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Bok et al.

(54) DYNAMIC AGGRESSIVE/PASSIVE PEGGED TRADING

(76) Inventors: **Tomas Bok**, Concord, MA (US); **Jose E. Gutierrez**, Brooklyn, NY (US); **Sam Shteingart**, Brooklyn, NY (US)

Correspondence Address:
**ROTHWELL, FIGG, ERNST & MANBECK, P.C.**
**1425 K STREET, N.W.**
**SUITE 800**
**WASHINGTON, DC 20005 (US)**

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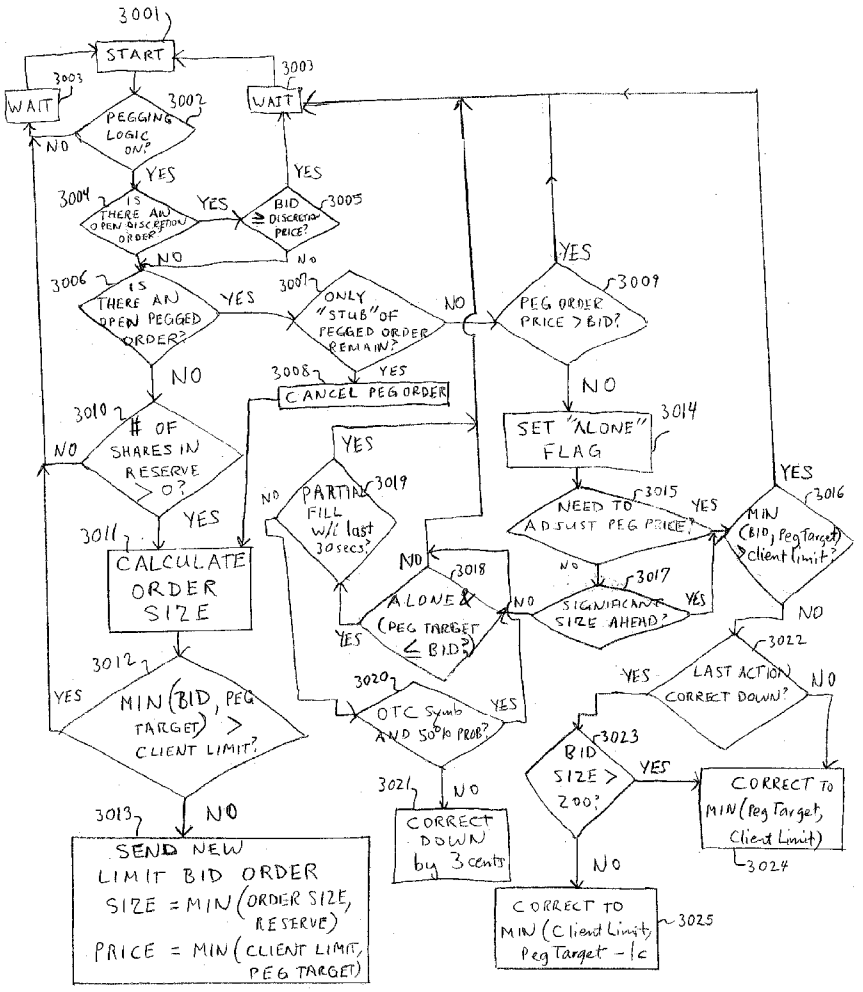
(57) **ABSTRACT**

A computer-implemented system and method for executing trades of financial securities according to a combination passive/aggressive trading strategy that reliably executes trades of lists of securities or blocks of a single security within a desired time frame while taking advantage of dynamic market movement to realize price improvement for the trade within the desired time frame. A passive trading agent executes trades at advantageous prices by floating portions of the order at the bid or ask to maximize exposure to the inside market and attract market orders. An aggressive agent opportunistically takes liquidity as it arises, setting discretionary prices in accordance with historical trading data of the specified security.



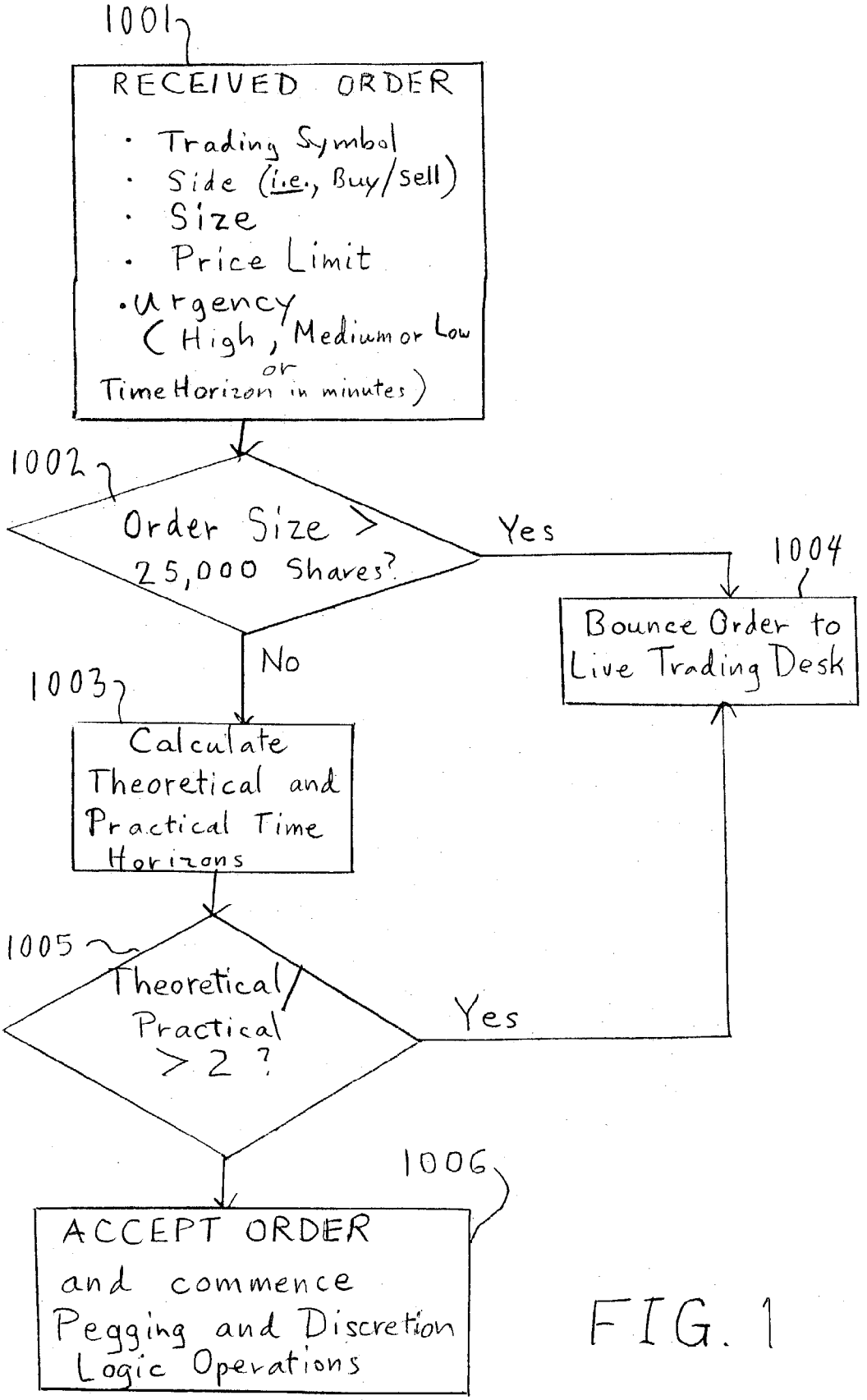

1001
RECEIVED ORDER
· Trading Symbol
· Side (i.e., Buy/sell)
· Size
· Price Limit
· Urgency
(High, Medium or Low
or
Time Horizon in minutes)
1002
Order Size > 25,000 Shares?
Yes
No
1004
Bounce Order to Live Trading Desk
1003
Calculate Theoretical and Practical Time Horizons
1005
Theoretical/Practical > 2 ?
Yes
1006
ACCEPT ORDER and commence Pegging and Discretion Logic Operations

FIG. 1

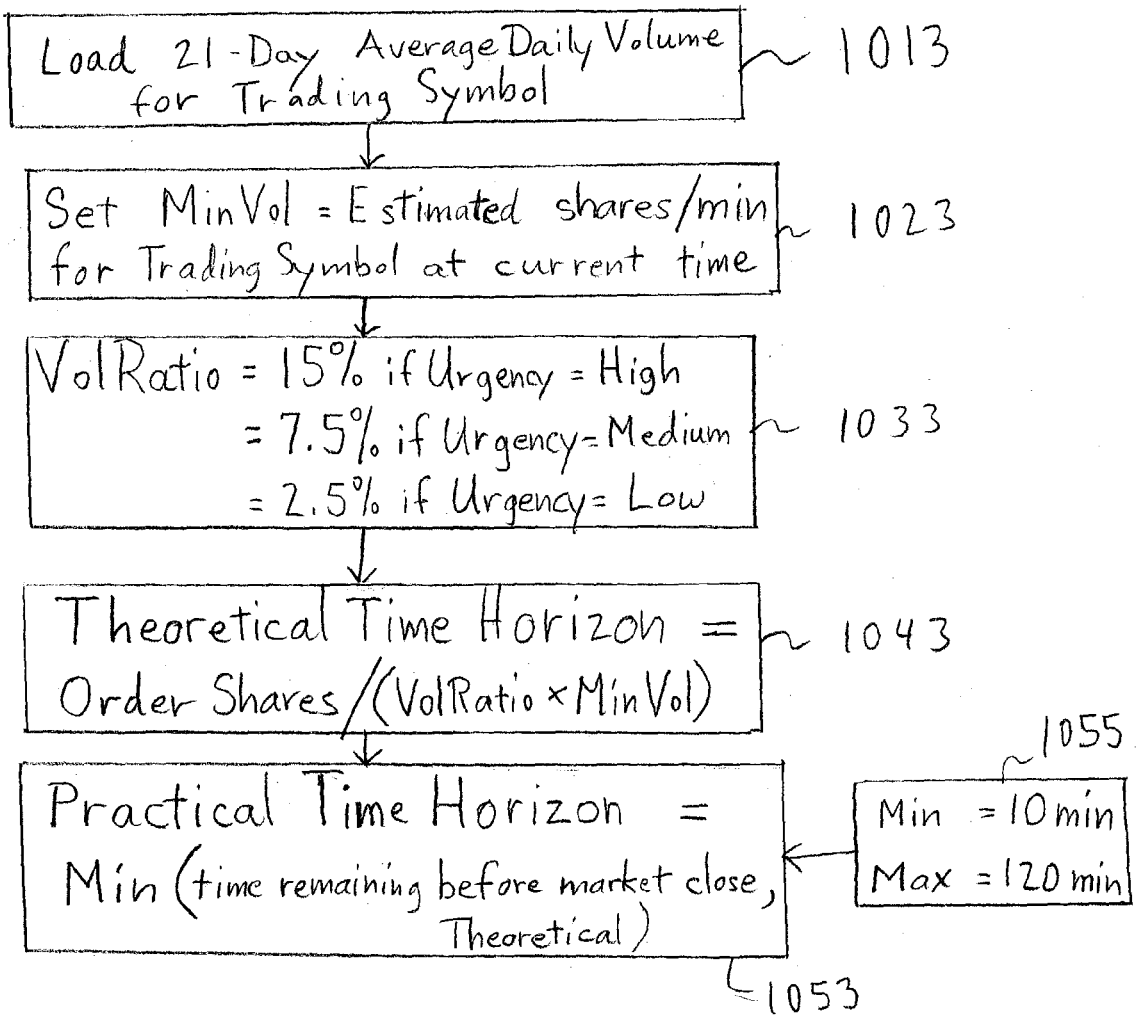

Load 21-Day Average Daily Volume for Trading Symbol
1013
Set MinVol = Estimated shares/min for Trading Symbol at current time
1023
VolRatio = 15% if Urgency = High
= 7.5% if Urgency = Medium
= 2.5% if Urgency = Low
1033
Theoretical Time Horizon = Order Shares/(VolRatio × MinVol)
1043
1055
Min = 10 min
Max = 120 min
Practical Time Horizon = Min (time remaining before market close, Theoretical)
1053

FIG. 2

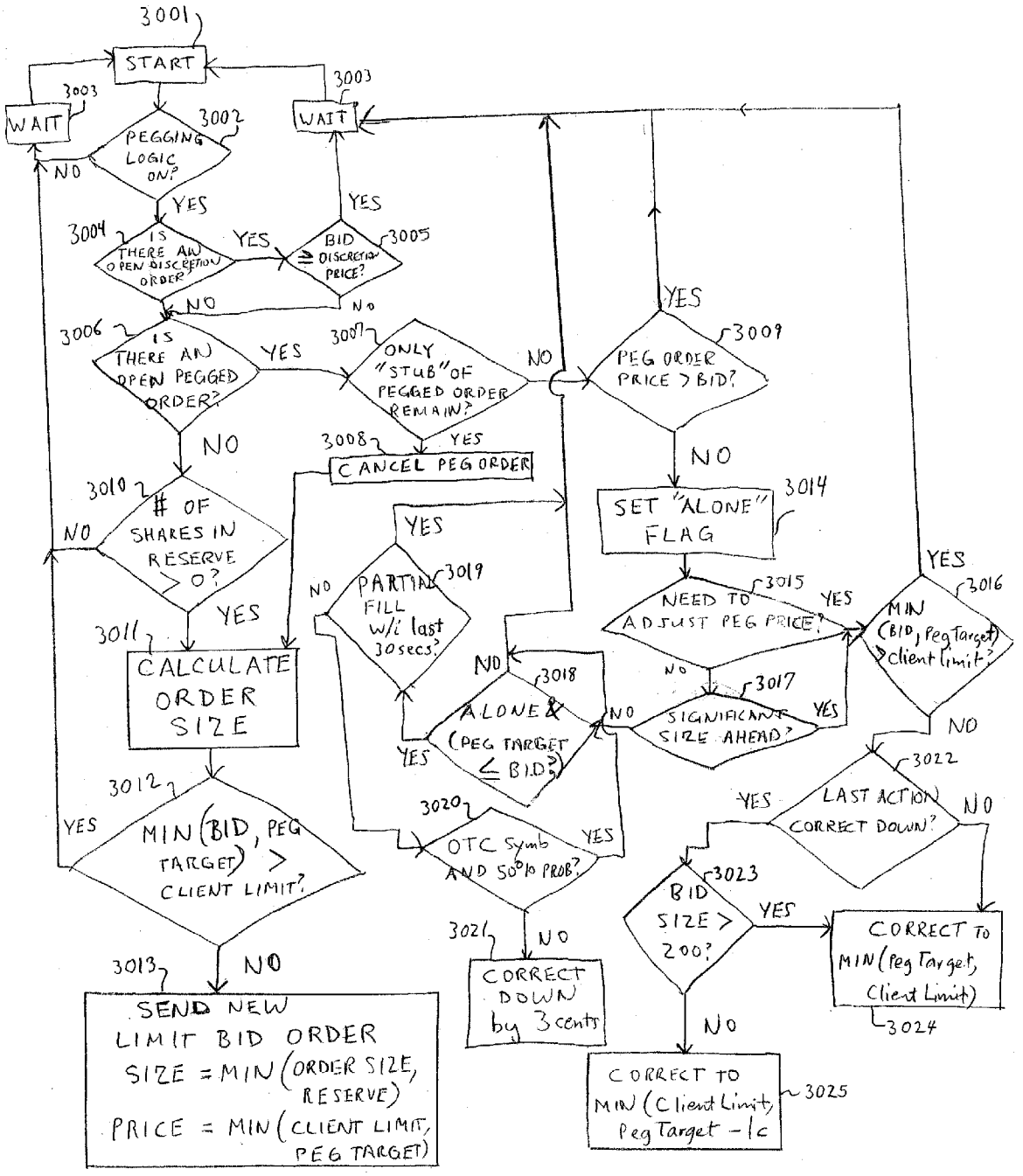

3001
START
3003
WAIT
3002
PEGGING LOGIC ON?
NO
YES
3004
IS THERE AN OPEN DISCRETION ORDER
YES
3005
BID ≥ DISCRETION PRICE?
NO
3006
IS THERE AN OPEN PEGGED ORDER?
YES
3007
ONLY "STUB" OF PEGGED ORDER REMAIN?
NO
YES
3008
CANCEL PEG ORDER
3009
PEG ORDER PRICE > BID?
3010
# OF SHARES IN RESERVE > 0?
3011
CALCULATE ORDER SIZE
3012
MIN (BID, PEG TARGET) > CLIENT LIMIT?
3013
SEND NEW LIMIT BID ORDER
SIZE = MIN (ORDER SIZE, RESERVE)
PRICE = MIN (CLIENT LIMIT, PEG TARGET)
3014
SET "ALONE" FLAG
3015
NEED TO ADJUST PEG PRICE?
3016
MIN (BID, Peg Target) > client limit?
3017
SIGNIFICANT SIZE AHEAD?
3018
ALONE & (PEG TARGET ≤ BID?)
3019
PARTIAL FILL w/i last 30secs?
3020
OTC Symb AND 50% PROB?
3021
CORRECT DOWN by 3 cents
3022
LAST ACTION CORRECT DOWN?
3023
BID SIZE > 200?
3024
CORRECT TO MIN (Peg Target, Client Limit)
3025
CORRECT TO MIN (Client Limit, Peg Target - 1c

FIG. 3

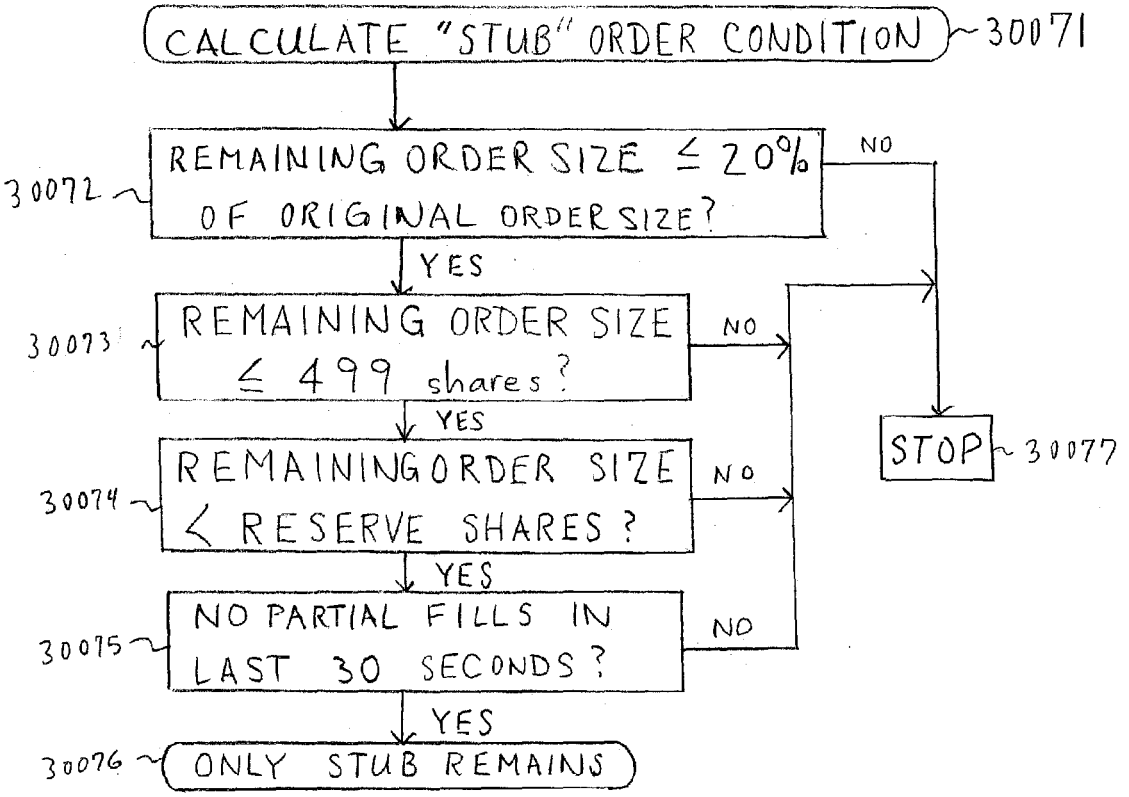

CALCULATE "STUB" ORDER CONDITION
30071
REMAINING ORDER SIZE ≤ 20% OF ORIGINAL ORDER SIZE?
30072
NO
YES
REMAINING ORDER SIZE ≤ 499 shares?
30073
NO
YES
REMAINING ORDER SIZE < RESERVE SHARES?
30074
NO
YES
NO PARTIAL FILLS IN LAST 30 SECONDS?
30075
NO
YES
ONLY STUB REMAINS
30076
STOP
30077

FIG. 4

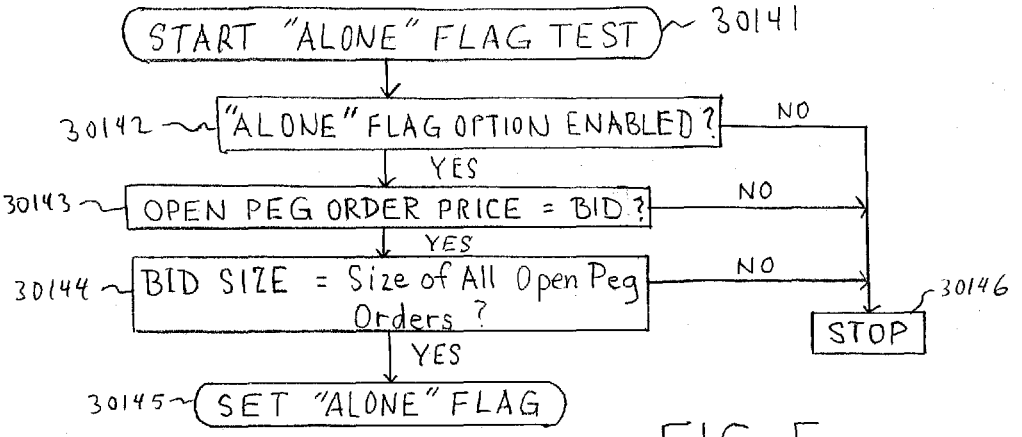

START "ALONE" FLAG TEST
30141
30142
"ALONE" FLAG OPTION ENABLED?
NO
YES
30143
OPEN PEG ORDER PRICE = BID?
NO
YES
30144
BID SIZE = Size of All Open Peg Orders ?
NO
30146
STOP
YES
30145
SET "ALONE" FLAG

FIG. 5

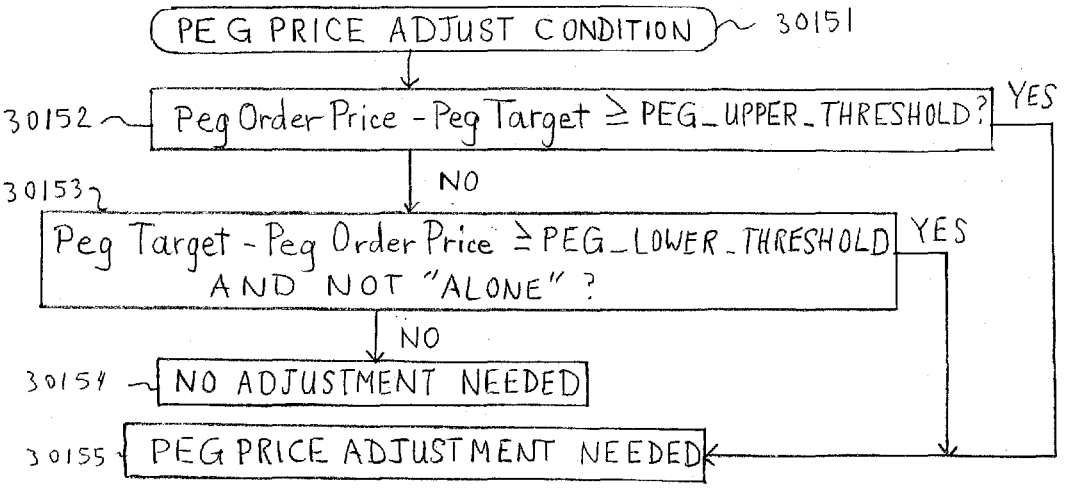

PEG PRICE ADJUST CONDITION
30151
30152
Peg Order Price - Peg Target ≥ PEG_UPPER_THRESHOLD?
YES
NO
30153
Peg Target - Peg Order Price ≥ PEG_LOWER_THRESHOLD AND NOT "ALONE"?
YES
NO
30154
NO ADJUSTMENT NEEDED
30155
PEG PRICE ADJUSTMENT NEEDED

FIG. 6

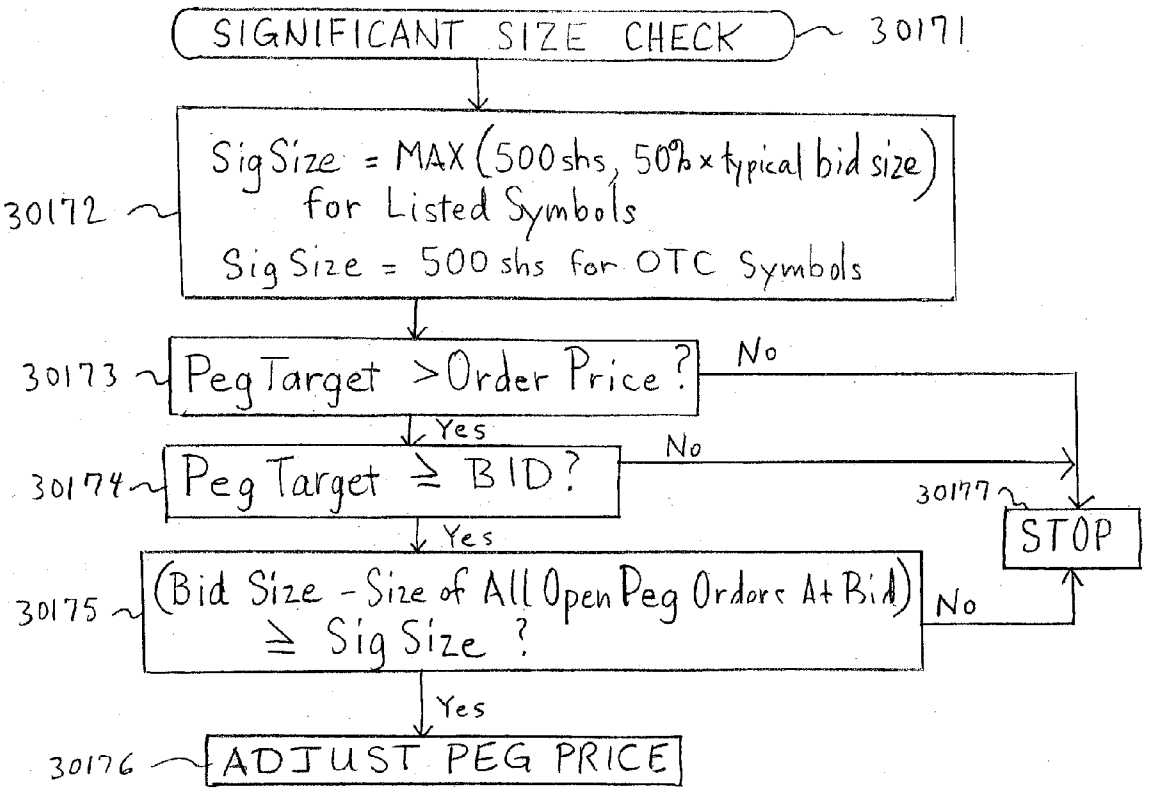

SIGNIFICANT SIZE CHECK
30171
SigSize = MAX (500 shs, 50% x typical bid size) for Listed Symbols
SigSize = 500 shs for OTC Symbols
30172
30173
PegTarget > Order Price ?
No
Yes
30174
Peg Target ≥ BID ?
No
30177
STOP
Yes
30175
(Bid Size - Size of All Open Peg Orders At Bid) ≥ Sig Size ?
No
Yes
30176
ADJUST PEG PRICE

FIG. 7

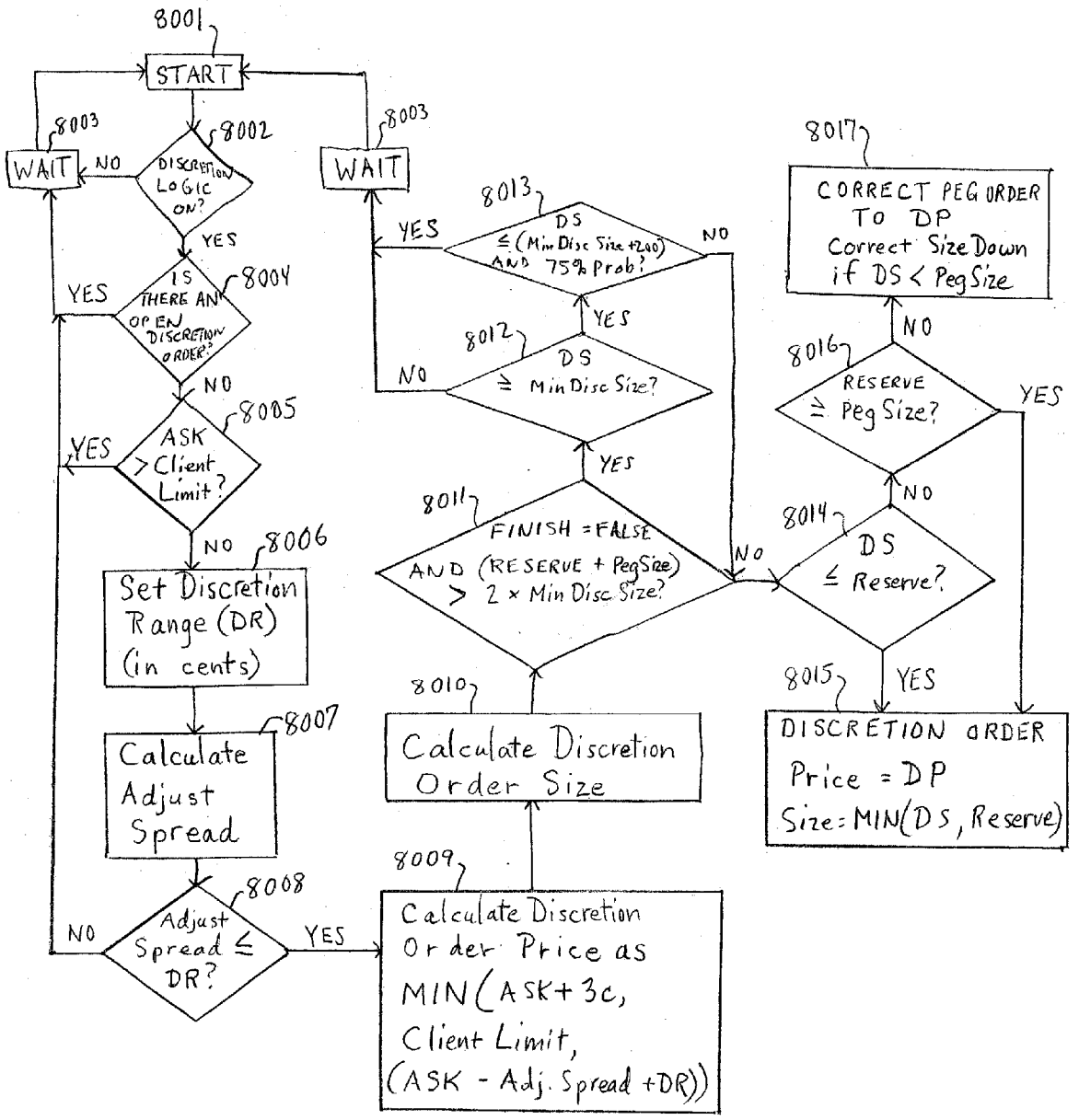

8001
START
8002
DISCRETION LOGIC ON?
NO
8003
WAIT
YES
8004
IS THERE AN OPEN DISCRETION ORDER?
YES
NO
8005
ASK > Client Limit?
YES
NO
8006
Set Discretion Range (DR) (in cents)
8007
Calculate Adjust Spread
8008
Adjust Spread ≤ DR?
NO
YES
8009
Calculate Discretion Order Price as MIN(ASK+3c, Client Limit, (ASK - Adj. Spread +DR))
8010
Calculate Discretion Order Size
8011
FINISH = FALSE AND (RESERVE + PegSize) > 2 × Min Disc Size?
YES
NO
8012
DS ≥ Min Disc Size?
YES
NO
8013
DS ≤ (Min Disc Size +200) AND 75% Prob?
YES
NO
8014
DS ≤ Reserve?
YES
NO
8015
DISCRETION ORDER
Price = DP
Size = MIN(DS, Reserve)
8016
RESERVE ≥ Peg Size?
YES
NO
8017
CORRECT PEG ORDER TO DP
Correct Size Down if DS < PegSize

FIG. 8

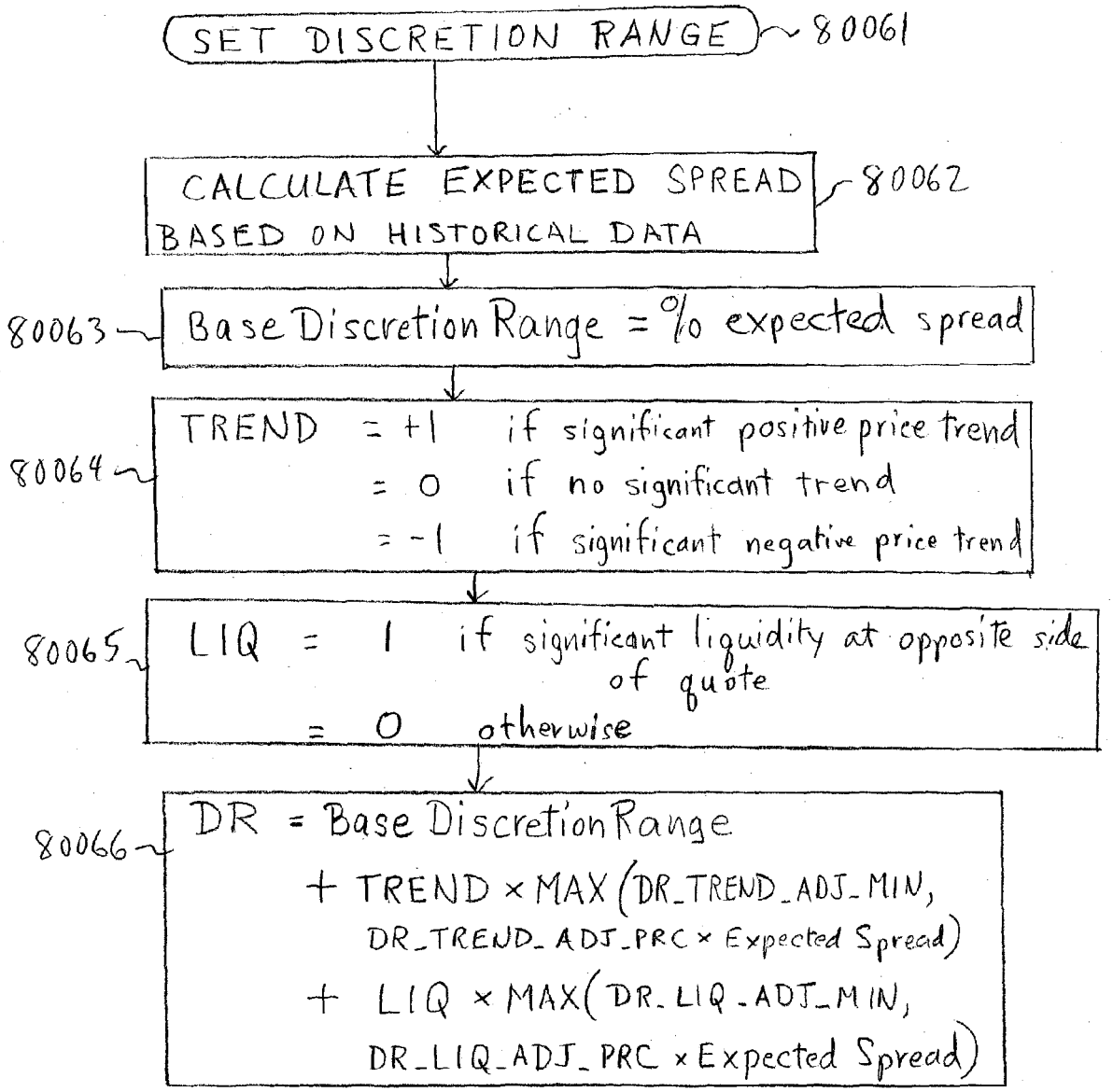

SET DISCRETION RANGE
80061
CALCULATE EXPECTED SPREAD BASED ON HISTORICAL DATA
80062
80063
Base Discretion Range = % expected spread
80064
TREND = +1 if significant positive price trend
= 0 if no significant trend
= -1 if significant negative price trend
80065
LIQ = 1 if significant liquidity at opposite side of quote
= 0 otherwise
80066
DR = Base Discretion Range
+ TREND × MAX (DR_TREND_ADJ_MIN, DR_TREND_ADJ_PRC × Expected Spread)
+ LIQ × MAX (DR_LIQ_ADJ_MIN, DR_LIQ_ADJ_PRC × Expected Spread)

FIG. 9

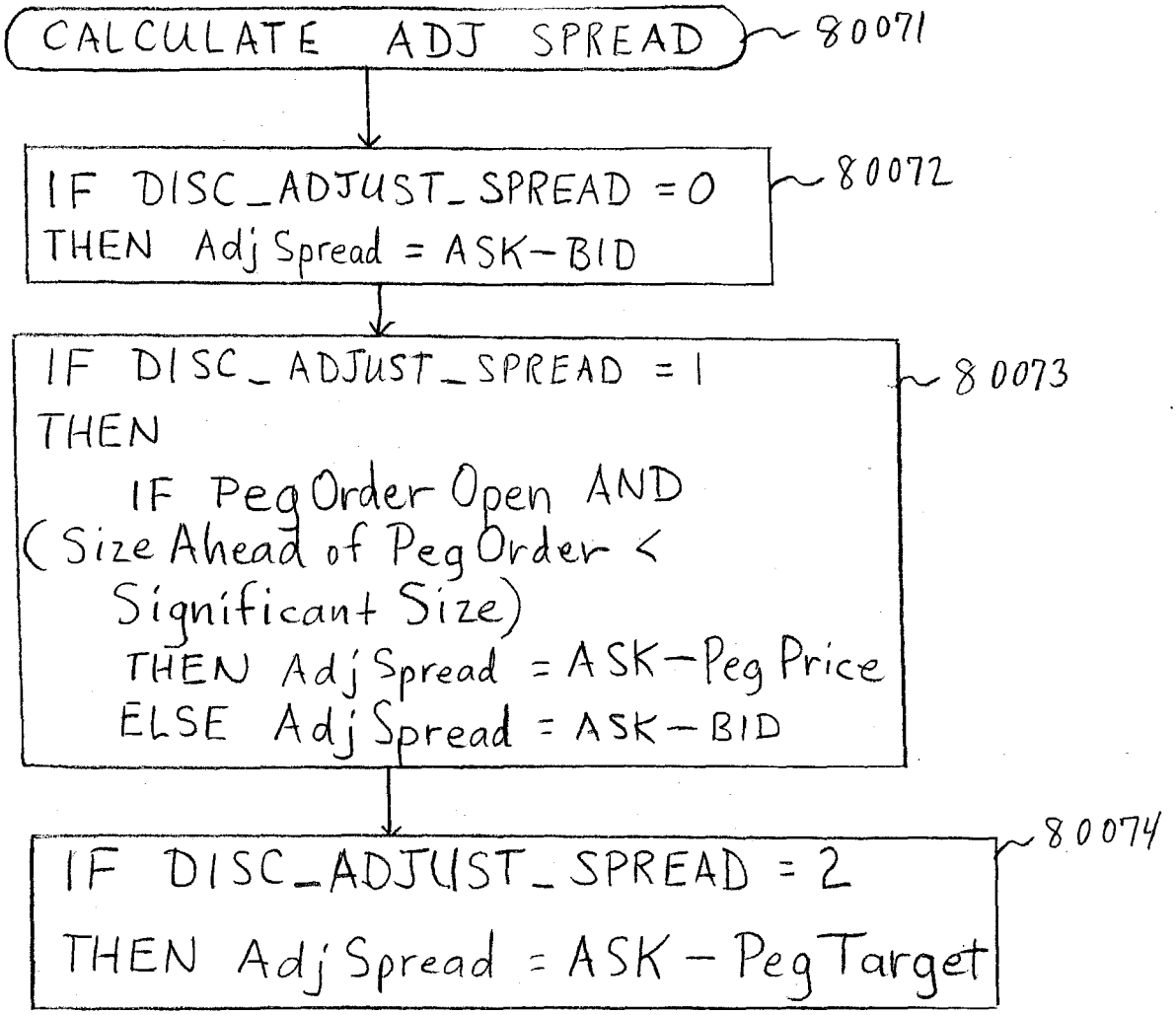

CALCULATE ADJ SPREAD
80071
IF DISC_ADJUST_SPREAD = 0
THEN Adj Spread = ASK−BID
80072
IF DISC_ADJUST_SPREAD = 1
THEN
IF PegOrder Open AND
(Size Ahead of PegOrder <
Significant Size)
THEN Adj Spread = ASK−Peg Price
ELSE Adj Spread = ASK−BID
80073
IF DISC_ADJUST_SPREAD = 2
THEN Adj Spread = ASK − PegTarget
80074

FIG. 10

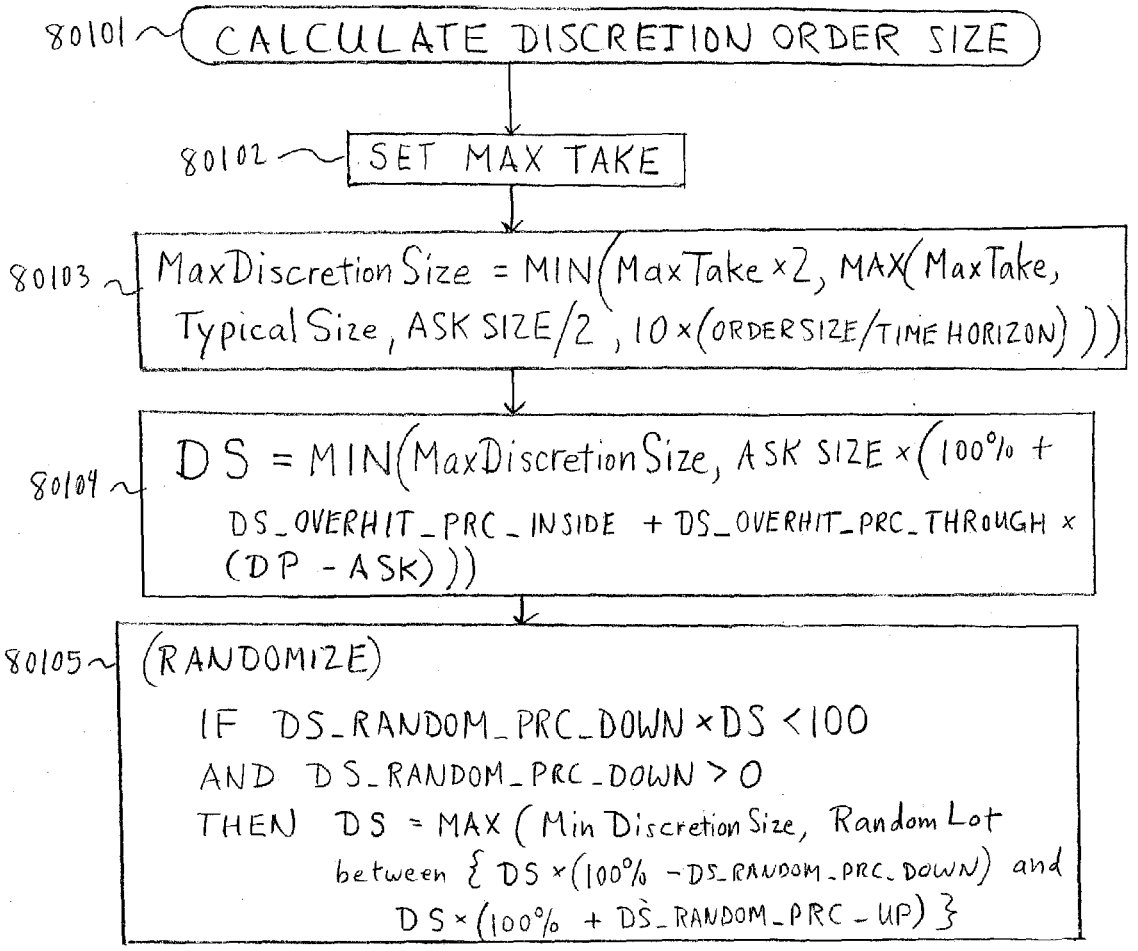

80101
CALCULATE DISCRETION ORDER SIZE
80102
SET MAX TAKE
80103
MaxDiscretionSize = MIN(MaxTake x 2, MAX(MaxTake, TypicalSize, ASK SIZE/2, 10 x (ORDERSIZE/TIME HORIZON)))
80104
DS = MIN(MaxDiscretionSize, ASK SIZE x (100% + DS_OVERHIT_PRC_INSIDE + DS_OVERHIT_PRC_THROUGH x (DP - ASK)))
80105
(RANDOMIZE)
IF DS_RANDOM_PRC_DOWN x DS < 100
AND DS_RANDOM_PRC_DOWN > 0
THEN DS = MAX (Min Discretion Size, Random Lot between { DS x (100% - DS_RANDOM_PRC_DOWN) and DS x (100% + DS_RANDOM_PRC_UP) }

FIG. 11

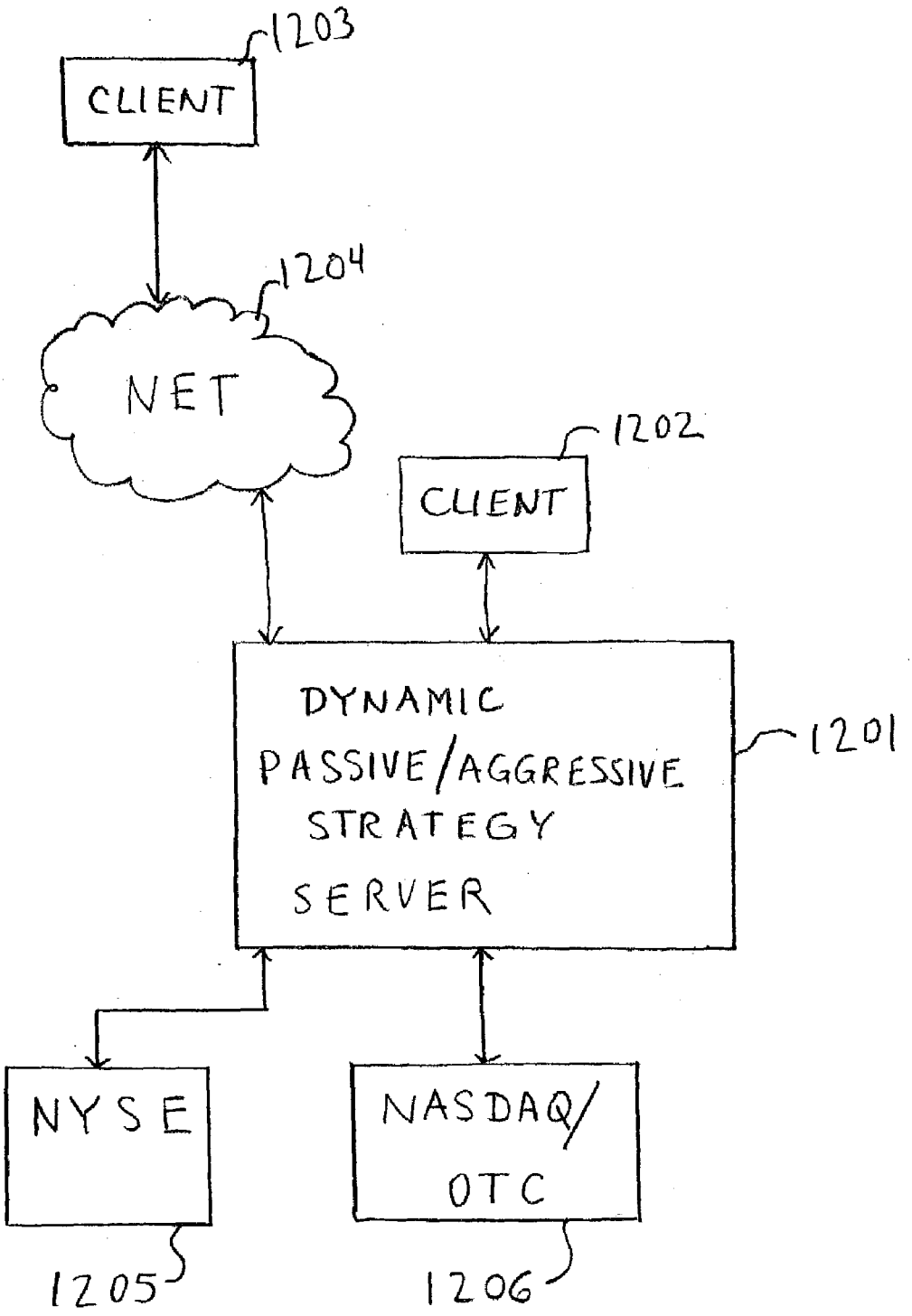

1203
CLIENT
1204
NET
1202
CLIENT
DYNAMIC
PASSIVE/AGGRESSIVE
STRATEGY
SERVER
1201
NYSE
NASDAQ/
OTC
1205
1206

FIG. 12

# DYNAMIC AGGRESSIVE/PASSIVE PEGGED TRADING

## FIELD OF THE INVENTION

[0001] This invention relates generally to securities markets. Particularly, the invention relates to a system and method for executing trades of financial securities according to a combination passive/aggressive trading strategy that reliably executes trades of lists of securities or blocks of a single security within a desired time frame while taking advantage of dynamic market movement to realize price improvement for the trade along with completion within the desired time frame.

## BACKGROUND OF INVENTION

[0002] A securities trading mechanism can be thought of as a set of protocols that translate the investors latent demands into realized prices and quantities. Various automated trading systems are known, which execute so-called "program" trading strategies in response to market movements.

[0003] Any trading strategy can be classified as passive or aggressive, or a combination of both. Passive trading strategies rely on the use of limit orders. For instance, if an investor wishes to buy (sell) 1,000 shares of XYZ Company, the investor may specify a maximum (minimum) price at which she is willing to buy (sell). This price is known as the limit price, and the order will remain pending until a counter party agrees to trade shares with her at this price. Typically traders will set the limit price to be at or below the current bid price for buy orders, and at or above the current offer price for sell orders. In these cases, the investor passively waits for the market to move in her favor and for her limit price to be accepted by a counter party. Such an approach gives the trader total control over her execution price, but no control over when, if ever, her order will execute. Thus passive strategies are not consonant with a requirement of immediacy or with a requirement that trading of all shares be completed within a given time "horizon" or period of time.

[0004] Market orders (or limit orders with marketable prices, such as a buy order with limit price equal to or above the current ask) are the building blocks of an aggressive strategy. A market order allows the trader to receive an immediate execution, but the trader loses control over the execution price. Large market orders pose a unique problem because there may not be enough interest at the quoted market price to satisfy the complete order size. In this case, the execution may result in substantial market impact: a worsening of the execution price relative to the current quoted market price. For example, the lowest current sell offer for ABC Company may be $10 with 400 shares for sale at that price. A market order to buy 100 shares is likely to execute at $10 exactly, but a larger market order for 10,000 shares may execute at an average price of $10.25, which is significantly higher than the current quote at the time the order was entered. The trader who submits such a market order has paid a substantial premium for the right to execute immediately.

[0005] Large institutional investors such as mutual funds, hedge funds, etc. face a dilemma. On the one hand, they are trading large blocks of stock and cannot afford to send large market orders that will result in market impact and inferior execution prices. On the other hand, they require a certain degree of immediacy to complete their trades within a defined time horizon. Thus neither a purely passive or purely aggressive approach is appropriate for institutional traders. This leads them to seek out compromise strategies that use a blended passive-aggressive approach.

[0006] One such strategy in the prior art is a pegged order. A pegged order, unlike a conventional limit order, automatically corrects its price according to movements in the quoted price. Typically a pegged buy order would be pegged to the bid, meaning that the order price is automatically adjusted to match the current quoted bid price. As counter parties (sellers) place market orders, those orders will execute first against the orders posted at the bid. By automatically maintaining an order price exactly at the bid, the pegged buy order is staying competitive relative to other passive buyers and therefore increasing the likelihood of an execution at a favorable price. Pegging is particularly useful in liquid stocks and fast-moving markets where quoted prices are continuously changing.

[0007] Another blended strategy is the discretion order. Discretion orders are basically just regular limit orders, except that they introduce a second limit price. This second price (called the discretion price) is the price at which the trader is willing to execute a trade aggressively. For example, consider a $10.00-$10.10 market, meaning that the current quoted bid is $10.00 and the current quoted offer or ask is $10.10. A trader issues a buy limit order at $10 with a $10.05 discretion price. This order will function as a normal limit order, posting the shares at $10, giving the order a chance of executing at a favorable $10 price if an aggressive seller agrees to sell at this price. But, if the current quoted offer price should ever fall to $10.05 or less, the order will automatically convert to an aggressive order at $10.05. With a discretion order, the trader maintains all of the benefits of a regular limit order (the ability to control execution price and the possibility of saving 10 cents relative to the likely execution price of a market order) but with an increased likelihood of execution. It is a selectively aggressive strategy in that it trades aggressively only when it is cheapest to do so, i.e. when spreads (the difference between the bid and ask) are narrow.

[0008] Pegging and discretion can be combined to make a third blended strategy. For example, our trader could issue a buy order pegged to the bid with a 5 cent discretion range. This automatically adjusts the order price so that it always is equal to the current bid, and also automatically adjusts the discretion price so that it is always five cents above the current bid. Thus the order receives all of the pegging advantages (staying competitive with other passive buyers) with all of the discretion advantages (ability to selectively trade aggressively in order to increase the probability of execution).

[0009] One way to think about a pegging-with-discretion strategy is that the order is being traded by two independent trading agents. A passive agent maintains an open limit order and automatically adjusts its limit price to match movements in the market. An aggressive agent watches the width of the spread and trades aggressively whenever the spread is narrow. The passive agent is constantly trying to "earn the spread" by attracting market orders from counter parties. The aggressive agent is waiting for opportunities to "pay the

spread" but only when it is least expensive to do so. The discretion range (the distance in cents between the limit price and the discretion price) is a measure of the aggressiveness of the strategy. If the discretion range is 0, then the aggressive agent will never trade a share, while if the discretion range is set very high then most if not all of the order will be traded by the aggressive agent.

[0010] The concept of the pegging-with-discretion strategy is potentially quite powerful, but the known embodiments of the pegging-with-discretion strategy have a number of drawbacks. First, a strategy of instantaneously adjusting the order price to match quote changes will contribute to momentum that disadvantages the order. For example, say that the current bid/ask for ABC Company is $10/$ 10. 10. Five buyers may place 1,000 share buy orders each pegged to the current bid. All of these orders thus are displayed with a $10.00 price. If a single day-trader submits a 100 share buy order at a $10.09 price, all five pegged buyers will immediately change their prices to $10.09 to match this new buyer. Any sellers watching the market may observe this sudden shift in demand, and may perceive this to be an indication of strong buying interest, in which case the sellers are likely to shift their asking prices higher accordingly. So a day-trader with a very small order has single-handedly moved the market by almost 1%. Moreover, since all five buyers are pegged to each other's bid price, these pegged buyers will never lower their price, only ratchet it higher.

[0011] A second drawback is the danger of a pegged strategy giving itself away. Using the example with the five buyers, anyone paying attention to this market is likely to notice the immediate, correlated movements of the five buyers, and it is not difficult to guess that these buyers are employing pegging strategies. This exposes the pegged strategies to exploitation by sellers. Any time a trader uses a systematic strategy for trading, it is imperative that she avoid tipping off other market participants to her strategy.

[0012] A third drawback of a pegging-with-discretion strategy is that discretion is cumbersome for traders to use appropriately. To be used effectively, a discretion range should be based on the current market conditions, the historical average bid-ask spread, and the trader's desired urgency for completing the order. The more stocks an investor is trading simultaneously, the more difficult it is to use discretion effectively since the discretion ranges must be set independently for each stock.

[0013] Fourth, the discretion range is static, and cannot respond to real-time changes in urgency. As described above, the discretion range is a measure of the aggressiveness of the strategy. It would be advantageous to adjust this discretion range based on the progress of the trade. Typically, a trader will have some notion of an expected time horizon associated with each trade: the expected time it will take for the market to absorb the full size of the trade, given the desired trading strategy. If a trade is progressing faster than expected, it would make sense to narrow the discretion range (i.e., to reduce the aggressiveness of the strategy), while it makes sense to increase the discretion range in cases where the trade progress is falling behind schedule. Since the known forms of discretion (or pegging-with-discretion) orders use a static discretion range, the only way to adjust the discretion range based on progress would be for the trader to make manual corrections. Again, this is cumbersome, particularly when the trader is working a large number of orders simultaneously.

[0014] Finally, the pegging, discretion, and pegging-with-discretion order types implemented by ECNs (Electronic Communication Networks) are fairly inflexible, with very limited ability for investors to tailor the strategies based on their individual trading style.

[0015] Thus there exists a need in the art for improvements to the known passive/aggressive blended trading strategies as implemented by the above pegging, discretion, and pegging-with-discretion strategies.

## SUMMARY OF THE INVENTION

[0016] The present invention provides a method and system for trading securities using a dynamic passive/aggressive trading strategy that delivers reliable execution over a pre-specified time horizon. The dynamic trading strategy uses two distinct automated trading agents working in tandem: a passive agent trades passively, floating portions of an order with the bid or offer to obtain favorable prices. An aggressive agent trades opportunistically, using carefully-timed orders at marketable prices to keep the overall trade on schedule.

[0017] In particular, the invention provides a computer-implemented method of implementing an order to trade on an exchange a specified number of shares of a specified security within a specified time horizon, including the steps of sending to the exchange a first partial order to trade the security having a peg order price, the peg order price being correlated to a current quote on the exchange for the same trading side as the order, and a peg size, the peg size being correlated to a size of the quote, the peg order price and peg size of said partial order further being modified according to the specified time horizon; and sending to the said exchange a second partial order to trade the security having a price set at a predetermined amount better than the current quote for the same side as the order, wherein the predetermined amount is automatically calculated based on historical trading data for the specified security and based on the ratio of order completion with respect to the specified time horizon.

[0018] According to another aspect of the invention, a computer-implemented system for implementing an order to trade on an exchange a specified number of shares of a specified security within a specified time horizon includes a server that receives the order over an electronic communication medium, and processes the order by using an automated passive trading agent which sends to the exchange a first partial order having a price correlated to a current quote on the exchange for the same trading side as the order, and having a size being correlated to a size of the quote, and by using an automated aggressive trading agent which calculates a discretion range based on historical trading data and the ratio of order completion with respect to the specified time horizon, and then sends to the exchange a second partial order priced equal to or better than the opposite side of the current quote, when the current bid-ask spread is less than the calculated discretion range.

[0019] The present invention will become more fully understood from the forthcoming detailed description of preferred embodiments read in conjunction with the accom-

panying drawings. Both the detailed description and the drawings are given by way of illustration only, and are not limitative of the present invention as claimed.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0020] **FIG. 1** is a flow diagram of a procedure for determining whether a received order is suitable for the active passive/aggressive trading strategy according to the present invention;

[0021] **FIG. 2** is a flow diagram of the steps involved in the time horizon calculation step of **FIG. 1**;

[0022] **FIG. 3** is a flow diagram of the dynamic Pegging agent strategy according to one preferred embodiment of the present invention;

[0023] **FIG. 4** is a flow diagram of the steps involved in the "stub order" calculation of **FIG. 3**;

[0024] **FIG. 5** is a flow diagram of the steps involved in the "alone flag" calculation of **FIG. 3**;

[0025] **FIG. 6** is a flow diagram of the steps involved in the peg order price adjustment calculation of **FIG. 3**;

[0026] **FIG. 7** is a flow diagram of the steps involved in the "significant size" calculation of **FIG. 3**;

[0027] **FIG. 8** is a flow diagram of the dynamic Discretion agent strategy according to one preferred embodiment of the present invention;

[0028] **FIG. 9** is a flow diagram of the steps involved in the discretion range calculation of **FIG. 8**;

[0029] **FIG. 10** is a flow diagram of the steps involved in the spread adjustment calculation of **FIG. 3**;

[0030] **FIG. 11** is a flow diagram of the steps involved in the discretion order size calculation of **FIG. 3**; and

[0031] **FIG. 12** is a block diagram of a system for implementing the processes shown in **FIGS. 1-11**.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0032] Prior to describing the invention, the following definitions of terms used hereinafter are provided:

[0033] BID=current national best quoted bid price across all markets that trade the symbol and publish electronic quotes

[0034] ASK=current national best quoted ask price across all markets that trade the symbol and publish electronic quotes

[0035] BID SIZE=current size quoted at BID, aggregated across all markets that trade the symbol and publish electronic quotes

[0036] ASK SIZE=current size quoted at ASK, aggregated across all markets that trade the symbol and publish electronic quotes

[0037] SPREAD=ASK−BID

[0038] MARKETABLE PRICE=ASK for buy orders, =BID for sell orders

[0039] SAME SIDE DEPTH=BID SIZE for buy orders, =ASK SIZE for sell orders

[0040] OPPOSITE SIDE DEPTH=ASK SIZE for buy orders, =BID SIZE for sell orders

[0041] MORE AGGRESSIVE: for buy orders, price x is 'more aggressive' than price y if x>y. For sell orders, price x is 'more aggressive' than price y if x<y.

[0042] MORE PASSIVE: for buy orders, price x is 'more passive than price y if x<y. For sell orders, price x is ' more passive than price y if x>y.

[0043] DEPTH AHEAD: The depth ahead of an order is the current aggregated quoted size at all price levels MORE AGGRESSIVE than the order price, counting only quoted size on the same side (buy or sell) of the market.

[0044] ALONE AT THE INSIDE MARKET: an order is ALONE at the inside market if the order price=the BID (buy orders) or ASK (sell orders) and SAME SIDE DEPTH=order size.

[0045] The present invention involves several improvements to the known pegging-with-discretion order type as described above. Like the pegging-with-discretion strategy, the invention uses two automated trading agents to trade the order, one of which is passive and one of which is aggressive. In place of the known pegging strategy, the passive agent uses an enhanced form of pegging that avoids contributing to adverse price momentum, and also disguises its behavior to avoid exposing the automated nature of the strategy to other market participants. The passive agent achieves the objective of maintaining a competitive order at the inside market without the negative consequences associated with the conventional simple pegging strategy. The aggressive agent also has a number of important enhancements. The discretion range (the key measure of aggressiveness for the order) is automatically set to an appropriate level (given historical analysis of the trading symbol) and this range is then automatically adjusted dynamically throughout the lifespan of the order. As shares fill, as time elapses, and as market conditions change in real time, the invention automatically and continuously adjusts the discretion range according to urgency. The aggressive agent's responsibility is to keep the trade on schedule and to minimize risk. If the passive agent has been successful at achieving fills at advantageous prices then the aggressive agent will play a limited role during the trade; but if the passive agent has not been successful and the trade is falling behind schedule, then the aggressive agent intervenes to ensure that the trade will complete on time.

[0046] The passive and aggressive agents are combined together in a computer server to provide a complete order type that delivers the power of the passive-aggressive trading approach in a convenient package. Instead of requiring traders to manually set all order parameters associated with pegging and discretion, this combined order type requires only an urgency score (such as for example "high,""medium" or "low") or a specific time horizon for completion of the order. Given the urgency allocated to each order, the two automated trading agents work together to execute the order.

[0047] As shown in **FIG. 12**, the trading strategy is implemented by a server **1201**, which is in communication

with various exchanges, such as the New York Stock Exchange **1205**, the NASDAQ/OTC market **1206**, and other like markets/exchanges. A client **1202** is composed of a PC, workstation or similar device, and may be directed coupled to the server **1201**; other clients, such as client **1203**, are coupled to the server **1201** through a distributed communication network **1204**, which may be the Internet, a Wide Area Network (WAN), a Local Area Network (LAN), or any other similar type of communication network.

[**0048**] Referring now to **FIG. 1**, the novel trading strategy according to the present invention will be described in detail. At step **1001**, an order is received by the server over a communication medium. The order includes a number of parameters including identification of the stock by its trading symbol, the "side" of the trade (i.e., buy or sell), the size of the trade in terms of the number of shares or units of the stock, the price limit, and an indicated "urgency" of the trade. The price limit is optional, and allows the client to specify the maximum/minimum price at which the client is willing to buy/sell the security. The urgency parameter may be submitted either as an urgency level (such as High, Medium or Low) or as a specific time horizon (e.g. 60 minutes) within which the trade is to be completed. The user of the system thus does not have to specify any complicated parameters when submitting the order, but instead needs only to specify the trading names or symbols, side of the trade, size of the trade, price limit (if any) and either urgency or time horizon. Hereinafter, such an order will be referred to as a client order.

[**0049**] At step **1002**, the client order size is compared with a preset variable labeled "INIT_MAX_ORDER_SIZE". The value of this variable determines the largest size order that the server will accept. A default value is set at 25,000 shares. If the received order size is greater than the preset value, then the process branches to step **1004**. At step **1004**, if a variable labeled "INIT_REJECT_OVERSIZED" is set to TRUE, the oversized order will be rejected and sent back to the client. If the variable is set to FALSE, then the oversized order will be bounced to a trading desk for handling by a live trading specialist.

[**0050**] If the order is not oversized, then at step **1003** theoretical and practical time horizons are calculated. The detailed steps involved in these calculations are shown in **FIG. 2**. At step **1013**, the 21-day Average Daily Volume for the specified trading symbol is loaded from a database. The 21-day ADV includes the average daily volume broken down by hour of day.

[**0051**] At step **1023**, the variable MinVol is set to be equal to the estimated number of shares per minute traded for the given trading symbol at the current time, based on the data received for the 21-day ADV. At step **1033**, the variable VolRatio is set in accordance with the received Urgency parameter. VolRatio represents the desired ratio of shares traded by the server to expected shares traded on the market by others, over the indicated time horizon for the order. This initial ratio is set to 15% if the Urgency entered by the client is High, 7.5% if the Urgency is Medium, and 2.5% if the Urgency is Low.

[**0052**] At step **1043**, a Theoretical Time Horizon is calculated to be equal to the number of shares in the order, divided by the product of VolRatio and MinVol. For example, if the number of shares specified in the order is 10,000 and the indicated urgency is High, and the MinVol is determined to be 500 shares per minute, then the Theoretical Time Horizon would be equal to 10,000/(0.15×500) 134 minutes to complete the trade.

[**0053**] At step **1053**, a Practical Time Horizon is calculated to be equal to the minimum of the time remaining before market close, or the Theoretical Time Horizon. For example, if the current time is 12:00 p.m., then the time remaining before market close is four hours (240 minutes). In this case, the Practical Time Horizon would be tentatively set to be equal to the determined Theoretical Time Horizon, since that variable is less than the time remaining before market close. However, minimum and maximum values are set for the Practical Time Horizon as shown in step **1055**. In the example, the default values are 10 minutes and 120 minutes, respectively. Other default values may be chosen in accordance with "fine-tuning" of the strategy. Thus, since the tentatively calculated Practical Time Horizon exceeds the default maximum, it is set to the default maximum of 120 minutes in the example. In the case where the client enters the Urgency parameter as a time horizon in minutes, then the theoretical time horizon would be set to be equal to the time horizon entered by the client.

[**0054**] Referring back to **FIG. 1**, at step **1005** it is next determined whether the Theoretical Time Horizon is greater than twice the Practical Time Horizon. If so, it is determined that there is insufficient time left before the close of market for the server to complete the order, and the order will be forwarded to the live trading desk at step **1004**. In the example, the Theoretical Time Horizon is only 1.12 times the Practical Time Horizon, the order is acceptable for processing by the server, and the process advances to step **1006** for commencement of pegging and discretion logic operations.

[**0055**] **FIG. 3** illustrates a flow diagram of the pegging logic according to one preferred embodiment of the invention. The process is explained using the example of a buy order. For a sell order, the logic would be the same, except the calculations regarding bid/ask values would be reversed. The process is started at step **3001**, upon acceptance of an order processed according to **FIG. 1**. At step **3002**, the value of a variable PEG_ON is checked to determine whether the pegging logic has been disabled. The default value is YES, and this parameter can be set to NO, to thereby disable the pegging agent. If the pegging logic is disabled, the pegging portion of the algorithm does not run. The process waits a predetermined amount of time at step **3003** (such as 15-35 seconds) and restarts. The peg interval is computed for each trading symbol and can be set differently based on whether the trading symbol is a liquid or illiquid security (based on the market in which the symbol trades and a predetermined cutoff, such as 1 million shares per day average volume). A randomization factor also may be added to this interval to mask the automated nature of the trading algorithm.

[**0056**] Assuming the pegging logic is enabled, at step **3004** it is determined whether there is an outstanding open discretion order (logic discussed below). The discretion logic is run upon arrival of the accepted client order, and thereafter only as scheduled. If an open discretion order exists, then at step **3005** it is determined whether the current bid is greater than or equal to the discretion order price. If so, the process waits at step **3003** and restarts after the

predetermined period of time has elapsed. This allows the open discretion order time to execute.

[0057] If the current bid is less than the discretion order price, this means that the discretion order is out in front of the best bid and thus should be executed substantially immediately, and thus is treated as if there is no open discretion order. If the current bid is less than the discretion order price, or no open discretion order exists, then at step **3006** it is determined whether there exists an open pegged order. If no open pegged order exists, then at step **3010** it is determined whether the number of shares in reserve is greater than zero. The reserve shares are the unfilled and unsent shares of the client order allocated to be traded.

[0058] In this regard, a limitation may be imposed on the speed of trading to prevent the algorithm from trading too many shares too soon. This limitation is set by specifying a value of a variable labeled "INIT_TRADE_FAST". The default value is set to 100%. This means that no limitation is imposed on the speed of trading. The default value can be changed to be between 0% and 100%. If the variable is set to less than 100%, trading can be slowed down to avoid getting too far ahead of schedule. For example, if it is desired not to allow trading to get ahead of schedule at all, "NIT_TRADE_FAST" would be set to 0%. The reserve shares are calculated as Target Size×MIN(100%, (Elapsed Time/Time Horizon+INIT_TRADE_FAST)) less any shares that have already filled or that have been sent and are currently outstanding. The Target Size is the client order size. Thus, if INIT_TRADE_FAST=0% and 30 minutes have elapsed in a 120 minute horizon, then the reserve shares would be calculated to be Target Size×(30/120+0%)= Target Size×25%. In this instance, the algorithm constrains itself to have no more than 25% of the client order sent (or completed).

[0059] If the reserve shares as calculated are zero, the process waits at step **3003** and then restarts at the predetermined time interval. If the reserve shares are greater than zero, then a new peg order is built. At step **3011** the peg order size is calculated. First, a base order size is determined with the objective of blending into the current market without attracting attention from other participants . For listed trading symbols, the base order size default is ⅔ the typical (i.e. historical average) bid size, subject to a base size floor (such as 500 shares) and a base size ceiling (such as 10,000 shares). For OTC symbols, the base order size is calculated to be equal to MIN(Target Size×25%, 20×(Target Size/Time Horizon)), subject to the same base size floor and ceiling constraints. The 25% factor represents an OTC target variable, and the 20 factor represents an OTC minutes variable. The calculated base size then can be randomized by adding or subtracting a predetermined percentage of the base size from the calculated base size.

[0060] The process then advances to step **3012**, wherein it is determined whether the minimum of the current bid or peg target price is greater than the limit price specified by the client. If this is the case, the process returns to step **3003** to wait for the elapsed time interval to restart. Otherwise, a new limit bid order is sent (assuming that the calculated size of the peg order is greater than zero), where the size of the peg order is the minimum of the calculated peg order size or the reserve shares, and the price is the minimum of the client limit price or the peg target. Initially, the peg target price is assumed to be the bid; however the peg target may be dynamically calculated to implement one of a family of different strategies. For example, the peg target may be the midpoint between bid and ask, or be opportunistically set in front of the best bid.

[0061] If it is determined at step **3006** that an open pegged order exists, then at step **3007** it is determined whether it is only a "stub" of the original peg order size. A "stub" order results when a previously-issued peg order has been almost but not completely filled, leaving only a small "stub" of the original peg order still open. As shown in **FIG. 4**, at step **30071** the stub order calculation is initiated. At step **30072** it is determined whether the remaining peg order size (after partial fills) is less than or equal to 20% of the original peg order size. If not, more than a stub remains, and the calculation is stopped at step **30077**. If so, then at step **30073** it is determined whether the remaining peg order size is less than 500 shares (less than or equal to 499 shares). If not, the calculation is stopped at step **30077**. If so, the process continues to step **30074** where it is determined whether the remaining peg order size is less than the reserve shares (as calculated using the INIT_TRADE_FAST variable factor). If not, the process ends at step **30077**. If so, at step **30075** it is determined whether any partial fills have occurred in the last 30 seconds. If so, the calculation is stopped at step **30077**, because if partial fills have recently occurred, the order will not be considered a "stub". If not, then it is determined that only a stub order remains, at step **30076**. It is noted that the 20% original order, 499 share, and 30 second partial fill parameters are adjustable variables and are set in advance of program execution.

[0062] If only a stub order remains, then at step **3008** the open peg order is cancelled, and a new peg order size is calculated at step **3011** (wherein the base order size may be randomly adjusted by a predetermined percentage). If it is determined that the open peg order is not a "stub" order, then at step **3009** it is determined whether the existing peg order price exceeds the current bid. If so, the process does nothing (as the result of the inference when existing peg order price exceeds current bid that the observed quotes are stale and have not yet been updated), advances to step **3003** to wait for the predetermined time interval to elapse and then restarts. If the peg order price does not exceed the current bid, then it is determined at step **3014** whether the peg order is "alone" on the market (i.e. there are no other orders at the peg order price (bid); in other words, the best bid equals the peg order price, and the size of the best bid equals the size of the peg order). The alone flag test is started at step **30141** as shown in **FIG. 5**.

[0063] At step **30142** it is determined whether the alone flag option is enabled. This is determined by checking the value of the variable labeled "ALONE_FLAG." The default value is TRUE. By setting the value to FALSE, the trading program never considers withdrawing when it is alone at the bid. Such a strategy would be needed, for example, where the peg target was set at ASK-N cents. If ALONE_FLAG is disabled, the routine ends at step **30146**. If enabled, at step **30143** it is determined whether the open peg order price is equal to the bid. If not, the peg order is not considered alone and the routine ends. If the open peg order price is equal to the bid, then at step **30144** it is determined whether the size of the bid is equal to the size of all the open peg orders on the server for all orders of the same side at the same price

for all customers. If so, the alone flag is set at step **30145**. If not, the flag is not set and the alone flag process ends at step **30146**.

[**0064**] The process then proceeds to step **3015** for determination of the need to adjust the peg order price. This calculation starts at step **30151** as shown in **FIG. 6**. At step **30152** it is determined whether the peg order price (e.g., the price of our outstanding peg order) minus the peg target price is greater than or equal to the PEG_UPPER_THRESHOLD, which defines the smallest distance between the peg order price and the peg target (where the peg order price is some distance above the peg target) wherein the order price would always be corrected. At step **30153** it is determined whether the peg target price minus the peg order price is greater than or equal to the PEG_LOWER_THRESHOLD, and the peg order is not "alone." If the peg target price minus the peg order price (where the peg order price is some distance below the peg target) is greater than or equal to the PEG_LOWER_THRESHOLD and the peg order is not alone, then an adjustment to the peg order price is needed. Otherwise, it is determined that no adjustment is needed. Similarly, if peg order price minus the peg target price is greater than or equal to the PEG_UPPER_THRESHOLD, then an adjustment to the peg order price is needed. The upper and lower threshold parameters have a default value of 2 cents. Thus, as a result of the adjustment determination, it is determined whether the pegged order priced at a deviation from the peg target (either positively or negatively) will be corrected.

[**0065**] If it is determined at step **3015** that no price adjustment is needed, then at step **3017** it is determined whether there exists a "significant size" order ahead of the peg order. The existence of a significant size ahead of the peg order will cause the pegged order to be corrected notwithstanding the fact that the pegged order is within the peg correction threshold amount (positive or negative) of the target price.

[**0066**] At step **30171** of **FIG. 7**, the process initiates a significant size check. At step **30172**, the SigSize variable is set to the maximum of 500 shares or 50% of the typical bid size for listed trading symbols, and for OTC trading symbols, SigSize is set to 500 shares. At step **30173**, it is determined whether the Peg Target is greater than the peg order price. If it is, the process advances to step **30174** to determine whether the Peg Target is greater than or equal to the current bid. If the Peg Target is not greater than the outstanding peg order price, and not greater or equal to the bid, then no price adjustment is needed, and the routine is stopped at step **30177**.

[**0067**] If at step **30174** it is determined that the Peg Target is greater than or equal to the current bid, then at step **30175** it is determined whether the size of the current bid minus the size of all open peg orders on the server at the bid is greater than the pre-set value of SigSize. If so, then peg order price adjustment is needed and at step **30176** processing advances to step **3016** (**FIG. 3**) for price adjustment as explained below.

[**0068**] If there is no significant size ahead of the open peg order, then at step **3018**, it is determined whether the "alone" flag is set and the Peg Target is less than or equal to the bid. If this condition is false, then the process returns to step **3003** to wait for expiration of the predetermined time interval to restart (the false result means that the peg order is either not alone at the bid, or that the peg order is alone but the peg target is intentionally set to be in front of the bid). If this condition is true, then at step **3019** it is determined whether any partial order fills have occurred within the last 30 seconds. The reasoning behind this logic is that when the peg order is alone at the inside market, correcting away may be desirable. However, no correcting away will be performed if recent partial fills have been received. A variable labeled "ALONE_TIME_CONDITION" is set to a value in seconds which defines what is considered "recent".

[**0069**] If no recent partial fills have been received, then at step **3020** it is determined whether the order is for an OTC trading symbol, and if so a random probability factor is used (default 50%) to decide whether to do nothing. The introduction of the probability factor takes into account the fact that for OTC symbols, the quote data does not always provide accurate numbers for depth at the top of the market. The probability factor is not used where the order is for a listed trading symbol.

[**0070**] At step **3021**, it has been determined that the open peg order is alone at the bid, and therefore it is desirable to correct the peg order away from the bid. The default ALONE_CORRECT_AWAY value is 3 cents, but may be set to any desired value and also can be randomized upon each instance of this step.

[**0071**] If at steps **3015** or **3017** it is determined that the peg order price needs to be adjusted, then it is determined at step **3016** whether the minimum of the bid and peg target exceeds the client price limit. If it does, no correction is made, and the process stops and waits to restart at step **3003**. If it does not, then at step **3022** it is determined whether the last action taken by the pegging algorithm was to correct the peg order price down. If the last action corrected the price down, then at step **3023** it is determined whether the current bid size exceeds 200 shares. If yes, then the peg order price is corrected at step **3024** to the minimum of the peg target (i.e. bid) or the client limit. If no, then the peg order price is corrected at step **3025** to the minimum of the client limit or the peg target (bid) minus 1 cent. If the determination at step **3022** is negative, then the peg order price is corrected as at step **3024**.

[**0072**] The 200 share comparison and the 1 cent differential are default values that may be changed. Steps **3023** and **3025** function to prevent "whipsaw" corrections, which occur when the following sequence happens: 1) the peg order is alone at the bid and a correction of 3 cents away from the bid is made; 2) the specialist posts 100 shares to replace the old bid; 3) after 30 seconds, the peg order is corrected back to the original price; 4) the specialist withdraws the quote, leaving the peg order alone at the bid, which invokes step **1** to be repeated ad infinitum. To prevent this, whenever the pegged order is corrected to a more aggressive price, it is checked to see if the last action was a correct-away. If it was, and there is no "significant size" order ahead of the peg order (default 200 shares), then the price of the peg order is corrected to just beyond the inside market.

[**0073**] **FIG. 8** is a flow diagram explaining the discretion agent logic. The discretion agent is run upon acceptance of the client order by the initial logic routine, and thereafter when scheduled after elapse of a predefined period of time

(such as 5 seconds). After initialization of the agent at step **8001**, at step **8002** it is determined whether the discretion order logic is desired to be performed by checking the value of the DISC_ON parameter (default =YES). If not turned on, the discretion logic will not run. The process waits until expiration of the predefined time period at step **8003** and then resets at step **8001**. If the discretion order logic is turned on, then at step **8004** it is determined whether an open discretion order already exists. If so, the logic waits at step **8003** to be restarted. If no open discretion order exists, then it is determined whether the current ask is greater than the specified client limit, at step **8005**. If so, then it is not possible to place a discretion order, and the logic returns to wait mode. If the ask is not above the client limit, then the discretion range (in cents) is set at step **8006**. The details of the discretion range setting routine is shown in **FIG. 9**

[**0074**] At step **80061**, the routine is initialized. At step **80062**, the expected spread (i.e., ask-bid) for the trading symbol is calculated based on historical data (which is obtained from a database). At step **80063**, a base Discretion Range is set to a percentage of the expected spread, based on the following table:

| | CPM | | | | | |
|---|---|---|---|---|---|---|
| BS | <=25% | 25–50% | 50–75% | 75–100% | 100–200% | >200% |
| <0% (ahead) | MIN | 50% × ES | 75% × ES | 100% × ES | 100% × MXES | 150% × MXES |
| <50% behind | 50% × ES | 75% × ES | 100% × ES | 150% × MXES | 150% × MXES | 200% × MXES |
| >=50% behind | 75% × ES | 100% × ES | 100% × MXES | 150% × MXES | 200% × MXES | 200% × MXES |

where CPM="Chunks" Remaining per Minute=[(Target Shares−Filled Shares)/(EFFECTIVE_TIME_HORIZON−UNBLOCKED ELAPSED TIME)]/Chunk-Size

BS=% Behind Schedule=(UNBLOCKED_ELAPSED-_TIME/EFFECTIVE_TIME_HORIZON)−(Filled Shares/Target Shares)

UNBLOCKED_ELAPSED_TIME=time now−client order arrival time−TIME_BLOCKED

TIME_BLOCKED=the number of minutes that have elapsed so far where the strategy has been prevented from trading by the client limit price

EFFECTIVE_TIME_HORIZON=MIN(Time Horizon, TOTAL_TIME_REMAINING+UNBLOCKED_E-LAPSED_TIME)

TOTAL_TIME_REMAINING=MIN(Client Order Arrival Time+INIT_MAX_TIME_HORIZON, Today's Market Close Time)−Time Now

ES=Expected Spread (based on historical data)

MXED=MAX (ES, ESP, EST)

ESP=Expected Spread Prior (based on today'and short-term historical data)

EST=Expected Spread Today (based on historical and today's prior spread data)

[**0075**] Each column contains a range of values for CPM, the number of "chunks" of shares that need to be traded per minute remaining in the schedule. Each "chunk" is a quantity of shares that is considered as capable of being traded in approximately one minute without resulting in significant market impact, and is calculated based on a model using parameters such as historical average daily volume, recent depth, liquidity, etc.

[**0076**] Next, market urgency is reflected by a variable called TREND at step **80064**. If there is a significant positive price trend (as determined using a short-term price trend model), then TREND is set to +1; if there is no significant price trend, then TREND is set to 0; and if there is a significant negative price trend, then TREND is set to −1. The liquidity flag LIQ (step **80065**) takes on a value of 1 if there is significant liquidity at the opposite side of the quote ("significant" being defined by a predetermined value); otherwise LIQ is set to zero.

[**0077**] The final Discretion Range (DR) is then calculated at step **80066** in accordance with the given equation. The variables DR_TREND ADJ_MIN and DR LIQ_ADJUST MIN define the minimum number of cents that can be added to (or subtracted from) the base discretion range based on the value of the TREND variable and the LIQ flag, while the DR_TREND_ADJUST_PRC and DR_LIQ_ADJUST_PRC variables define the percentage of expected spread that is to be added/subtracted to/from the base discretion range. Similar constraints can be placed on maximum amounts that can be added to or subtracted from the base discretion range. It is here reiterated that in contrast to the prior art discretion order, the present invention provides a dynamic discretion range that is calculated automatically for each trading symbol and adjusted in accordance with real-time market conditions.

[**0078**] After the discretion range DR is calculated at step **8006**, whether and how to adjust the calculation of the spread for purposes of the discretion order logic is determined at step **8007**. The adjust spread routine is initialized at step **80071** as shown in **FIG. 10**. A flag labeled DISC-_ADJUST_SPREAD can have one of three values, 0, 1 or 2. If the flag is set to 0, at step **80072** the adjusted spread AdjSpread is considered to be the ask-bid. If the flag is set to 1, at step **80073** AdjSpread is considered to be the ask-peg order price, if there is an open peg order and the size of all orders ahead of the open peg order is less than the Significant Size (as defined in the pegging agent logic). Otherwise, AdjSpread is considered to be the ask-bid. If the flag is set to 2, then at step **80074** the AdjSpread is considered to be the ask-Peg Target.

[**0079**] After the discretion range DR and AdjSpread values are calculated, at step **8008** it is determined whether AdjSpread is less than or equal to DR. If the adjusted spread is greater than the discretion range, then no discretion order will be placed, and the logic waits at step **8003** for expiration of the predefined time interval to restart. If the adjusted

spread is less than or equal to the discretion range DR, then a discretion order will be assembled.

[0080] At step **8009**, the price of the discretion order is determined to be the minimum of the current ASK plus 3 cents (where 3 cents represents an adjustable value of a variable labeled DISC_PRICE_THROUGH), the specified client limit, or the current ASK minus the AdjSpread plus the discretion range DR. This calculation allows a discretion order to be priced through the inside market, so long as it does not violate the client's price limit or the calculated discretion range DR.

[0081] After the price of the discretion order is calculated, the size of the discretion order is calculated at step **8010**. The details of this calculation are shown in **FIG. 11**. At step **80101**, the routine is initialized. At step **80102**, the value of the variable MaxTake is set. The value of MaxTake is based on the ADV (Average Daily Volume) of the trading symbol. For ADV over 20 million shares, MaxTake is set to 8,000 shares; for ADV between 5 and 20 million shares, MaxTake is set to 5,000 shares; for ADV between 1 and 5 million shares, MaxTake is set to 4,000 shares; and for ADV less than 1 million shares, MaxTake is set to 3,000 shares.

[0082] Next, at step **80103**, a maximum discretion size is calculated as the minimum of two values: MaxTake×2; or the maximum of MaxTake, TypicalSize (as determined by historical data), one-half the current ask size, or 10 times the total client order size divided by the time horizon. After the MaxDiscretionSize is calculated, the discretion size DS is calculated at step **80104**.

[0083] As shown, the discretion size DS is calculated to be the minimum of two values: the previously determined MaxDiscretionSize, or a value determined by the settings of variables DS_OVERHIT_PRC_INSIDE and DS_OVERHIT_PRC_THROUGH. These variables control whether or not an oversized discretion order (i.e., an order larger than the displayed depth at the ask) may be placed under certain circumstances. For example, without oversizing of the discretion order, where the discretion range DR is 4 cents, the spread is 1 cent, and 100 shares are displayed on the ASK, the discretion agent logic would only consider placing a 100 share discretion order. The oversizing analysis allows the possibility of placing a larger-sized discretion order where the discretion order may be priced through the ASK (e.g., 3 cents through the ASK in the example). It is noted, however, that as indicated in the equation of step **80104**; the oversizing calculation will not result in discretion orders any larger than the maximum order size generated by the MaxDiscretionSize calculation. The default values for DS_OVERHIT_PRC_INSIDE and DS_OVERHIT_PRC_THROUGH are 0% and 50%, respectively. Using the default values in the equation of step **80104**, it will be seen that the discretion size DS potentially could be increased to a percentage over the current ask size as determined by the difference between the discretion price and the ask, subject to an upper size limit defined by MaxDiscretionSize.

[0084] After the discretion size DS is determined, it is subjected to a randomization process in step **80105**, wherein DS may be randomized slightly up or down depending upon the set values of variables DS_RANDOM_PRC_DOWN and DS_RANDOM_PRC_UP. The default values for these variables are 10% and 0%, respectively. According to the randomization generator, a random round lot value (i.e., a multiple of 100 shares) would be chosen between a lower bound of DS×(1−DS_RANDOM_PRC_DOWN) and an upper bound of DS×(1+DS_RANDOM_PRC_UP). The final discretion size DS will be determined to be the maximum of the randomly chosen size within the constraints above, or a minimum discretion order size specified by the client as reflected in the value of the variable DS_MIN_DISC_SIZE (which is the same as MinDiscretionSize in the equation of step **80105**).

[0085] After the suggested discretion order price and suggested discretion order size have been determined, at step **8011**, it is determined whether a FINISH flag is set to TRUE or FALSE, and whether the sum of the reserve shares and the peg order size is greater than twice the MinDiscretionSize. If the FINISH flag is set to TRUE or the reserve shares plus the peg order size is less than twice the MinDiscretionSize, processing branches to step **8014**. If FINISH=FALSE and the reserve shares plus the peg order size is more than twice the MinDiscretionSize, then it is determined at step **8012** whether the calculated discretion size DS is greater than or equal to the MinDiscretionSize. If it is not, this means that the calculated discretion order size is less than the minimum size specified by the client, and thus the process proceeds to wait at step **8003** and restarts after the expiration of the predefined time interval.

[0086] If DS is at least equal to the MinDiscretionSize, then at step **8013** a behavior randomization is performed to mask any attempt by other participants to discern the existence of the automated strategy trading agent. Specifically, using a default random probability setting of 75%, if the size of the suggested discretion order DS is at least equal to the specified minimum discretion size, but is less than 201 shares greater than the specified minimum size, then a 75% random chance exists that the discretion agent will do nothing, and not send a discretion order. The "75% Prob" refers to a variable labeled DS_MIN_DISC_SIZE_RANDOM_PRC and signifies the operation of a random decision process that 75% of the time will do nothing, and 25% of the time will place the discretion order. It is noted that when the FINISH flag is TRUE steps **8012** and **8013** will be bypassed.

[0087] Next, at step **8014** it is determined whether the suggested discretion size DS is less than or equal to the amount of reserve shares (as defined above). If DS is greater than the reserve shares, and the reserve shares are less than the peg order size as determined in step **8016**, then a discretion order is not sent, but instead at step **8017** the open peg order price is corrected to the suggested discretion order price DP, and the size of the open peg order is corrected down if the suggested discretion order size DS is less than the peg size.

[0088] On the other hand, if either the suggested discretion order size DS is less than or equal to the reserve shares, or the reserve shares are at least equal to the peg size, then a discretion order is assembled at step **8015**, with a price set at the suggested discretion order price DP as determined at step **8009**, and a size set to the minimum of the suggested discretion order size DS at determined according to **FIG. 11** or the reserve shares (in other words, the size of the discretion order cannot exceed the number of shares remaining in the unfilled portion of the client order).

[0089] After the discretion order is sent in step **8015**, or the peg order is corrected at step **8017**, the discretion agent

logic waits N seconds before re-running. The value of N is determined according to the following table:

| | Small Order | Large Order |
|---|---|---|
| Liquid Trading Symbol | 10 sec | 20 sec |
| Non-liquid Trading Symbol | 20 sec | 30 sec |

[0090] If the discretion order is completely filled, then the discretion agent logic waits N seconds as determined according to the following table:

| | Small Order | Large Order |
|---|---|---|
| Liquid Trading Symbol | 1 sec | 1 sec |
| Non-liquid Trading Symbol | 20 sec | 30 sec |

[0091] Note that both tables are consulted simultaneously to determine the value of N. In other words, if a small order for a liquid trading symbol is sent and filled within 10 seconds, the logic waits at least 10 seconds before re-running.

[0092] As explained above, the definition of "liquidity" can be set in advance, and is usually defined to mean trading symbols that trade at least an average of 1 million shares per day.

[0093] Unfilled discretion orders automatically are cancelled after a specified time interval has elapsed, according to the following table:

| Average Daily Volume | Unfilled Discretion Order Cancel Time |
|---|---|
| 1+ million | 20 sec |
| 250 K to 1 million | 60 sec |
| <250 K | 120 sec |

[0094] The values in the tables of course may be changed according to individual strategy.

[0095] According to the invention as described, the peg order agent continuously sends out passive pegged orders in an attempt to attract market orders, while the discretion order agent works in tandem with the peg order agent and sends out aggressively priced discretion orders to take advantage of liquidity and to the keep the client's order trading on schedule so as to be completed within the specified time horizon.

[0096] The invention being thus described, it will be apparent to those skilled in the art that the same may be varied in many ways without departing from the spirit and scope of the invention. Any and all such modifications are intended to be included within the scope of the following claims.

**1**. A computer-implemented method of trading a security, comprising the steps of:

receiving from a customer a client order to trade a specified number of shares of a specified security;

forming an initial order to trade said security, said initial order having a peg order price being correlated to a current quote for said security;

sending said initial order to a trading medium where shares of said security are traded;

while an order remains open, periodically checking at a predetermined time interval said current quote to determine whether said peg order price needs to be adjusted, said predetermined time interval being varied according to a randomization process;

upon determination of a need for adjustment, calculating a new peg order price correlated to a current quote for said security, said new peg order price being modified from said current quote according to predetermined trading criteria for said security; and

sending an adjusted order to said trading medium to replace said open order.

**2**. A computer-implemented method as set forth in claim 1, wherein said step of forming an initial order further comprises the step of calculating a size of said initial order based on historical trading data for said security.

**3**. A computer-implemented method as set forth in claim 1, wherein determination of a need for price adjustment comprises the step of determining whether a difference between the open order price and the current quote exceeds a predetermined threshold value.

**4**. A computer-implemented method as set forth in claim 1, wherein determination of a need for price adjustment comprises the step of determining whether the depth ahead of said open order is greater than or equal to a predefined threshold size.

**5**. A computer-implemented method as set forth in claim 1, wherein said predetermined trading criteria comprises a consideration of the direction of a previous peg order price correction.

**6**. A computer-implemented method as set forth in claim 5, wherein said predetermined trading criteria comprises a consideration of the same-side depth for said security when a previous peg order price correction was in a passive direction.

**7**. A computer-implemented method as set forth in claim 1, wherein the step of calculating a new peg order price comprises the step of adjusting said peg order price when an existing open order is alone at the inside market.

**8**. A computer-implemented method as set forth in claim 1, wherein the step of calculating a new peg order price comprises the step of adjusting said peg order price to a more passive price than the current same-side quote relating to said order, when a previous peg order price adjustment was in a favorable direction and the size of the current quotation exceeds a predetermined value.

**9**. A computer-implemented method as set forth in claim 1, further comprising the steps of:

determining whether an existing open order has a size less than a predefined proportion of said specified number of shares, cancelling said existing open order if its size is determined to be less than said predefined proportion, and calculating a new peg size and peg order price in accordance with said current quote and size of said current quote on said exchange, and sending a new order having said new peg size and peg order price.

**10**. A computer-implemented method of trading a security, comprising the steps of:

receiving from a customer an order to trade a specified number of shares of a specified security with a price pegged to a current quote for said security;

forming an initial order to trade said security, said initial order having a peg order price being correlated to a current quote for said security, and calculating a size of said initial order based on historical trading data for said security;

sending said initial order to a trading medium where shares of said security are traded;

while an order remains open, periodically checking at a predetermined time interval said current quote to determine whether said peg order price needs to be adjusted;

upon determination of a need for adjustment, calculating a new peg order price correlated to a current quote for said security; and

sending an adjusted order to said trading medium to replace said open order.

**11**. A computer-implemented method of trading a security, comprising the steps of:

receiving from a customer an order to trade a specified number of shares of a specified security;

calculating a discretion range for said specified security based on historical trading data for said specified security;

determining whether the spread between current bid and ask quotes for said specified security is less than or equal to said calculated discretion range; and

sending to a trading medium an order for said specified security at a marketable price when it is determined that said spread is less than or equal to said calculated discretion range.

**12**. A computer-implemented method according to claim 11, further comprising the steps of:

receiving from said customer an indication of a level of urgency for completing said trade; and

dynamically adjusting said calculated discretion range in accordance with said indicated level of urgency.

**13**. A computer-implemented method according to claim 12, wherein said indication of urgency is a specified time horizon within which said trade must be completed.

**14**. A computer-implemented method according to claim 11, further comprising the step of calculating a size of said order to be larger than the opposite side size for said specified security, where the amount of excess order size is determined by historical data, the difference between said calculated discretion range and the current spread, and predefined parameter values.

**15**. A computer-implemented method according to claim 11, wherein a price of said order may be set to be more aggressive than the marketable price for said specified security.

**16**. A computer-implemented method according to claim 11, wherein subsequent orders are delayed from prior orders by a predetermined delay time subjected to a randomization process before being sent.

**17**. A computer-implemented method of trading a security, comprising the steps of:

receiving from a customer an order to trade a specified number of shares of a specified security;

forming an initial order to trade said security, said initial order having a peg order price being correlated to a current quote for said security;

sending said initial order to a trading medium where shares of said security are traded;

while an order remains open, periodically checking at a predetermined time interval said current quote to determine whether said peg order price needs to be adjusted, said predetermined time interval being varied according to a randomization process;

upon determination of a need for adjustment, calculating a new peg order price correlated to a current quote for said security, said new peg order price being modified from said current quote according to predetermined trading criteria for said security;

sending an adjusted order to said trading medium to replace said open order;

calculating a discretion range for said specified security based on historical trading data for said specified security;

determining whether the spread between current bid and ask quotes for said specified security is less than or equal to said calculated discretion range; and

sending to a trading medium an order for said specified security having at a marketable price when it is determined that said spread is less than or equal to said calculated discretion range.

**18**. A computer-implemented method of executing a plurality of orders to trade specified securities within a specified time horizon, comprising the steps of

receiving from a customer over a communication medium a plurality of client orders, each client order specifying a security to be traded, a quantity of shares of said security to be traded, a trade side, and a time horizon within which said orders are to be completed;

sending to a trading medium orders having prices pegged to a current quote for each said security and sizes determined in accordance with historical trading data for each said security, said orders being corrected in accordance with market activity for said specified securities at randomized intervals;

calculating for each of said securities a discretion range based on historical trading data for each said security and as a function of the ratio of order completion with respect to said specified time horizon; and

sending to said trading medium marketable orders for certain of said specified securities when a current spread between bid and ask quotes for said certain securities is less than or equal to said calculated discretion range.

**19**. A computer-implemented method of trading a security, comprising the steps of:

receiving from a customer an order to trade a specified number of shares of a specified security;

calculating a discretion price for said specified security based on historical trading data for said specified security;

determining whether the current ask quote for said specified security is less than or equal to said calculated discretion price; and

sending to a trading medium an order for said specified security at a marketable price when it is determined that said current ask quote is less than or equal to said calculated discretion price.

**20**. A computer-implemented method according to claim 19, further comprising the steps of:

receiving from said customer a limit price for said security; and

dynamically adjusting said calculated discretion price in accordance with said received limit price.

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