IP87932

बौद्धिक संपदा
भारत
एकस्व / अभिकल्प / व्यापार चिह्न
भौगोलिक उपदर्शन

INTELLECTUAL PROPERTY
INDIA
Patents / Designs / Trade Marks
Geographical Indications

सत्यमेव जयते
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GOVERNMENT OF INDIA
पेटेंट कार्यालय
THE PATENT OFFICE
वाणिज्य और उद्योग मंत्रालय
Ministry of Commerce & Industry
उद्योग संवर्धन और आंतरिक व्यापार विभाग
Department for Promotion of Industry and Internal Trade

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संख्या/No. : IPO MUM/CERT.COPY/2025/ 921 दिनांक/Date: 25 /06/2025

सेवा में / To,
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विषय Sub: अभिप्रमाणित प्रतिलिपि / Certified Copy.

महोदय / महोदया,
Sir / Madam,

अभिप्रमाणित प्रतिलिपि के लिए दिनांक 10/06/2025 के सीबीआर संख्या 21332 द्वारा किए गए अनुरोध के अनुसार पेटेंट आवेदन संख्या 353/BOM/1999 से संबंधित (1 प्रति) एतद द्वारा संलग्न हैं।

As requested vide CBR No 21332 dated 10/06/2025 the certified copy (1 copy) related to Patent Application No 353/BOM/1999 are enclosed herewith.

भवदीया / Yours Faithfully,

(सपना नरवरिया / Sapna Narvariya)
सहायक नियंत्रक, एकस्व एवं अभिकल्प / Assistant Controller of Patents & Designs
प्रभारी अधिकारी, आरएमआईडी / Officer In-Charge of RMID

संलग्न: यथोक्त (1 प्रति)
Encl: As above (1 copy)

EX1008
HARBOR FREIGHT TOOLS
IPR2025-01463

INTELLECTUAL PROPERTY INDIA
PATENTS | DESIGNS | TRADE MARKS
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भौगोलिक उपदर्शन

सत्यमेव जयते

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MINISTRY OF COMMERCE & INDUSTRY
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THE PATENT OFFICE

जिस किसी से संबंधित हो
TO WHOMSOEVER IT MAY CONCERN

मैं, अधोहस्ताक्षरी जो पेटेंट अधिनियम, 1970 की धारा 73(3) के तहत महानियंत्रक एकस्व, अभिकल्प एवं व्यापार चिह्न की ओर से प्रमाणपत्र हस्ताक्षर व जारी करने के लिए प्राधिकृत अधिकारी हूँ, एतदद्वारा यह प्रमाणित करता(ती) हूँ कि निम्नलिखित पेटेंट आवेदन के संबंध मे फाइल दस्तावेज़(जों) की सही प्रतिलिपि इसके साथ संलग्न है:

I, the undersigned, being an officer duly authorized to sign and issue the certificate on behalf of the Controller General of Patents, Designs and Trademarks in accordance with the provisions of Section 73(3) of the Patents Act, 1970, hereby certify that annexed hereto is a True Copy of the document(s) as filed in connection with the following Patent Application:

क) आवेदन संख्या / a) Application Number: **353/BOM/1999**

ख) फाइल करने की तारीख / b) Date of Filing: **10/05/1999 post dated to 29/09/2003**

ग) अनुरोधित दस्तावेज़(जों) का नाम / C) Name of the document(s) requested:

Granted Specification of Patent No. 207333

यह प्रमाणपत्र पेटेंट अधिनियम, 1970 की धारा 147(1) के अधीन मुझमे निहित शक्तियों के तहत जारी किया गया है।

This certificate is issued under the powers vested in me U/S 147(1) of The Patents Act, 1970.

दिनांक / Dated this 25th *day of* JUNE *2025*

(सपना नरवरिया / SAPNA NARVARIYA)
सहायक नियंत्रक पेटेंट व डिजाइन / Assistant Controller of Patents and Designs
(प्राधिकृत हस्ताक्षरी/ Authorized Signatory)

FORM – 2

THE PATENTS ACT, 1970

COMPLETE
SPECIFICATION

SECTION 10

TITLE : LIQUEFIED PETROLEUM GAS (LPG) VAPOR FUEL METERING SYSTEM FOR STATIONARY BI-FUEL ENGINES.

APPLICANT (S) : THE AUTOMOTIVE RESEARCH ASSOCIATION OF INDIA (A RESEARCH ORGANISATION JOINLY SET UP BY THE AUTOMOTIVE INDUSTRY AND MINISTRY OF INDUSTRY, GOVERNMENT OF INDIA) S.NO. 102, OFF PAUD ROAD, VETAL HILL, PUNE 411 038, MAHARASHTRA, INDIA & SHRI SHAKTI LPG LIMITED ADJACENT TO AIRPORT BEGUMPET, HYDERABAD 500 016, [illegible], INDIA.

GRANTED
29-3-2003

The following Specification particularly describes and ascertains the nature of this invention and the manner in which it is to be performed:-

TITLE:

LIQUEFIED PETROLEUM GAS (LPG) VAPOR FUEL METERING SYSTEM FOR STATIONARY BI-FUEL ENGINES.

TECHNICAL FIELD:

The present invention relates to the field of vaporized LPG fuel metering system for stationary engines. Particularly, the present invention relates to a system for supplying Liquefied Petroleum Gas (LPG) to bi-fuel stationary engines in response to the load and speed of the engine, such engines preferably being coupled to a portable generator.

BACKGROUND ART:

Stationary application engines are popularly known to be powered by fuels such as gasoline, kerosene, diesel etc. because of their cost- effectiveness.

Kerosene fired engines which are generally designed based on the physio-chemical characteristics of kerosene, normally possess restricted design such as low compression ratio which results in associated higher level of exhaust emissions.

In an attempt to reduce the exhaust emissions from the engine, use of Liquefied Petroleum Gas as an alternate fuel is one of the best options. Such engines which normally run on kerosene are fitted with 'Add-On' systems which supply Liquefied Petroleum Gas (LPG) as alternate source of fuel to the engine.

Such Add-On systems known in the art generally adopt liquid withdrawal system from the LPG source (tank) for supply of LPG to the engine. The inherent disadvantages of such liquid withdrawal system are as follows:

i) a heating circuit is required to vaporize the liquid withdrawn, thereby requiring additional heating and associated components and hence cannot be used for air cooled engines;

ii) Complexity of the system increases due to large number of fuel supply components.

Our inventors, by determined research and intuitive knowledge, have developed a system for supplying fuel to stationary engines which would overcome the drawbacks of the existing Add-On system and provide an improved LPG Fuel Supply System to the stationary engine by withdrawing LPG directly in vapor form from the LPG source (tank) for metered supply of LPG to the engine.

OBJECTS OF THE INVENTION :-

1. An object of the present invention is to provide an improved fuel supply system wherein efficient fuel supply is achieved with less number of components.

2. Another object of the present invention is to provide a fuel supply system wherein optimum quantity of LPG is supplied in response to load and speed of the engine.

3. An object of the present invention is to provide a fuel supply system wherein power loss at wide open throttle (WOT) is minimized

4. Yet another object of the present invention is to provide a fuel supply system wherein emissions such as carbon-monoxide and hydro-carbon gas from the engine are minimized.

5. A further object of the present invention is to provide a fuel supply system wherein the system is safe enough to use due to the provision of electrical

solenoids, vacuum switch, vacuum bypass switch, fuel selection switch, high pressure pipes and low pressure hoses.

A more detailed explanation of the invention is provided in the following description and appended claims taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS:

To complement the description that is being given and in order to promote a better understanding of the characteristics of the invention in accordance with a practical embodiment of the same and as an integral part of the said description a set of drawings accompany it in which, in an illustrative and non-restrictive way, the following are represented :-

Fig.1: is schematic representation of the components of the fuel supply system according to the present invention.

Fig. 2A: shows the comparative graph of carbon monoxide emission against load of the engine for kerosene and LPG fuels.

Fig.2B: shows the comparative graph of hydro carbon emission against engine load for kerosene and LPG fuels.

DETAILED DESCRIPTION OF THE INVENTION:

A detailed description of the preferred embodiments and best mode for practicing the invention are described herein.

The present invention discloses a system for supplying Liquefied Petroleum Gas especially to a bi-fuel stationary 4 stroke spark ignition engine coupled to a portable generator. . The present invention is suitable especially for low power stationary internal combustion engines in which consumption rate of

LPG would match the natural vaporization rate of LPG under typical engine running conditions.

FIG1: In the embodiment shown, a fuel storage cylinder hereinafter referred to as an LPG cylinder (1) is connected to the inlet of a primary regulator (3) using a high pressure tube. (2) The high pressure tube (2) may be made up of an annealed copper/steel tube.

A needle valve is mounted on the LPG Cylinder (1) to draw LPG in vapour form, from the LPG cylinder (1) for supply to the primary regulator (3). The outlet of the primary regulator (3) is connected to the inlet of an LPG solenoid valve (4). The outlet of LPG solenoid valve (4) is connected to a mechanically operated second stage regulator (5) which is connected to the inlet of a power screw (6). The outlet of the power screw (6) is connected to the inlet of a gas-air mixer (8). The gas-air mixer (8) supplies air-fuel mixture through a carburetor (9) to an engine (12) coupled to a generator. The second stage regulator (5) meters exact quantity of gas as per engine load and speed.

The structure and functions of the second stage regulator (5) used in this invention is described in detail and claimed in applicant's co-pending patent application No.654/Mum/1998.

The power screw (6) enables fine tuning of engine rpm and load and thereby adjusts fuel supply to the engine (12) through the gas- air mixer (8).

An air cleaner (7) is connected at the inlet of the gas-air mixer (8). A fuel tank (17) storing either kerosene or gasoline is connected to the carburetor (9) through a fuel solenoid valve (13). The LPG solenoid valve (4) and the fuel solenoid valve (13) are controlled through vacuum switch (11) by a selector switch (14) which allows the user to select the fuel either LPG gas or

kerosene. The power supply to the selector switch (14) and the solenoid valves (13, 4) is provided by a chargeable battery (15). A battery charger (16) is provided to keep the battery optimally charged. Battery charger (16) is activated by means of output of generator (12).

The gas-air mixer (8) may be a conventional device capable of mixing air and fuel in desired proportion. During operation of the engine in bi-fuel mode, the gas-air mixer (8) is connected between the carburetor (9) and the air cleaner (7).

A vacuum switch (11) is provided to sense vacuum created in the running engine and to switch off the solenoid valve (4) ensuring stoppage of gas flow to engine in case there is absence of vacuum. A metallic insulator gasket (10) is provided between the mating faces of the engine (12) and the carburetor (9).

The pumping action of the running engine (12) causes vacuum pressure in the intake system of engine. Due to this pumping action, air starts flowing through the venturi of gas air mixer (8) resulting in a pressure drop across the venturi throat. In response to the pressure drop at the throat, the second stage regulator (5) meters required quantity of gas, for mixing with air at desired air-fuel ratio in the gas air mixer (8). This mixture of air & fuel enters engine for combustion to deliver the required power output.

The selector switch (14) switches ON one of the two solenoid valves (4,13) while the other remains OFF. This enables the user to select the desired fuel. The electricity required for the system is provided by the battery (15) which is kept optimally charged by the battery charger (16). The vacuum switch (11) senses the vacuum in the engine and switches OFF the gas supply while

switching OFF the solenoid valve (4), if there is absence of vacuum thus ensuring safety.

Fig.2A and Fig.2B : When the generator is tested on both the fuels, viz the kerosene and LPG, using electric load bank, the power and fuel consumption was compared and the results are given in the following table 1.

Table 1

Comparison of Genset Performance

(Kerosene mode vs LPG mode)

Load	Kerosene Mode			LPG Mode		
(%)	Engine Speed (rpm)	Observed Power (W)	Fuel Con-Consumption (g/hr)	Engine Speed (rpm)	Observed Power (W)	Fuel Con-Consumption (g/hr)
100	3000	650	482	3000	650	391
75	3084	509	418	3120	513	357
50	3108	344	353	3162	365	340
25	3144	173	307	3180	183	330
0	3180	-	277	3180	-	313

Use of electric solenoids along with fuel selection switch ensures that only one fuel, either LPG or kerosene, will be metered to the engine. Also use of vacuum switch allows LPG to enter as a fuel only when the engine gets cranked and gets started. As soon as the engine stops, it does not allow LPG to enter into the engine, thus ensuring the safety.

Thus, while there have been shown and described and pointed out fundamental novel features of the present invention as applied to preferred embodiments thereof, it will be understood that various omissions and substitutions and changes in the form and details of the methods described

may be made by those skilled in the art without departing from the spirit of the present invention. For example, it is expressly intended that all combinations of those elements and/or method steps which perform substantially the same function in substantially the same way to achieve the same results are within the scope of the invention. Substitutions of elements from one described embodiment to another are also fully intended and contemplated. It is the intention, therefore, to be limited only as indicated by the scope of the claims appended hereto.

WE CLAIM :

1. A Liquefied Petroleum Gas (LPG) vapor fuel metering system for stationary bi-fuel engine, comprising :

   (i) a fuel cylinder for storing a predetermined quantity of Liquefied Petroleum Gas under pressure.

   (ii) said fuel cylinder connected to a first stage regulator;

   (iii) said first stage regulator connected to a second stage metering regulator through a solenoid valve;

   (iv) said second stage metering regulator connected to a gas-air mixing device through a power screw and

   (v) said gas-air mixing device connected to an engine through a carburetor wherein :

   the fuel cylinder comprises a needle valve to draw out LPG in vapor form for supply to the first stage regulator.

2. The system as claimed in claim 1, wherein the first regulator is adapted for maintaining constant outlet pressure.

3. The system as claimed in claim 1 or 2 wherein the second stage metering regulator is a mechanically operated device for metering gas in response to the load and speed of the engine.

4. The system as claimed in claim 1,2 or 3 wherein the power screw is operated for fine tuning of engine rpm and load and thereby adjust fuel supply to the engine through the gas-air mixer.

Dated this 30th day of May, 1999.

FOR THE AUTOMOTIVE RESEARCH ASSOCIATION OF INDIA and SHRI SHAKTI LPG LIMITED
By their Agent

(R. LAKSHMINARAYANAN)
KRISHNA & SAURASTRI

Name : The Automotive Research Association of India and Shri Shakti LPG Ltd.

Sheet No. : 1

Total Sheets : 3

Appl.No.: 353/BOM/1999

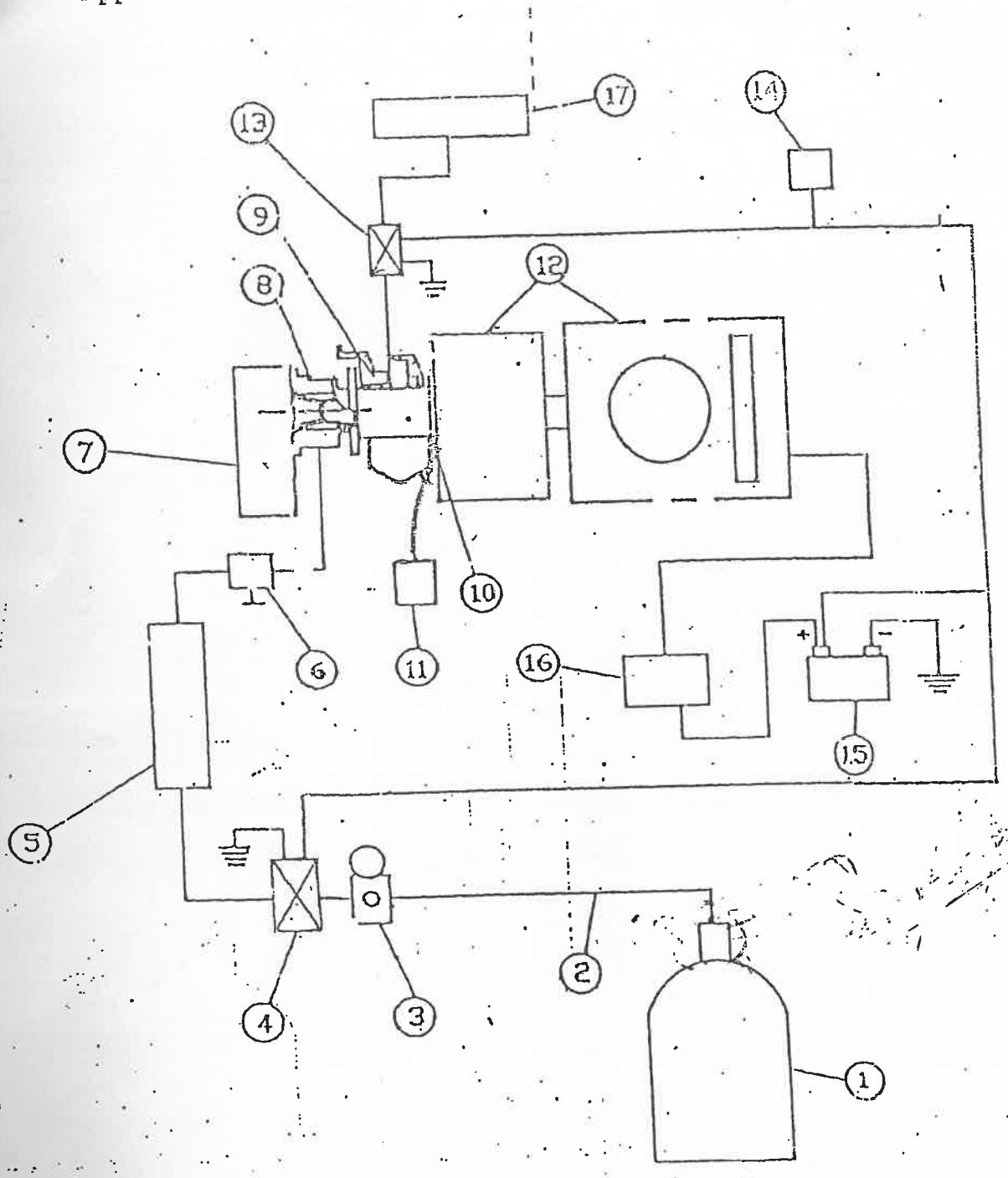

FIG. 1

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Name : The Automotive Research Association Sheet No. : 2
Of India and Shri Shakti LPG Ltd.
Total Sheets : 3

Appl.No.: 353/BOM/1999

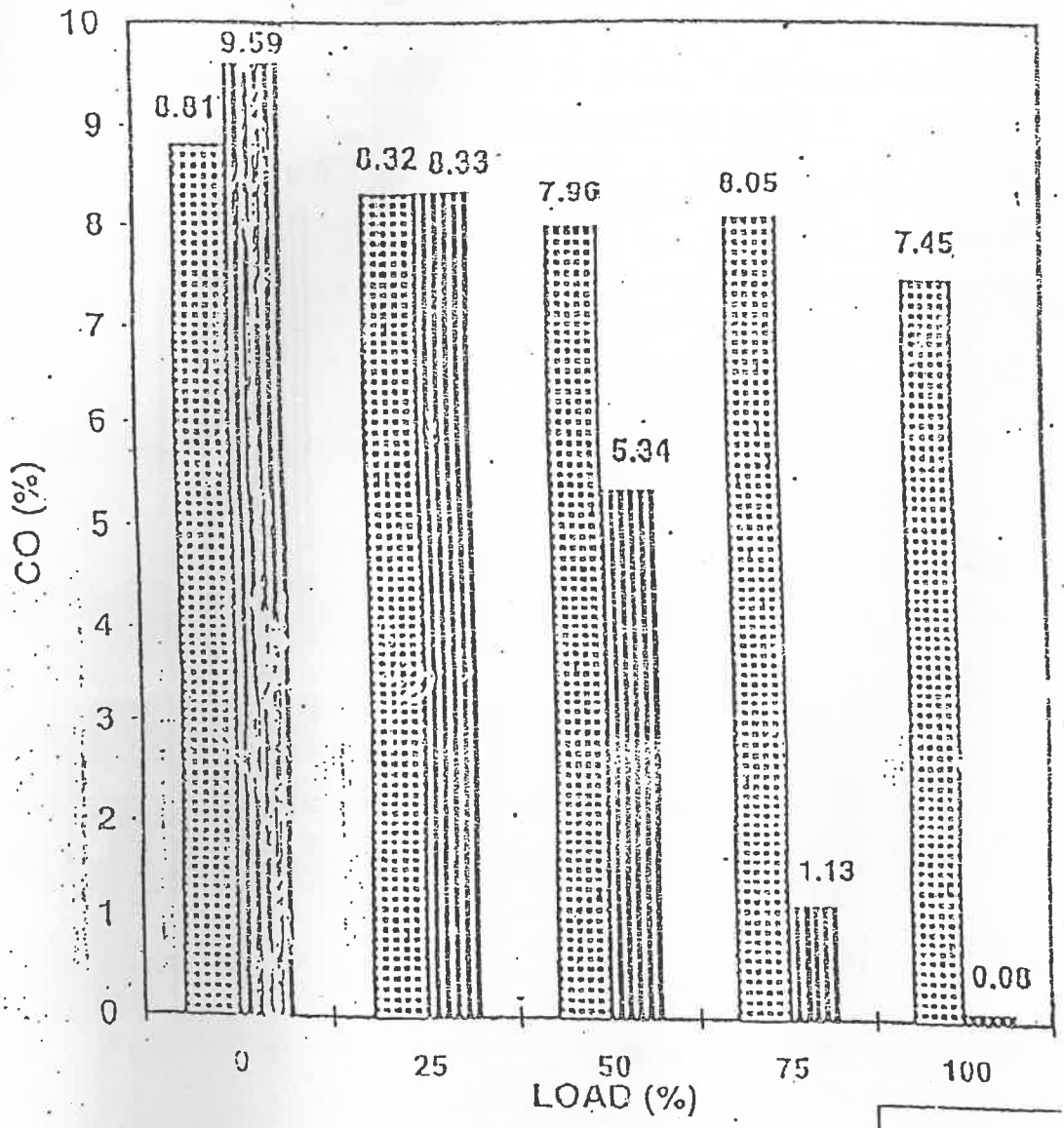

FIG. 2 A

(R. LAKSHMINARAYANAN)
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Name : The Automotive Research Association Of India and Shri Shakti LPG Ltd. Sheet No. : 3

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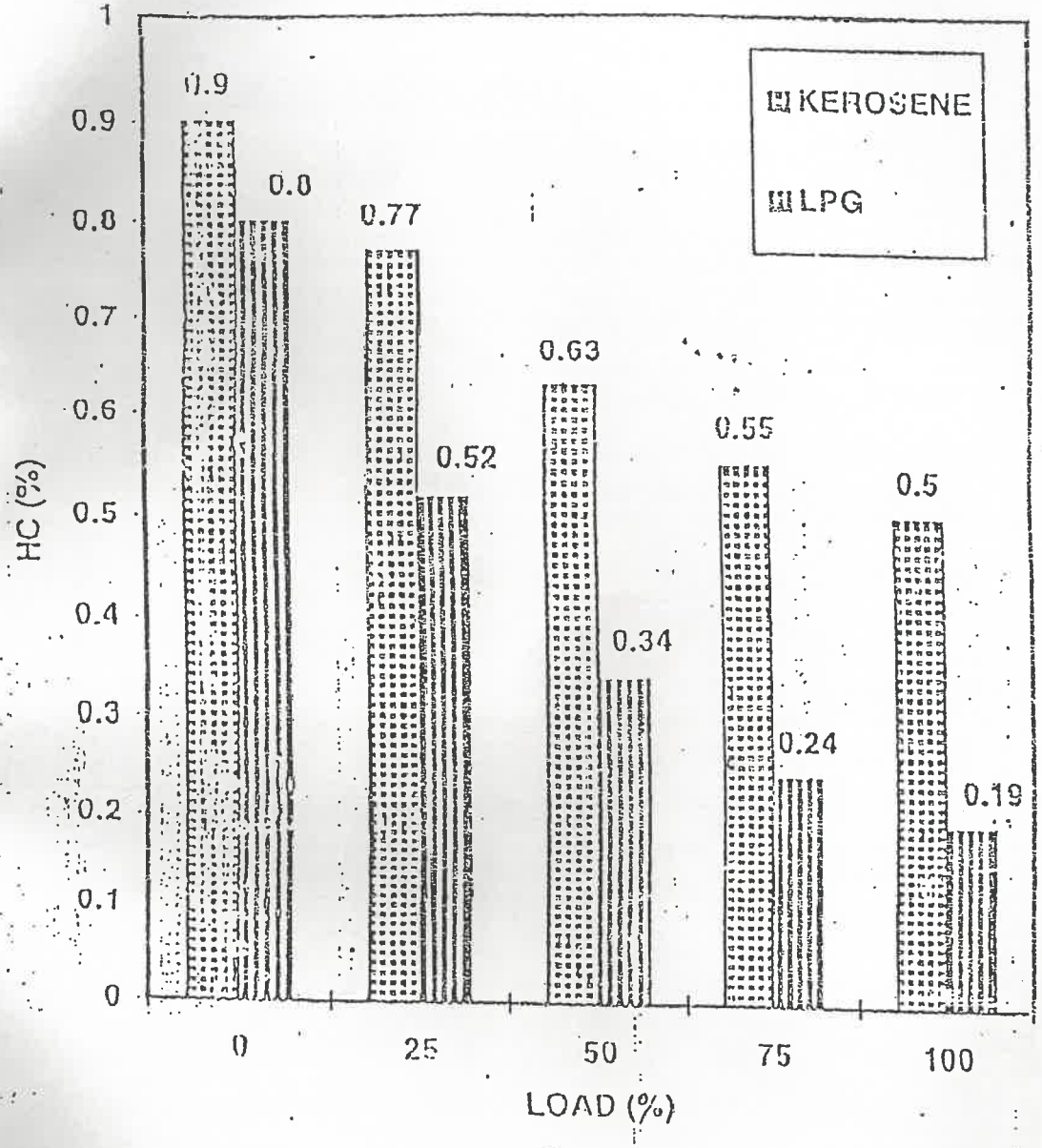

FIG. 2B

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INCOMING COURIER
SCANNED
K & S Partners
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