsop & Co. Black Boy Yard 15 High Street
 West Wycombe High Wycombe, Bucks. HP14 3AE (GB)</p> <p>58 References cited:
 29th IEEE VEHICULAR TECHNOLOGY CONFERENCE, Arlington Heights, 27-30 March 1979, pages 307-308 Conference Record of papers presented at the 29th Annual Conference, published by IEEE INC. New York, U.S.A. O. BILLSTROM: "A taxi communication systems"

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|---|--|

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Courier Press, Leamington Spa, England.

EP 0 032 607 B1

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Description

The present invention relates to fare computation and dispatching methods or similar computational applications, being more particularly concerned with adapting taxi meters and the like to accommodate simultaneous and overlapping customers with varied pick-up and delivery locations, and with automatically provided sophistication and equitably proper control and/or corrections for such factors as time of day, traffic conditions, minimal routing and the like. While hereinafter described with reference to the illustrative and preferred application to taxi operations, it should be understood that the concepts and techniques here-involved may also be applied to other applications, as well, where the features or some of the features of the invention may also be desired.

It has previously been proposed to provide computation circuits in taxi meters and the like for separately computing the fares of a plurality of passengers with overlapping trips as disclosed, for example, in U.S. Letters Patent No. 3,953,720; and numerous systems have been proposed for computing fare indications with the aid of pulse measuring systems for determining time and distance, as disclosed, for example, in U.S. Letters Patent Nos. 3,843,870 and 3,860,806. Of course, the concept of radio communication with vehicles or other moving objects for controlling the same or functions therein has long been proposed in a variety of applications as disclosed, for example, in U.S. Letters Patent Nos. 3,284,627 and 3,286,091; and the use of a central dispatching or control office with vehicle communication links has long been used in the railroad and other arts.

Also relevant to the prior art is the article entitled "A computer controlled dial-a-ride system" by K. K. Rebibo appearing in the periodical AFCET Traffic Control and Transportation Systems 16—21 September 1974 pages 121 to 131.

This article discloses a dial-a-ride system which lessens the burden of control room personnel and offers door-to-door service on demand using shared vehicles with dynamically changing routes. In this prior system pick-ups and deliveries are relayed to the drivers via two-way mobile radios. When a vehicle arrives at a stop the driver radios the dispatcher in the control room who interrogates a computer to obtain the vehicle's next destination.

All of this, however, falls far short of the concept underlying the present invention which involves a central control system for monitoring not only the fare needs of the taxi fleets, but for enabling central computation of the fares, estimated trip time information and other needs for overlapping trip passengers, without penalty to a deviated rider, together with the sophisticated use of experience in the peculiarities of different routes, traffic patterns and exigencies or difficulties of travel at different times of day or weather and the like. The

invention, thus, introduces compensations and corrections based upon the particular routes and time of day with its differing traffic and similar circumstances, and, in addition, may select the most expeditious, economical or otherwise suitable routes for the driver to take consistent with the best service to the customer—again from centralized stored information elicited when the pick-up and destination points are communicated to the central computing and controlling headquarters.

All of this is done, moreover, in a manner that, once the pick-up and destination is communicated, does not involve the driver in so far as the computation and presentation of the indicated data is concerned. The prior art approaches to fare calculations and time-distance techniques for rate calculation and the like, with emphasis upon calculations effected at the taxi meter, seem to have led the art away from the concept of the present invention since such techniques are not practically adapted to incorporate historical data, minimal route and related corrections which are eminently feasible with the centralized computation and automatic precalculation and remote control of local meter displays in accordance with the present invention.

It is accordingly an object of the invention to provide such a new and improved method of and system for automatic taxi meter control, incorporating statistical corrective data for automatic overlapping-trip fare computation, including such importance refinements as compensation for traffic conditions, weather and routing from stored historical and statistical data relating to the same; the method and system being thus not subject to the limitations and relatively less sophisticated capabilities of prior art proposals.

A further object is to provide a technique whereby real-time indications may be provided to the central station of various taxicab mechanical data such as engine temperature, oil temperature and oil pressure, as well as such data as how many seats in the taxicab are occupied.

A further object is to provide a system wherein emergency signals can be provided to the central station and which may be inconspicuously communicated by the taxicab operator to indicate, for example, that police aid is desired.

A further object is to provide such a novel method and system that may be applicable to other vehicular and related control applications, as well, wherein advantages and functions similar to those attained by the invention in taxi usages may be desired.

Other and further objects will be explained hereinafter and are more specifically delineated in the appended claims.

In summary, this invention embraces a method of fare computation and dispatching referred to herein as the Ride Shared Vehicle Paratransit System (RSVP System), and comprising storing information in a computer at a central control station relating to routes and distances between street addresses and historical data as to time for

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normal transit therebetween under different times of day and traffic conditions; peripherally interfacing with the central control station through communication links with moving vehicles; communicating pick-up and deposit addresses along such links to the central control station from each vehicle for each hire thereof; calculating fares and estimating times of transit using said stored information; characterised by transmitting along said links, said calculated fares and estimated times of transit selectively addressed to the corresponding vehicle; and receiving and automatically displaying said transmitted fares and times at the respective vehicles, the displaying step including simultaneously displaying pluralities of fare and corresponding time data at the vehicles transmitted for overlapping hires. Preferred details are hereinafter set forth.

The invention will now be described in connection with the accompanying drawings wherein the symbols used conform to the International Organization for Standardization (ISO) Recommendation R1028 Flowchart Symbols for Information Processing, and conform to American National Standard Flowchart Symbols and Their Usage in Information Processing, X3.5—1970.

Fig. 1 is a flow-chart in block diagram form of the entire RSVP System illustrating preferred RSVP System hardware; and

Fig. 2 is a flow-chart in block diagram form of the calculation scheme for the RSVP System, illustrating the software and processing system aspects of the invention.

Fig. 3 is a flow-chart in block diagram form of the calculation scheme for the computer program used in the invention.

It is now in order more fully to describe the underlying concept of the invention with reference to the illustrative specific exemplary embodiment of the same as shown in the drawings.

Central control station hardware

The Central Control Station of Figure 1, serves as the focal point for all operations, which includes the following basic hardware components:

(1) The Central Computer 2a, labeled "RSVP calculations", its Monitor Console 3a, labeled "CRT Display Dispatcher", and a cartridge disk storage unit 1, termed "RSVP data base";

(2) A Dispatcher Console 3b, labeled "address input by dispatcher," for entering trip data and displaying system information at 3a;

(3) A Backup Console which provides backup manual dispatching capabilities shown as a "voice channel" 3c; and

(4) Vehicle communication hardware 5 for transmitting and receiving vehicle messages.

The Central Computer 2a will perform all calculations, communications processing, and real-time monitoring in the system. In a tested system, a PDP 11/10 mini-computer served as the

Central Computer, although initial program development was performed on a PDP 11/40. The PDP 1110, which can address a maximum of 32K 16-bit words, was configured with 16K words of core memory, and an internal 60 Hz line frequency clock providing timing signals for real-time monitoring, with an extended arithmetic element permitting hardware fixed-point integer-multiplication and division.

The Operation Console 2b of the Central Computer 2a consisted of a hard copy terminal equipped with a paper tape reader/punch, used for entering programs and for monitoring computer operations. All programs were developed by using a disk based operating system with text editing capabilities; however, after development, the system programs function independently of the operating system.

Secondary storage at 1 for the system was provided by a moving-head cartridge disk system containing one fixed disk and one removable disk cartridge, each of which had a 2.5 million word capacity. The disk system was completely compatible with DEC hardware and software. Thus, vendor software protection features permitted using the device to store operating system files in addition to storing the hash-coded Address-Coordinate File and the Time/Distance File.

Under normal operating conditions, the Dispatch Console of the Central Control station 3a and 3b may be used to enter origin or pick-up and destination or deposit address data and to display operating information (e.g. fares, estimated trip times for each hire, system messages, vehicle messages). In the tested embodiment, the Dispatch Console was the Cathode Ray Tube terminal 3a which stored up to 1920 characters (24 lines of 80 characters) and which had a protected field capability for display in pre-arranged screen formats.

The computer interface for the Dispatch Console 3a and 3b and for the Operations Console 2b was a standard DEC DL11-E asynchronous line interface with modem control capability which permitted demonstrations at remote locations using voice grade telephone lines. Vehicle communications were routed through a special purpose interface with 64-bit (i.e. four word) input/output capability. The interface supported one or two base station transmitters and was capable of adequately communicating with up to 500 vehicles. Since a portion of the interface capacity may be unused, various system display functions may easily be added by connecting interface outputs to a stand-alone static display.

For example, the display could indicate emergency conditions without tying up the Operations Console 2b; and the before-mentioned Dispatch Console 3a functions may also be displayed thereon at the central station.

The interfacing Command Module 4a and 4b interpret commands, execute commands, and control vehicle communications. They also format the Operations Console display at 3a,

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check input data for validity, and initialize internal buffers with valid data.

Vehicle hardware

Turning, now, to a possible implementation of the vehicle hardware and usable with the system of the invention, the vehicle display may show the trip fare and estimated trip time of each hire generated by the Central Computer, or the fare as determined by the electronic meter in the event of a computer failure, the mode in which fares are calculated by computer being the normal operating mode and the electronic meter capability providing a manual back up. Trip and fare data are continuously accumulated and may be accessed manually or by the computer, with the meter distance fare rate and time fare rate being adjustable to accommodate virtually any fare rate structure.

Digital radio transmission along the communications link between the central station and the vehicles, with individual vehicle addressing, error checking and command control capabilities, may provide the means for computer-based control of the entire fleet, with communications and monitoring capabilities being expandable by incorporating micro-processor techniques.

As before indicated, the vehicle unit operates either in conventional taxi mode or the computer-controlled mode with the latter mode initiated after the digital carrier is detected and the vehicle has been addressed. The transmission along the radio communications link can then be either a system code or the display code. In the present demonstration system, the display is activated with a flag button, though the display, flag and hold buttons may all be simultaneously activated by a display on (DO) code immediately following the vehicle ID. This action locks out the backup meter. The DO sets the display to 00/0000, and indicates that, for example, the next six words sent to the vehicle are the fare and trip time following by an EOM (End-of-message). (If the carrier has not been received for 50 milliseconds, an EOM is assumed).

The fare display at 10 remains set until the vehicle operator turns the display off as by depressing the flag button. This will allow separate fares for each trip. The minute display begins to decrement as soon as DO (or vehicle addressed) is received. The normal meter mode can be initiated at any time by depressing the flag button so that, in the event of a communication or computer failure, the meter automatically provides back-up fare calculations.

The meter unit 10, and speedometer cable (SC) sensor 8 form the basic vehicle meter, requiring input from the SC sensor and two clock frequencies such as (960 Hz and 1 Hz). It outputs fare increments and 1/10 mile pulses. Fare counters total the fare increments and drive the display unit. The 1/10 mile pulse is used to increment the complete daily (or monthly) mileage on the vehicle. The meter memory may contain the total

1/10 miles, the paid 1/10 miles, the number of flag drops (i.e. trips), the accumulated revenue collected in meter mode and the accumulated revenue collected in computer-controlled mode. Memory capacity may be expanded to permit additional monitoring and the meter memory may be read from the vehicle remotely via computer or with, for example, a key lock rotary selector switch. After the meter memory is read, it may be zeroed.

The meter unit will permit fare rate structure adjustments using wire jumpers that determine the cents/minute, cents/mile, and threshold velocity (i.e. the point at which the instantaneous time fare rate is the same as the distance fare rate). Below the threshold velocity, fares are based on time; above, only on distance. The fare jumpers may be sealed to prevent unauthorized adjustments and may be located on the display processor/memory circuit board and set initially by switches.

The communication and control hardware for a vehicle to be used in the taxi fleet operated under this mode may consist of a six digit display, electronic fare meter, and digital radio transmission equipment. The display shows the trip fare and estimated trip time generated by the Central Computer, or the fare determined by the electronic meter in the event of a computer failure. Trip and fare data are continuously accumulated in the meter, and may be accessed manually or by the computer and the meter may readily also be adjusted to accommodate virtually any fare structure. Digital radio transmission, with unique vehicle addressing, error checking and command control capabilities, will permit efficient computer-assisted control of a taxi fleet.

In addition to a speedometer cable sensor, connected to vehicle driveshaft, various other sensors may be used including oil pressure, amount of gas, engine temperature, engine vacuum, and other quantities that are good indicators of the vehicle's mechanical status, which can be reported to the base station. Other, more specialized sensors such as set switches to verify occupancy, or hidden panic switches to indicate an emergency by the driver, can be incorporated into the system. This real-time monitoring capability also permit regulatory agencies to inspect a transit operation effectively from the base station using the monitor console.

The display unit may, for example, utilize LED or incandescent two-digit displays for indicating time in minutes, four-digit displays for fares up to \$99.99, the hold and flag buttons (which may be illuminated when depressed), and a communication keyboard.

Transmission error detection and vehicle identification

As for ID and error encoding and decoding, the vehicle identification numbers (such as 0—99) may be switch selectable on the vehicle FSK transmitter and receiver card. Each ID word in the tested system was two bytes long and contained

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one initial control code nibble and three ID number nibbles. The controlled code specified the function to be performed by the vehicle receiver. Identification numbers were encoded in binary coded decimal (BCD) format.

ID numbers may be decoded on the receiver card by sequentially comparing the address bytes. If the first byte received matches the first bank of switches, the decoder is advanced, which in turn activates the second bank of switches. If the second byte matches, the vehicle addressed flag is set. Subsequent data will then be processed and the addressing cycle is completed. The addressed flag is cleared either by dropping the carrier for 50 milliseconds or by sending an end of message (EOM) code.

The vehicle ID is encoded on a universal transmitter card (universal because it may be used for the base station as well). The transmitter may be set, by switches or by the computer, to transmit either two bytes for complete identification (contained in two words), or one byte. In transmissions from vehicles to the base, error, hardware malfunction, emergency, and data out flags are all tied into the first nibble out (switch bank 1, Bits 0—3), which ordinarily would be set to the address code. Sensing elements and status latches may be added to permit transmitting important status conditions as well as the ID number.

To ensure accurate transmission in noisy commercial radio bands, it may be desirable to do some form of error checking on incoming messages. Two separate techniques may be utilized. Consider, for example, a transmission format consisting of:

1 word=16 bits=3 start bits+parity bit+
8 data bits+4 stop bits.

The start and stop bits can be checked for data over/under run and message completeness, and the parity bit may be used to check data validity. If an error occurs after the addressing words have been received by the vehicle, an error flag is set and returned with the vehicle ID. Error flagging at the base station may be done visually and digitally.

A vehicle printer may also be incorporated for printed receipts. In multi-origin/destination applications, the printer would also be used to differentiate between trips.

The Dispatcher essentially acts as a switch-board by routing information to and from the interface. The status of interface output bits control the information flow. In general, after a fare and an estimated time have been computed and displayed, if the Transmit (T) command is entered, the information is sent along the radio communications link in FSK format to the appropriate vehicle. If the message is received without error, the vehicle response consists of its ID alone. If, however, an error has occurred, an error code is returned with the vehicle ID, an error

message is displayed on the CRT 3a, and the message is transmitted again.

R.S.V.P. data base

5 The basic software includes a vendor-supplied operating system and the Data Base Management System 13 of Figure 2. Considering, now, further details of the computation data base management unit at the central station and dispatch console 3a and 3b of Figure 2, the system contains a control structure 13 which links processing modules and data files including:

10 (1) A Time/Distance File within the R.S.V.P. Data Base 1 containing travel times and distances between zones in the service area;

15 (2) An Address Coordinate File also in the Data Base 1 containing state plane coordinates for all street addresses in the service area that makes possible interpolation of distances from the centroid of each appropriate zone to augment the interzonal time and distance file above.

20 (3) A Processing module within the data base management system 13 cooperative with respective calculation portions 2c, 2d and 2e for computing fares and estimated travel times; and

25 (4) A processing module withing 13 for interpreting and executing commands. The Time/Distance File contains shortest-time-path distances, travel time during uncongested periods, and travel time during congested periods for trips between all possible pairs of traffic zones. The Address-Coordinate File associates state plane coordinates with all street addresses in the service area. The initial service area, in the test system before-mentioned, consists of 100 traffic zones with 2,179 unique streets, and encompasses approximately 17 square miles. System Files require 251,904 words of disk storage.

30 Considering, first, the expanded flexibility attainable by the invention even for a single-origin/destination trip, the fare may be calculated on the basis of estimated travel distance and travel time. Zone-to-zone time and distance data are obtained from a Time/Distance File which, in the experimental version tested, was originally developed by the South-western Pennsylvania Regional Planning Commission (SPRPC). The file contains shortest-time-path distances, travel times during uncongested periods, and travel times during congested periods for trips between all possible pairs of traffic zones. An Address-Coordinate File, also developed by the SPRPC, associates state plane coordinates with all streets addressed in the service area. The time and distance for a trip between a specific origin and destination pair are obtained by adjusting the zone-to-zone time and distance in the Time/Distance File by a correction factor based on the information available in the Address-Coordinate File.

35 The Address-Coordinate File consists of two distinct components: a Street Name File and a Street Segment File. Each Street Name record contains a pointer to a chain of segment records;

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each segment record contains the state plane coordinates for a particular set of address ranges on the street, and a pointer to a record in the Time/Distance File. Each record in the Time/Distance File contains travel data for trips from the given origin zone to all other zones. The fare calculation for a specific trip requires obtaining origin and destination coordinates, retrieving and adjusting the appropriate distances and times, computing the fare, and displaying the results.

In the preliminary system, the records in the Street Name File were assigned to disk locations by a hashing algorithm. The initial algorithm simply treated six characters from a street name as three 16-integers and multiplied them together. Sixteen bits were masked from the result and used to specify an absolute disk location for one "bucket". Up to 39 street names can be stored in one bucket without causing overflow. When overflow occurs, the extra records are placed in the first bucket on the track which has been addressed. The distribution from the hashing algorithm is such that there is sufficient overflow space available on each track.

The Street Name File may contain:

- (1) The street name;
- (2) The street suffix;
- (3) The last three digits of the zip code area;
- (4) The field for a frequency-of-use count;
- (5) A pointer to the first street segment for the street.

Conceptually, the Time/Distance File may be viewed as an $N \times N$ matrix containing information about all possible trips among N zones. Element (i, j) in record i , refers to a trip originating in zone i and terminating in zone j . The first two fields in record i contain the state plane coordinates of the centroid of zone i ; the third field contains accumulated computed distances for trips within zone i .

Each element (i, j) in record i consists of sub-fields that may contain the following:

- (1) A flag field to indicate special circumstances;
- (2) The accumulated number of trips from zone i to zone j ;
- (3) The shortest-time-path distance from zone i to zone j ;
- (4) The average velocity for trips from zone i to zone j ;
- (5) The accumulated actual trip distances from zone i to zone j ;
- (6) The accumulated actual trip times from zone i to zone j ;
- (7) The time of the last update of average velocity;
- (8) A special distance adjustment factor;
- (9) A special velocity adjustment factor.

In elements (i, i) , two changes in sub-field assignments occur. Sub-fields two contains the distance adjustment factor for trips within zone i .

Use of special distance and velocity adjustment factors is determined by setting appropriate bits in the flag field.

The Address-Coordinate and Time/Distance Files are organized to minimize read/write arm movement when retrieving trip information. Conceptually, the physical disk drive may be divided into cylinders, with four tracks in each cylinder. Read/Write heads can thus be positioned over four tracks simultaneously when a given cylinder is accessed. In the present organization, one track is used for street name records, two tracks for the associated segments of the remaining track for Time/Distance File records, (three per track). Although assignment of Time Distance records is arbitrary, after operating experience is accumulated, the three most frequently accessed traffic zones for segments in a cylinder may be placed on the available track. This reorganisation will further reduce the arm movement required for fare calculations.

Calculation of fares

The fare for the single-origin/destination trip is calculated on the basis of estimated travel distance and travel time from the centroid-to-centroid distances and times for the specific pairs of traffic zones in the Time/Distance File. This data is adjusted by correction factors to yield estimates for trips between the indicated origin and destination.

The metered taxi fare for a single-origin/destination trip can be expressed as

$$f = f_o + f_c,$$

where f_o is the fixed portion, f_c the variable portion, and f the total fare. Since the variable portion is dependent on distance x and time t of the ride, an equitable variable fare will be such that

$$f_c(x_1 + x_2, t_1 + t_2) = f_c(x_1, t_1) + f_c(x_2, t_2),$$

where x_1 and x_2 are the distances of the two portions of a ride with an intermediate stop while t_1 and t_2 are the corresponding times. Hence variable fare must be a linear function of distance and time, i.e.

$$f_c(x, t) = ax + bt,$$

where a and b are constant coefficients. Then, the total fare can be expressed as:

$$f(x, t) = f_o + ax + bt,$$

which is a linear combination of time and distance. Since both off-peak time and peak time are available, stratification of fare with respect to time-of-day (peak or off-peak) is straightforward. The constant f_o and the coefficients a and b can, in general, be adjusted to fulfil desired objectives. In the system for single-origin/destination trips, for example, they may be chosen to reflect current practice in metered taxi fare calculation.

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The taxi meter charges a fixed fare f_0 for the "flag drop" and incremental charge c of each hire for every (δ) miles travelled or (γ) minutes elapsed after pick-up, whichever is reached first. Under conditions of idealized stop-and-go traffic, the trajectory of a vehicle is either stationary or moving with a constant speed $v > \delta\gamma$.

The Fare Module calculates fares and estimated trip times, and places the results in a communication buffer for further processing by the Command Module. To ensure reasonable system response times as these expansions are implemented, Command Module message processing subroutines may be interrupt-driven, and disk files organized to minimize read/write head movement. A count field is reserved in each file record to permit periodic file reorganization based upon record activity.

Key program steps for achieving the calculations of the system in Figure 2 are: selection of the appropriate address information from the R.S.V.P. Data Base 13; and forwarding the data from the Data Base to the proper calculation subroutines for distance 2e of Figure 2, time 2c of Figure 2 and trip fare 2d of Figure 2.

The fare for a single origin/destination trip is calculated on the basis of estimated travel distance and travel time. The estimates are obtained from the centroid-to-centroid distances and times for all possible pairs of traffic zones in the Time/Distance File stored in the R.S.V.P. Data Base 1. These data are adjusted by correction factors to yield exact figures for trips between a specific origin and destination. Once a trip distance and trip time are determined through simple, conventional calculation techniques, they are used to determine the trip fare.

Figure 3 of this application shows a simple flow diagram demonstrating the logic involved in the actual operation of the program.

The trip data, comprised of the desired origin and destination, is entered into the computer system by the Keyboard 20 of Figure 3. This information is used to retrieve selected information from the disk memory which contains the R.S.V.P. Data Base 1. This selection of the appropriate interzone travel distances and times is achieved using conventional, well known computer programming techniques, and is represented in Figure 3 by block 21. This trip information is applied to subroutines, within the computer system, which are individually programmed to compute the exact fare and exact distance utilizing the pre-programmed arithmetic equations involved in process 23 and process 24. The result of these calculation processes is then applied to the fare calculation subroutine 25, which has within it a preprogrammed arithmetic equation for determining the fare utilizing the results of calculation 23 and calculation 24. The exact arithmetic equation schemes programmed into each subroutine are themselves obvious to one skilled in the art.

While, as before stated, it is believed that the invention can be implemented in various ways

that will suggest themselves to those skilled in this art, once the underlying concepts of the invention are known, the particular types of components, hardware, interconnections and process and flow steps above-described are considered to be preferred. Modifications will thus suggest themselves to those skilled in this art, and such are considered to fall within the scope of the invention as defined in the appended claims.

Claims

1. A method of fare computation and dispatching comprising storing information in a computer at a central control station relating to routes and distances between street addresses and historical data as to time for normal transit therebetween under different times of day and traffic conditions; peripherally interfacing with the central control station through communication links with moving vehicles; communicating pick-up and deposit addresses along such links to the central control station from each vehicle for each hire thereof; estimating times of transit at the central station by using said stored information; characterised by calculating fares at the central station transmitting along said links, said calculated fares and estimated times of transit selectively addressed to the corresponding vehicle; and receiving and automatically displaying said transmitted fares and times at the respective vehicles, the displaying step including simultaneously displaying pluralities of fare and corresponding time data at the vehicles transmitted for overlapping hires.

2. A method as claimed in claim 1 characterised in that the fare and time transmissions are corrected during the calculating at the station by introducing corrections for different traffic and related conditions.

3. A method as claimed in claim 1 characterised in that said calculating is modified by up-dated changes in addresses communicated from said vehicles.

4. A method as claimed in claim 1 characterised in that the calculating includes selecting optimum routes between said addresses.

5. A method as claimed in claim 1 characterised in that the stored time data is corrected from time to time by comparison with real-time data obtained at said vehicles.

6. A method as claimed in claim 1 characterised in that data as to conditions in the vehicle is also communicated along said links for monitoring at the station.

7. A method as claimed in claim 1 characterised in that said displaying step includes disconnecting communication and control from said station and controlling the same locally from the vehicle.

Patentansprüche

1. Fahrpreisberechnungs- und Fahrdienstleistungs- verfahren unter Verwendung eines

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Rechners an einer zentralen Kontrollstation, in welchem Informationen bezüglich der Routen sowie der Entfernung zwischen Straßenadressen und zeitbedingte bzw. historische Daten, wie die normalerweise zu verschiedenen Trageszeiten und unter verschiedenen Verkehrsbedingungen benötigte Fahrzeit zwischen diesen Straßenadressen gespeichert sind, sowie unter Verwendung einer peripheren Verbindung über Kommunikationskanäle zwischen der zentralen Kontrollstation und den mobilen Fahrzeugen, wobei für jedes gemietetes Fahrzeug die Adresse des Fahrbeginns und des Fahrziels über derartige Kommunikationskanäle an die zentrale Kontrollstation übermittelt werden und die geschätzte Fahrzeit in der zentralen Kontrollstation aufgrund der gespeicherten Informationen errechnet wird, dadurch gekennzeichnet, daß die Fahrpreise an der zentralen Kontrollstation errechnet und über die Kommunikationskanäle übertragen werden, daß die errechneten Fahrpreise sowie die geschätzten Fahrzeiten selektiv an das entsprechende Fahrzeug adressiert werden, und daß die übertragenen Fahrpreise und Fahrzeiten an dem entsprechenden Fahrzeug empfangen und automatisch angezeigt werden, wobei bei dieser Anzeigevorgang gleichzeitig auch mehrere Fahrpreise und die zugehörigen Zeitdaten an den Fahrzeugen angezeigt werden, die für einander sich überschneidende Vermietungen bzw. Inanspruchnahmen übertragen wurden.

2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß die Fahrpreis- und Fahrzeitübertragungen während der Berechnung an der Kontrollstation korrigiert werden, und zwar durch Einführung von Korrekturen für unterschiedliche Verkehrsverhältnisse und hieraus resultierende Bedingungen.

3. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß die Berechnung durch Update-Änderungen bzw. aktualisierte Änderungen in den Adressen, die von den Fahrzeugen übertragen werden, modifiziert wird.

4. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß die Berechnung die Auswahl der optimalen Routen zwischen den Adressen einschließt.

5. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß die gespeicherten Zeitdaten von Zeit zu Zeit durch einen Vergleich mit den aktuellen Zeitdaten, die von den Fahrzeugen erhalten werden, korrigiert werden.

6. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß Daten bezüglich der Bedingungen in dem Fahrzeug über die Kommunikationskanäle für eine Anzeige an der Station ebenfalls übertragen werden.

7. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß der Anzeigeschritt die Unterbrechung der Kommunikation sowie der Steuerung mit bzw. von der Station sowie eine lokale Steuerung der Anzeige vom Fahrzeug aus einschließt.

Revendications

1. Une méthode de calcul et de répartition du prix d'un transport comprenant le fait d'emmagasiner des informations dans un ordinateur au niveau d'une station de commande centrale relativement à des parcours et des distances entre des adresses de rues et des données historiques concernant la durée pour un transport normal entre aux, à différentes heures du jour et sous différentes conditions de circulation; interfacer, de manière périphérique, avec la station de commande centrale, par l'intermédiaire de liaisons de communication avec des véhicules en déplacement; communiquer des adresses de prise en charge et de dépôt le long de telles liaisons à la station de commande centrale à partir de chaque véhicule pour chacune de ses courses; estimer la durée du transport au niveau de la station centrale en utilisant lesdites informations enregistrées; caractérisée par le fait de calculer les durées de transport au niveau de la station centrale, transmettre le long desdites liaisons lesdits prix calculés et les durées de transport estimées adressées de manière sélective vers le véhicule correspondant puis recevoir, et afficher de manière automatique les prix et les durées de transport ainsi transmis aux véhicules respectifs, l'opération d'affichage incluant simultanément l'affichage de plusieurs données de prix et de durées correspondantes transmises aux véhicules pour des courses se chevauchant.

2. Une méthode selon la revendication 1, caractérisée en ce que les transmissions de prix et de durées sont corrigées au cours de l'opération de calcul à la station en introduisant des corrections pour différentes conditions de circulation et conditions analogues.

3. Une méthode selon la revendication 1, caractérisée en ce que ladite opération de calcul est modifiée par des changements mis à jour dans des adresses communiquées par lesdits véhicules.

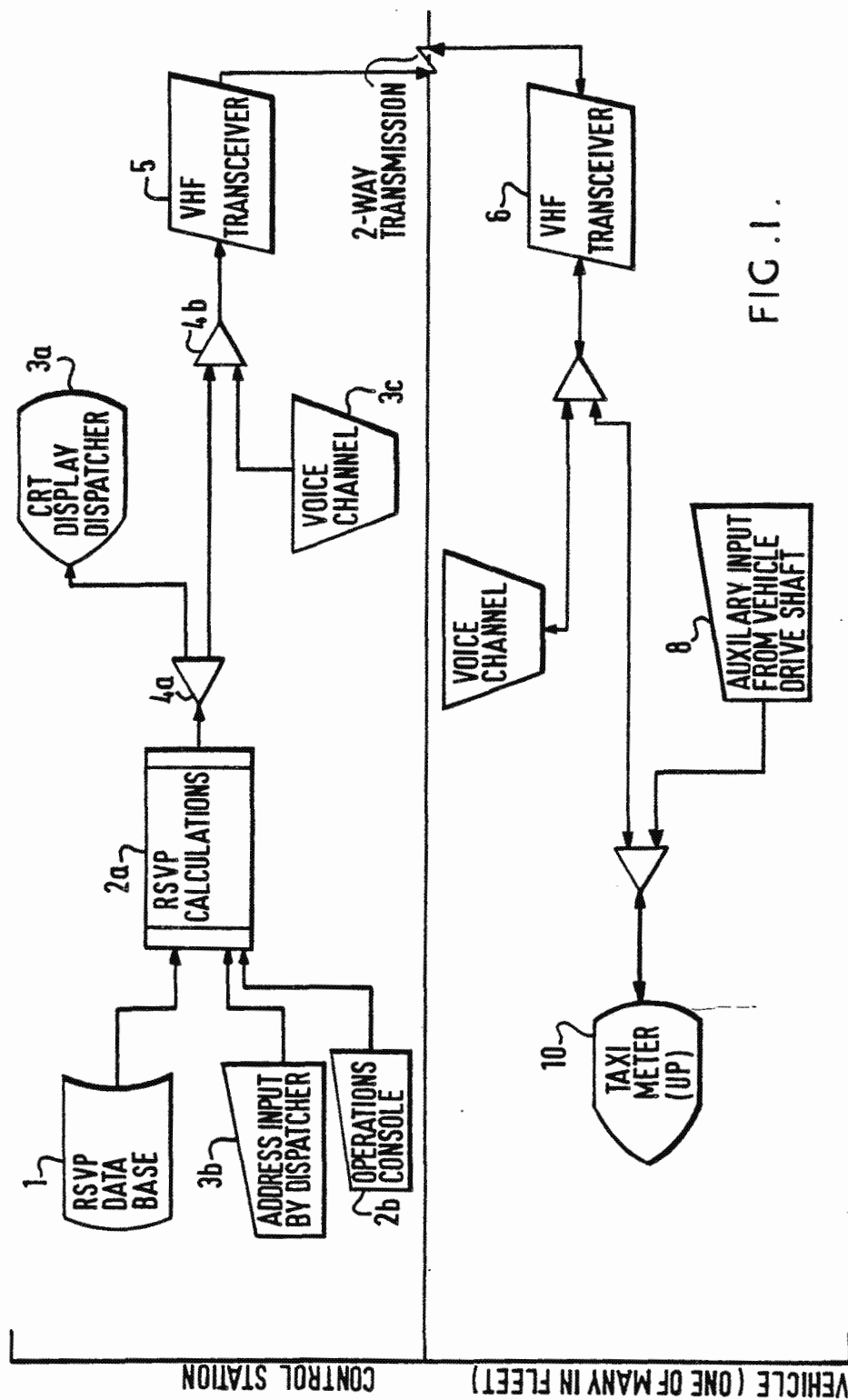
4. Une méthode selon la revendication 1, caractérisée en ce que l'opération de calcul comprend le fait de choisir des parcours optimum entre lesdites adresses.

5. Une méthode selon la revendication 1, caractérisée en ce que les données de durée emmagasinées sont corrigées de temps à autre par comparaison avec des données en temps réel obtenues au niveau desdits véhicules.

6. Une méthode selon la revendication 1, caractérisée en ce que des données concernant des conditions dans le véhicule sont également communiquées le long desdites liaisons pour un contrôle à la station.

7. Une méthode selon la revendication 1, caractérisée en ce que ladite opération d'affichage comprend le fait de déconnecter toute communication et commande provenant de ladite station et commander cette dernière localement à partir du véhicule.

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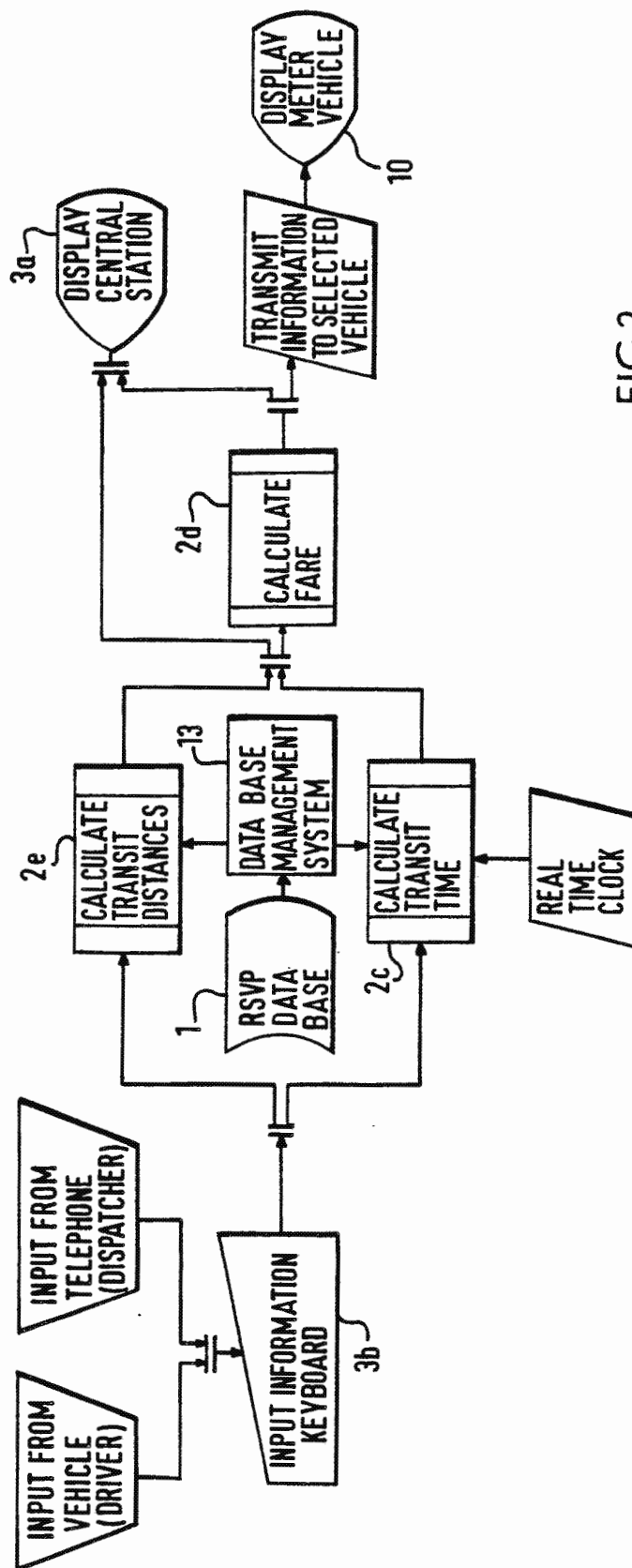


FIG.2

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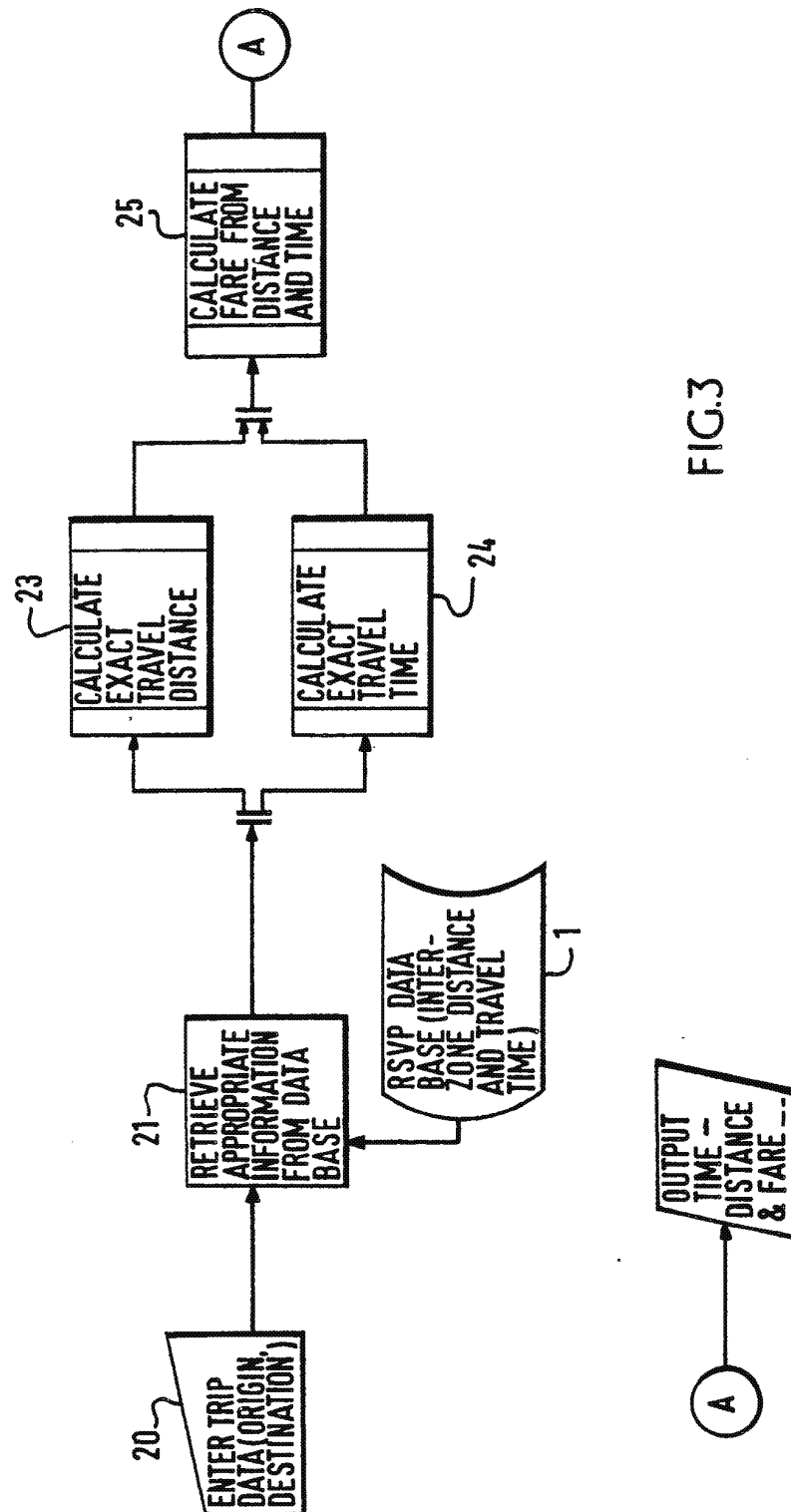


Exhibit 16

Tweet     

Follow Post Graphics:  

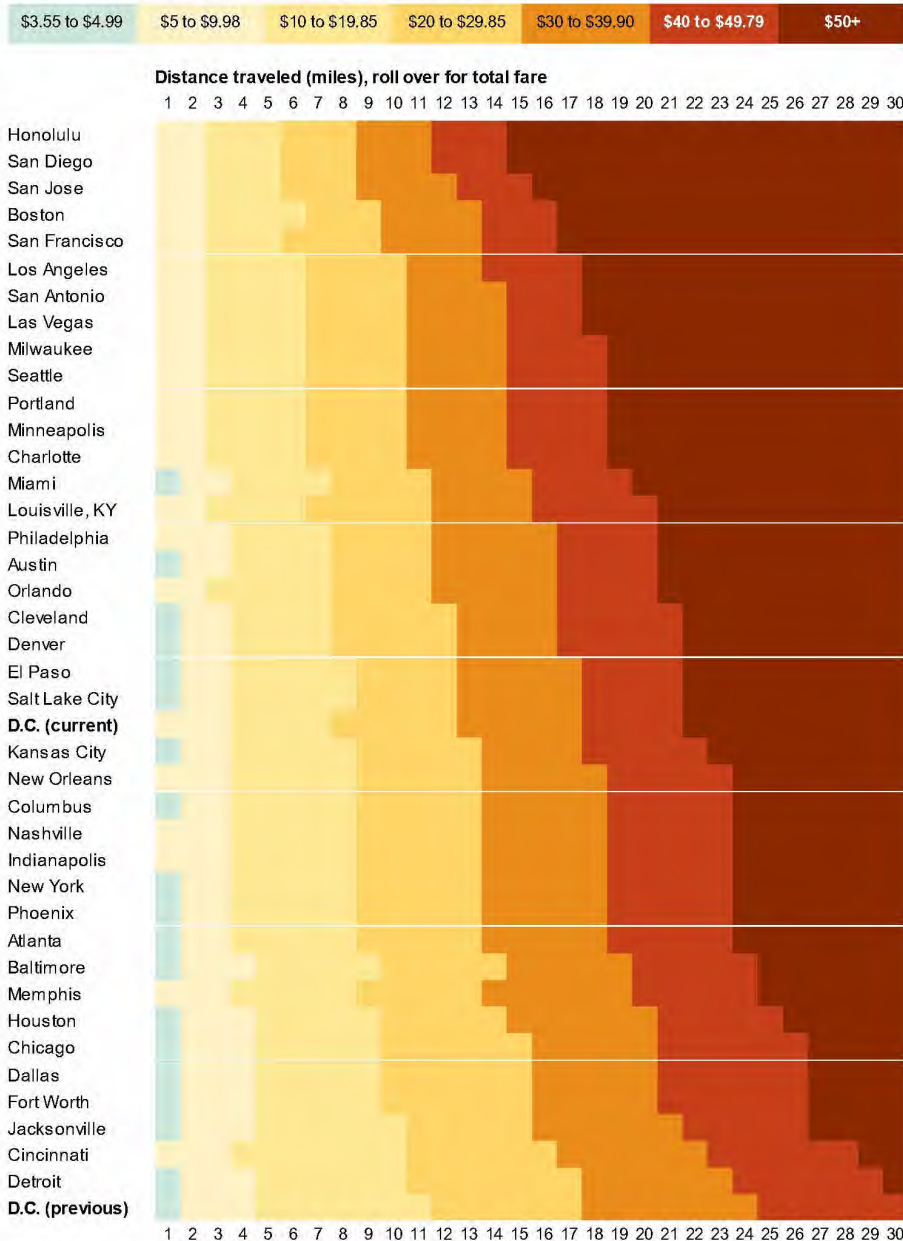
ADVERTISEMENT

Metered taxicab fares in 40 major U.S. cities

On April 21, D.C. cab fares will increase from \$1.50 to \$2.16 per mile and the wait-time rate will jump from \$15 to \$25 an hour. Additional fees for luggage handled by the operator remain in effect, but other fees for pets and personal service will be eliminated. The \$1 fuel surcharge is authorized through June 20.

Previously D.C. had the cheapest rates among 40 major U.S. cities. The new fare elevates D.C. cab prices to the middle of the pack. [Read related article.](#)

Total taxi fare for one passenger in select U.S. cities



Note: Total cost is calculated by adding the cost-per-mile charge to the initial fare - the cost to sit in the taxicab. Cost-per-mile charge and initial fare varies by city. Totals do not include a charge for wait time, an additional cost the meter calculates when a cab is sitting idle or moving at slow speeds, or other charges such as luggage.

Sources: City ordinances, cab companies, Council for Community and Economic Research, MapQuest. By Todd Lindeman and Sisi Wei - The Washington Post. Published Nov. 4, 2011. Updated April 19, 2012.

Exhibit 17



A B C D E F G H I J K L M N O P Q R S T U V W X Y Z 🏠

DICTIONARY OF AUTOMOTIVE TERMS - 'Tr'

Ta Tb Tc Td Te Tf Tg Th Ti Tj Tk Tl Tm To Tp Tq Tr Ts Tt Tu Tv Tw Ty

TR

1. Abbreviation for **Thermal reactor**
2. Abbreviation for **Transmission Range Sensor** Commonly called PRNGL - this provides input of the Gear Selector position

TRA

Tire and Rim Association.

Tracer

See

- **Sound Tracer**

Track

1. Front track is the distance between the center of the left front wheel and the center of the right front wheel when the vehicle is set to its normal **ride height** and wheel **alignment specifications**. Rear track is the distance between the center of the left rear wheel and the center of the right rear wheel. They are not always the same.
2. A designated course or roadway where vehicles race.

See

- **Axle track**
- **Carbon Tracks**
- **Eight-track**
- **One-groove track**
- **Oval track**
- **Sand tracks**
- **Short track**
- **Tri-oval track**
- **Warning tracks**

Track arc

The path traveled by a road wheel during a turn

Track bar

See



Tri pin

Triple

See

- **Touring triple**

Trip Leasing

Leasing a company's vehicle to another transportation provider for a single trip.

Triple clamp

The devices which secure the **handlebar** to the **Triple tree** on a motorcycle. Named because it has three clamping points -- one for each of the two front forks, and one for the steering tube.

Triple crank

A crankset with three chainrings designed to provide a wide range of gears and gear intervals

Triple point

Pressure-temperature condition in which a substance is in equilibrium (balance) in solid, liquid, and vapor states.

Triple tree

The **yoke** that supports the **handlebar** on a motorcycle.

Triplex chain

A chain with three rows of rollers.

See

- **Duplex chain**
- **Simplex chain**

Trip meter

An instrument which measures the distance a vehicle travels from the last time it was reset and runs in conjunction with the odometer

Trip mileage counter

An instrument which measures the distance a vehicle travels from the last time it was reset and runs in conjunction with the odometer

Tripod jack

A device for lifting a vehicle.

Tripod joint

A constant velocity joint with three balls engaged in curved grooves

Exhibit 18

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Section 5.54. Taximeters

A. Application

A.1. General. – This code applies to taximeters; that is, to devices that automatically calculates at a predetermined rate or rates and indicate the charge for hire of a vehicle.

A.2. Exceptions. – This code does not apply to odometers on vehicles that are rented on a distance basis (for which see Section 5.53. Code for Odometers).

(Amended 1977)

A.3. Additional Code Requirements. – In addition to the requirements of this code, Taximeters shall meet the requirements of Section 1.10. General Code.

S. Specifications

S.1. Design of Indicating and Recording Elements.

S.1.1. General. – A taximeter shall be equipped with a primary indicating element and may be equipped with a recording element.

(Amended 1988)

S.1.2. Advancement of Indicating Elements. – Except when a taximeter is being cleared, the primary indicating and recording elements shall be susceptible of advancement only by the movement of the vehicle or by the time mechanism.

(Amended 1988)

S.1.3. Visibility of Indications. – The indications of fare, including extras, and the mode of operation, such as “time” or “hired,” shall be constantly displayed whenever the meter is in operation. All indications of passenger interest shall be easily read from a distance of 1.2 m (4 ft) under any condition of normal operation.

(Amended 1977, 1986, and 1988)

S.1.3.1. Minimum Height of Figures, Words, and Symbols. – The minimum height of the figures used to indicate the fare shall be 10 mm and for extras, 8 mm. The minimum height of the figures, words, or symbols used for other indications, including those used to identify or define, shall be 3.5 mm.

(Added 1986)

S.1.3.2. Lighting of Indications. – *Integral lighting shall be provided to illuminate the fare, extras, the rate or rate code, and the taximeter status (i.e., vacant, hired, and time off).*

[Nonretroactive as of January 1, 1989]

(Added 1988) (Amended 1990)

S.1.4. Actuation of Fare-Indicating Mechanism. – When a taximeter designed to calculate fares upon the basis of a combination of distance traveled and time elapsed is operative with respect to fare indication, the fare-indicating mechanism shall be actuated by the distance mechanism whenever the vehicle is in motion at such a speed that the rate of distance revenue equals or exceeds the time rate, and may be actuated by the time mechanism whenever the vehicle speed is less than this and when the vehicle is not in motion. Means shall be provided for the vehicle operator to render the time mechanism either operative or inoperative with respect to the fare-indicating mechanism.

(Amended 1977)

S.1.5. Operating Condition.

S.1.5.1. General. – When a taximeter is cleared, the indication “Not Registering,” “Vacant,” or an equivalent expression shall be shown. Whenever a taximeter is set to register charges, it shall indicate “Registering,” “Hired,” or an equivalent expression and the rate at which it is set shall be automatically indicated (Rate 1 or Rate A, for example).

(Amended 1988)

S.1.5.2. Time not Recording. – When a taximeter is set for fare registration with the time mechanism inoperative, it shall indicate “Time Not Recording” or an equivalent expression.

(Amended 1988)

S.1.6. Fare Identification. – Fare indications shall be identified by the word “Fare” or by an equivalent expression. Values shall be defined by suitable words or monetary signs.

S.1.7. Extras. – Extras shall be indicated as a separate item and shall not be included in the fare indication. They shall be identified by the word “Extras” or by an equivalent expression. Values shall be defined by suitable words or monetary signs. Means may be provided to totalize the fare and extras if the totalized amount returns to separate indications of fare and extras within 5 seconds or less.

(Amended 1988)

S.1.7.1. Nonuse of Extras. – If and when taximeter extras are prohibited by legal authority or are discontinued by a vehicle operator, the extras mechanisms shall be rendered inoperable or the extras indications shall be effectively obscured by permanent means.

S.1.8. Protection of Indications. – Indications of fare and extras shall be displayed through and entirely protected by glass or other suitable transparent material securely attached to the housing of the taximeter.

S.1.9. Recorded Representation. – *A printed receipt issued from a taximeter, whether through an integral or separate recording element, shall include the following:*

(a) *date;*

(b) *unique vehicle identification number, such as the medallion number, taxi number, vehicle identification number (VIN) or permit number;**

(c) *start and end time of trip;**

(d) *distance traveled, maximum increment of 0.1 kilometer (0.1 mile);**

(e) *fare in \$;*

(f) *for multi-rate taximeters, each rate at which fare was computed and the associated fare at that rate;**

(g) *additional charges where permitted such as extras, surcharge, telephone use, tip and tax shall be identified and itemized;** and

(h) *total fare in \$ (total charge).**

[Nonretroactive as of January 1, 1989] *[Nonretroactive as of January 1, 2000]

(Added 1988) (Amended 1999)

S.1.9.1. Multiple Recorded Representations.

S.1.9.1.1. Duplicate Receipts. – *A recording element may produce a duplicate receipt for the previous transaction provided the information printed is identical to the original with the exception of time issued. The duplicate receipt shall include the words “duplicate” or “copy.” The feature to print a duplicate receipt shall be deactivated at the time the meter is hired for the next fare.*

[Nonretroactive as of January 1, 2000]

(Added 1999)

S.1.10. Non-fare Information. – *The fare and extras displays may be used to display auxiliary information provided the meter is in the vacant condition and such information is only displayed for 10 seconds, or less. If the information consists of a list of information, the list may be displayed one item after another, provided that each item is displayed for 10 seconds, or less.*

[Nonretroactive as of January 1, 2002]

(Added 2000)

S.2. Basis of Fare Calculations. – A taximeter shall calculate fares only upon the basis of:

- (a) distance traveled;
- (b) time elapsed; or
- (c) a combination of distance traveled and time elapsed.

(Amended 1977)

S.2.1. Initial Time and Distance Intervals. – The time and distance intervals of a taximeter shall be directly proportional as expressed in the following formula:

$$\frac{\text{Seconds of Initial Time Interval}}{\text{Seconds per Non – Initial Time Interval}} = \frac{\text{Distance of Initial Mileage Interval}}{\text{Distance per Non – Initial Mileage Interval}}$$

(Added 1990)

S.3. Design of Operating Control.

S.3.1. Positions of Control. – The several positions of the operating controls shall be clearly defined and shall be so constructed that accidental or inadvertent changing of the operating condition of the taximeter is improbable. Movement of the operating controls to an operating position immediately following movement to the cleared position shall be delayed enough to permit the taximeter to come to a complete rest in the cleared position.

(Amended 1988)

S.3.2. Flag. – If the control for the operating condition is a lever-arm and flag, the flag shall be at its highest position when the taximeter is cleared, and in this position the whole of the flag shall be above the level of the taximeter housing.

S.3.3. Control for Extras Mechanism. – The knob, handle, or other means provided to actuate the extras mechanism shall be inoperable whenever the taximeter is cleared.

S.4. Interference. – The design of a taximeter shall be such that there will be no interference between the time and the distance portions of the mechanism device at any speed of operation.

(Amended 1977 and 1988)

S.5. Provision for Security Seals. – Adequate provision shall be made to provide security for a taximeter. Security may be provided either by:

- (a) Affixing security seals to the taximeter and to all other components required for service operation of a complete installation on a vehicle, so that no adjustments, alterations, or replacements affecting accuracy or indications of the device or the assembly can be made without mutilating the seal or seals; or
- (b) Using a combination of security seals described in paragraph (a) and, in the case of a component that may be removed from a vehicle (e.g., slide mounting the taximeter), providing a physical or electronic link between components affecting accuracy or indications of the device to ensure that its performance is not affected and operation is permitted only with those components having the same unique properties.

The sealing means shall be such that it is not necessary to disassemble or remove any part of the device or of the vehicle to apply or inspect the seals.

(Amended 1988 and 2000)

S.6. Power Interruption, Electronic Taximeters.

- (a) After a power interruption of 3 seconds or less, the fare and extras indications shall return to the previously displayed indications and may be susceptible to advancement without the taximeter being cleared.
- (b) After a power interruption exceeding 3 seconds, the fare and extras indications shall return to the previously displayed indications and shall not be susceptible to advancement until the taximeter is cleared.

*After restoration of power following an interruption exceeding 3 seconds, the previously displayed fare shall be displayed for a maximum of 1 minute at which time the fare shall automatically clear and the taximeter shall return to the vacant condition.**

*[*Nonretroactive as of January 1, 2002]*

(Added 1988) (Amended 1989, 1990, and 2000)

S.7. Anti-Fraud Provisions, Electronic Taximeters. – An electronic taximeter may have provisions to detect and eliminate distance input that is inconsistent with output of the vehicle's distance sensor. When a taximeter equipped with this feature detects input inconsistent with the distance sensor:

- (a) The meter shall either filter out the inconsistent distance input signals or cease to increment fare based on distance until the distance input signal returns to normal. If the meter ceases to increment fare based on distance, the taximeter may continue to increment fare based on elapsed time;
- (b) The taximeter shall provide a visible or audible signal that inconsistent input signals are being detected; and
- (c) The taximeter shall record the occurrence in an event logger. The event logger shall include an event counter (000 to 999), the date, and the time of at least the last 1000 occurrences.

(Added 2001)

N. Notes

N.1. Distance Tests.

N.1.1. Test Methods. – To determine compliance with distance tolerances, a distance test of a taximeter shall be conducted utilizing one or more of the following test methods:

- (a) **Road Test.** – A road test consists of driving the vehicle over a precisely measured road course.

(b) **Fifth-Wheel Test.** – A fifth-wheel test consists of driving the vehicle over any reasonable road course and determining the distance actually traveled through the use of a mechanism known as a “fifth wheel” that is attached to the vehicle and that independently measures and indicates the distance.

(c) **Simulated-Road Test.** – A simulated road test consists of determining the distance traveled by use of a roller device, or by computation from rolling circumference and wheel-turn data.

(Amended 1977)

N.1.2. Test Procedures. – The distance test of a taximeter, whether a road test, a simulated-road test, or a fifth-wheel test, shall include at least duplicate runs of sufficient length to cover at least the third money drop or 1 mi, whichever is greater, and shall be at a speed approximating the average speed traveled by the vehicle in normal service. In the case of metric-calibrated taximeters, the test should cover at least the third money drop or 2 km, whichever is greater.

(Amended 1977)

N.1.3. Test Conditions.

N.1.3.1. Vehicle Lading. – During the distance test of a taximeter, the vehicle shall carry two persons, or in the case of a simulated-road test, 70 kg or 150 lb of test weights may be substituted in lieu of the second person.

N.1.3.2. Tire Pressure. – At the completion of test run or runs, the tires of the vehicle under test shall be checked to determine that the tire pressure is that operating tire pressure posted in the vehicle. If not, the tire pressure should be adjusted to the posted tire pressure and further tests may be conducted to determine the operating characteristics of the odometer.

(Amended 1977)

N.2. Time Test. – If a taximeter is equipped with a timing device through which charges are made for time intervals, the timer shall be tested at the initial interval, four separate subsequent intervals, and an average time test of at least four consecutive subsequent time intervals.

(Amended 1988)

N.3. Interference Test. – If a taximeter is equipped with a timing device through which charges are made for time intervals, a test shall be conducted to determine whether there is interference between the time and distance elements. During the interference test, the vehicle’s operating speed shall be 3 km/h or 4 km/h, or 2 mi/h or 3 mi/h faster than the speed at which the basic distance rate equals the basic time rate. The basic rate per hour divided by the basic rate per mile is the speed (km/h or mi/h) at which the basic time rate and basic distance rate are equal.

(Amended 1988)

T. Tolerances

T.1. Tolerance Values.

T.1.1. On Distance Tests. – Maintenance and acceptance tolerances for taximeters shall be as follows:

- (a) On Overregistration: 1 % of the interval under test.
- (b) On Underregistration: 4 % of the interval under test, with an added tolerance of 30 m or 100 ft whenever the initial interval is included in the interval under test.

T.1.2. On Time Tests.

T.1.2.1. On Individual Time Intervals. – Maintenance and acceptance tolerances on individual time intervals shall be as follows:

- (a) On Overregistration: 3 seconds per minute (5 %).
- (b) On Underregistration: 9 seconds per minute (15 %) on the initial interval, and 6 seconds per minute (10 %) on subsequent intervals.

T.1.2.2. On Average Time Interval Computed After the Initial Interval. – Except for the initial interval, maintenance and acceptance tolerances on the average time interval shall be as follows:

- (a) On Overregistration: 0.2 second per minute (0.33 %).
- (b) On Underregistration: 3 seconds per minute (5 %).

(Amended 1991)

T.1.3. On Interference Tests.

T.1.3.1. The registration of a taximeter in the “time on” position shall agree within 1 % of its performance in the “time off” position.

(Added 1988)

UR. User Requirements

UR.1. Inflation of Vehicle Tires. – The operational tire pressure of passenger vehicles and truck tires shall be posted in the vehicle and shall be maintained at the posted pressure.

(Amended 1977)

UR.2. Position and Illumination of Taximeter. – A taximeter shall be so positioned and illuminated that its indications, operational markings, and controls of passenger interest can be conveniently read by a passenger seated in the back seat of the vehicle.

(Amended 1985 and 1986)

UR.3. Statement of Rates. – The distance and time rates for which a taximeter is set, including the initial distance interval and the initial time interval, the local tax rate, and the schedule of extras when an extras indication is provided shall be conspicuously displayed inside the front and rear passenger compartments. The words “Rate,” “Rates,” or “Rates of Fare” shall precede the rate statement. The rate statement shall be fully informative, self-explanatory, and readily understandable by the ordinary passenger, and shall either be of a permanent character or be protected by glass or other suitable transparent material.

(Amended 1977, 1988, 1990, and 1999)