

Sept. 19, 1933.

C. T. FOSS

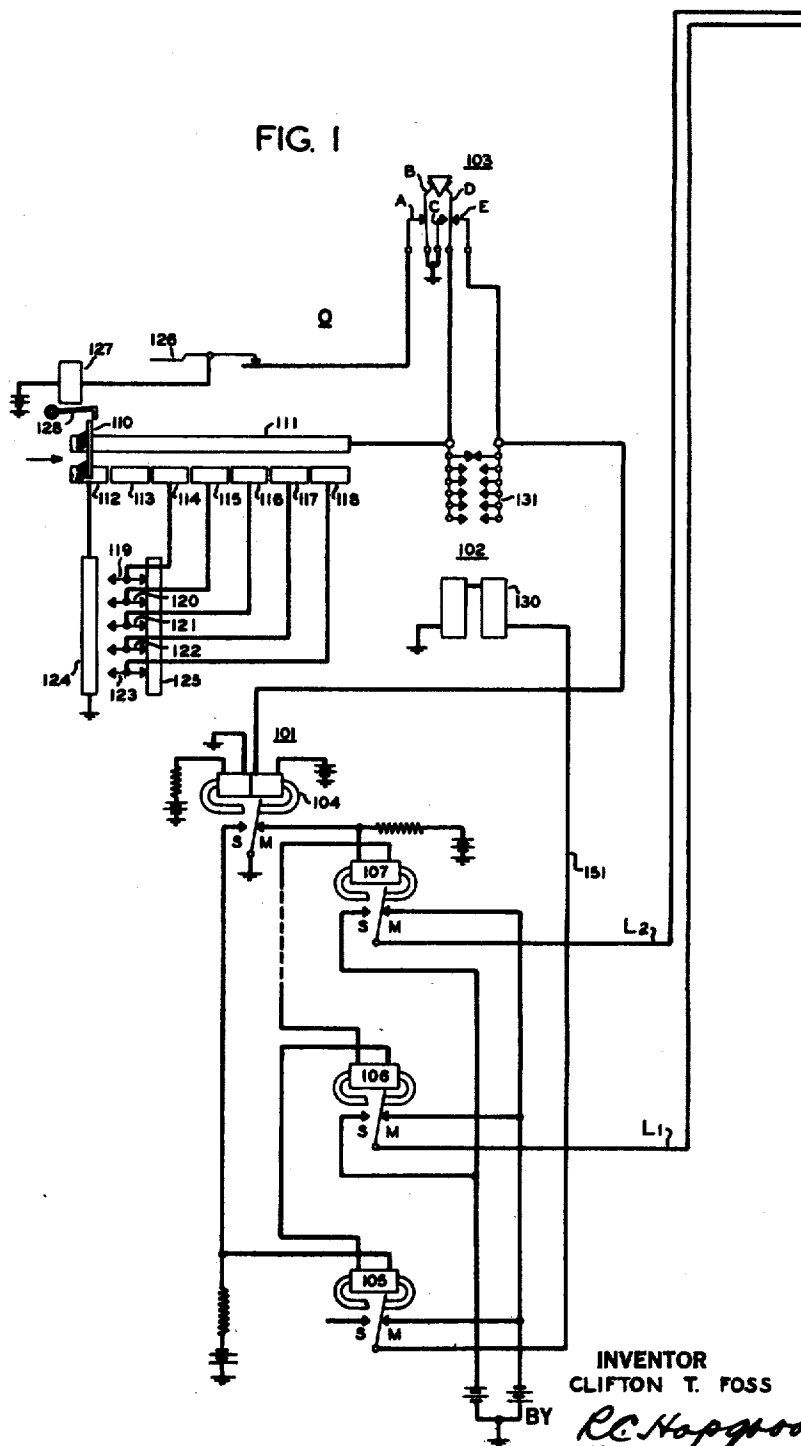
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AVERAGE PRICE COMPUTER

Filed Dec. 3, 1932

13 Sheets-Sheet 1

FIG. 1



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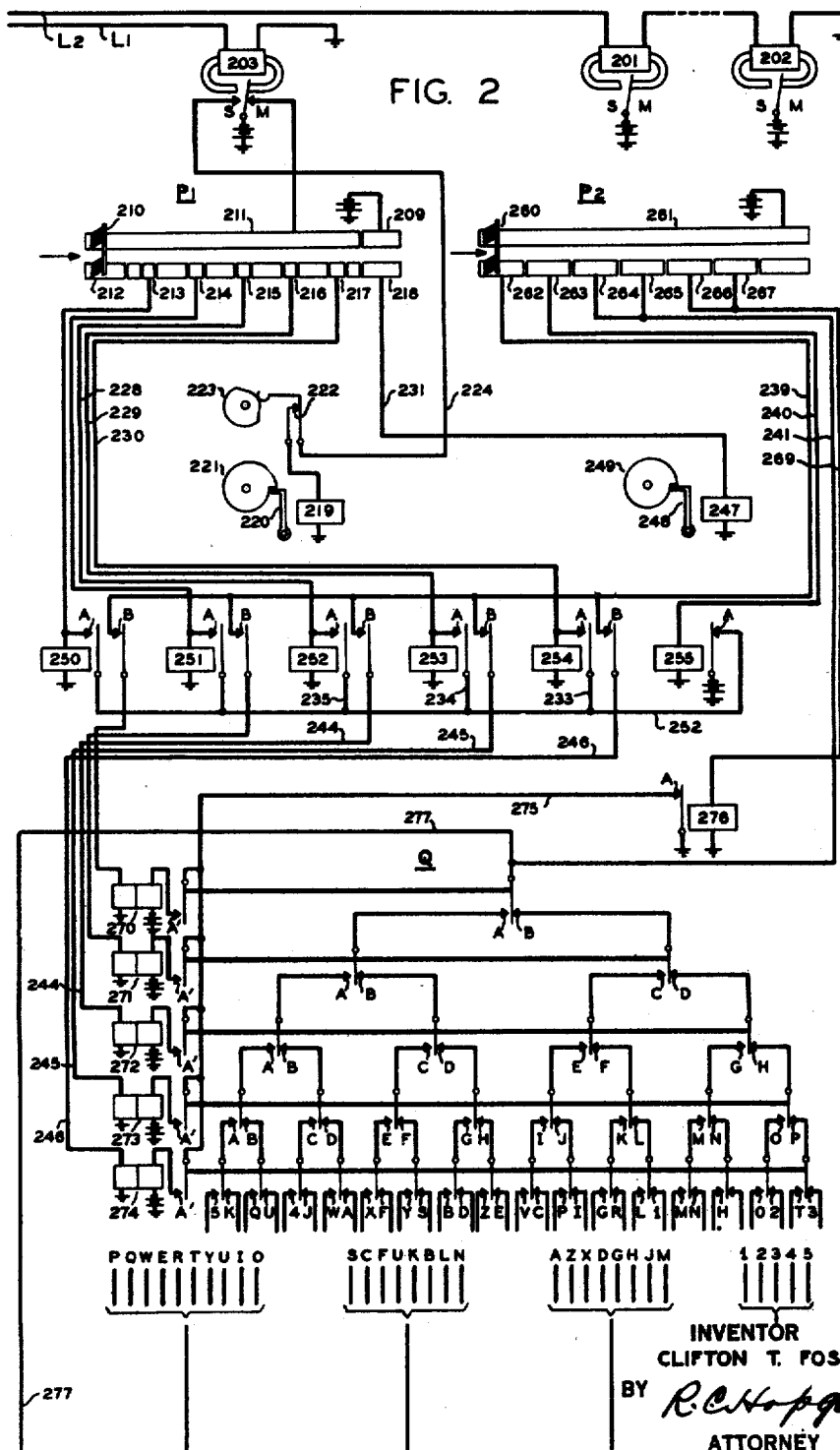
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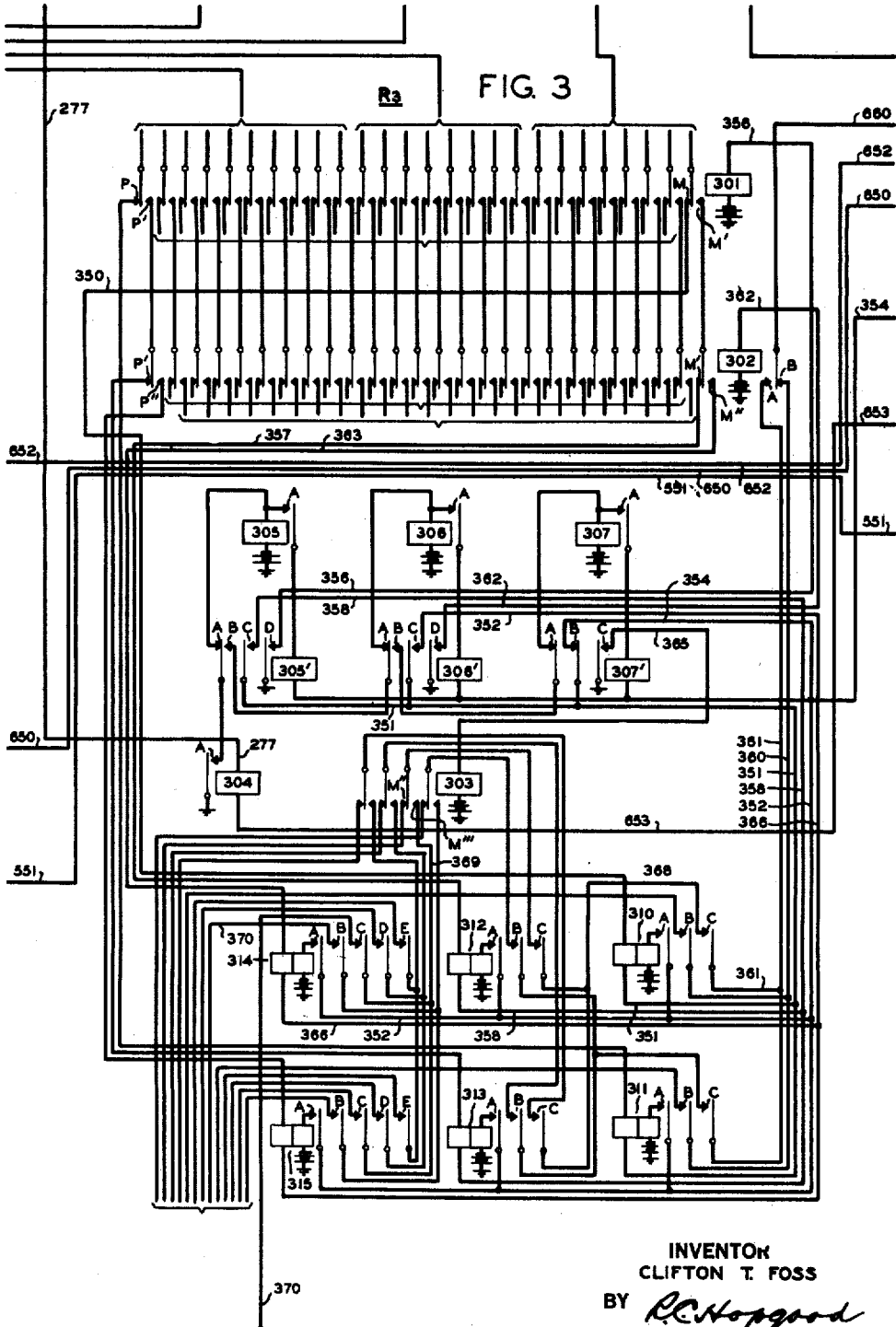
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AVERAGE PRICE COMPUTER

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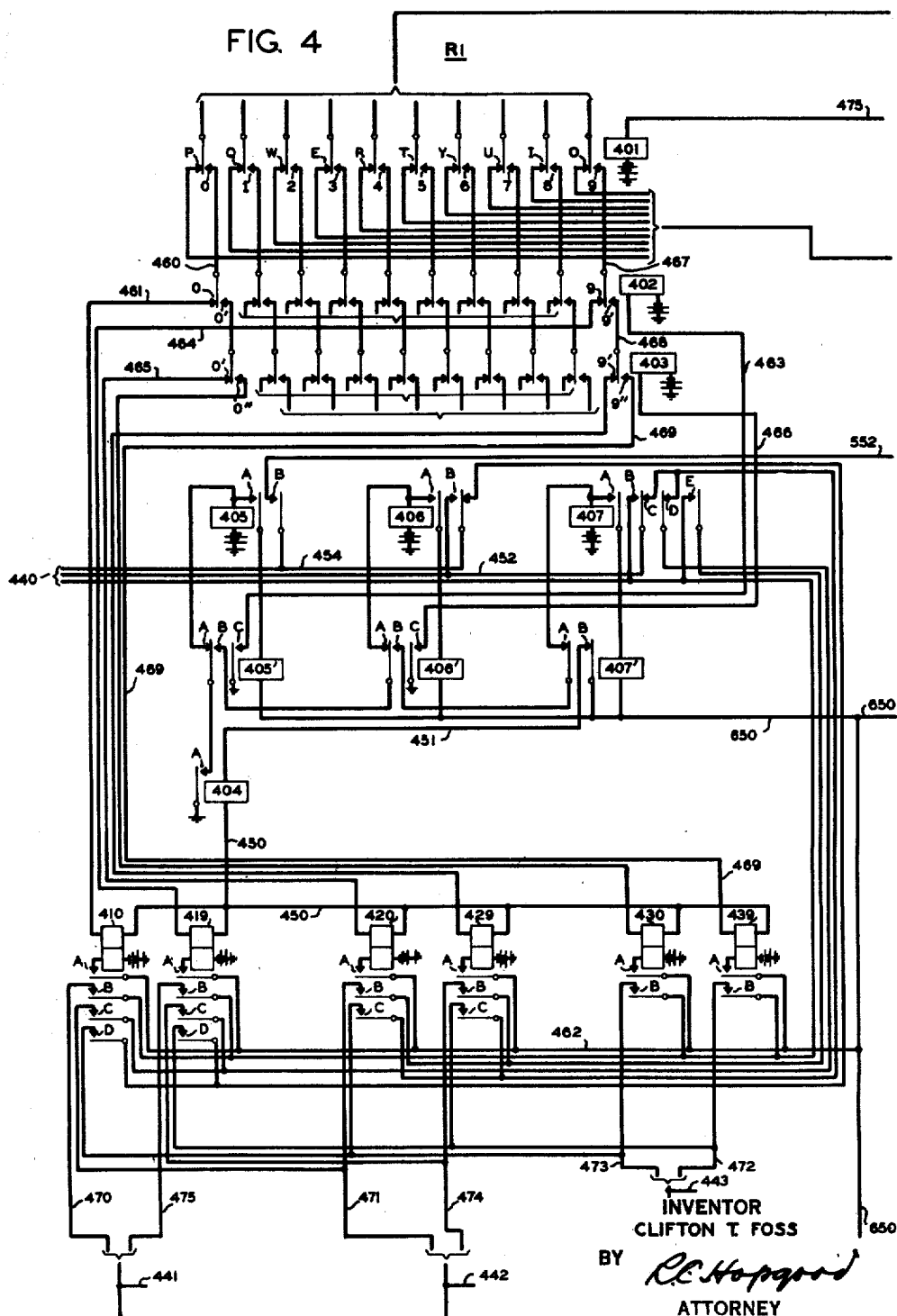
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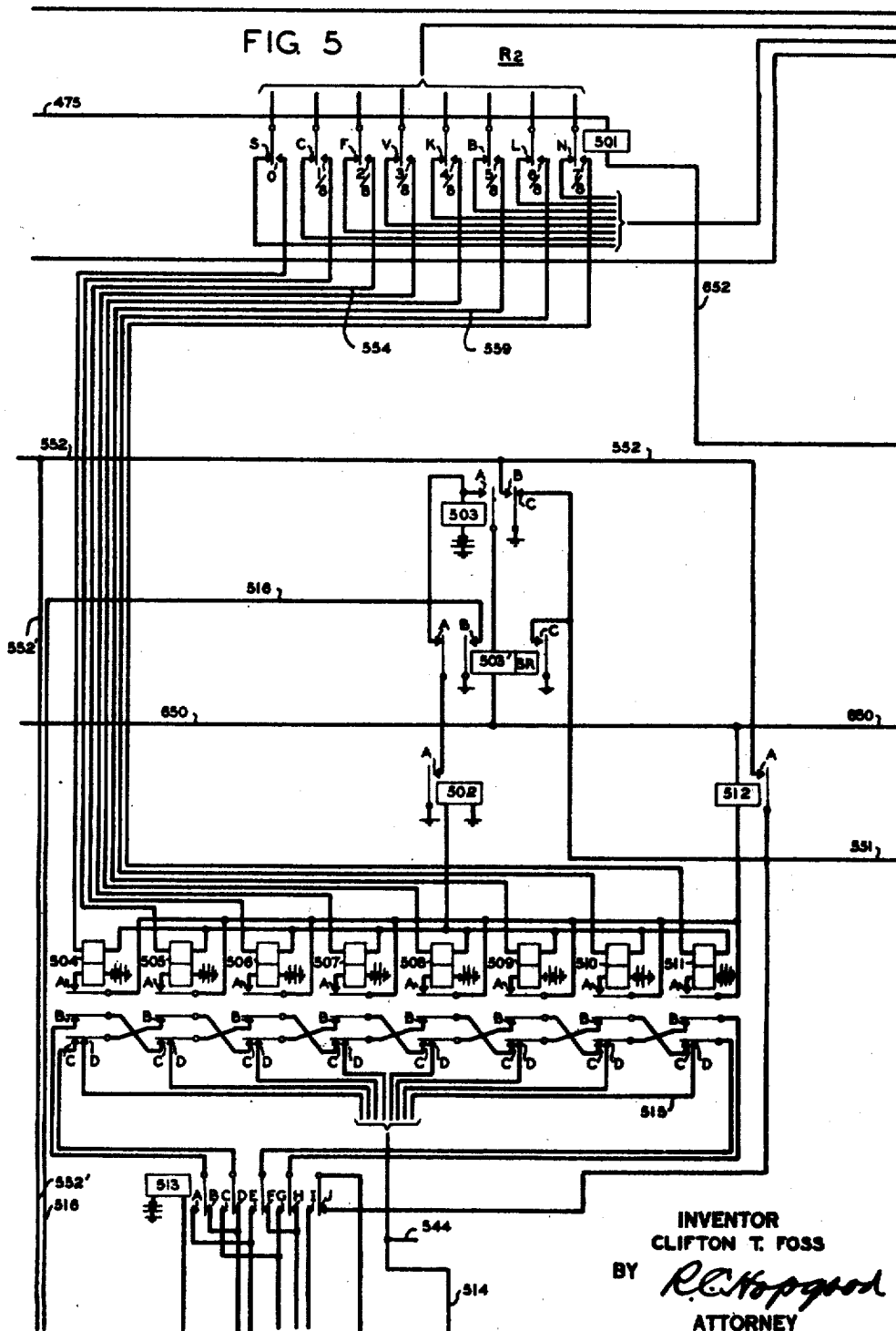
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AVERAGE PRICE COMPUTER

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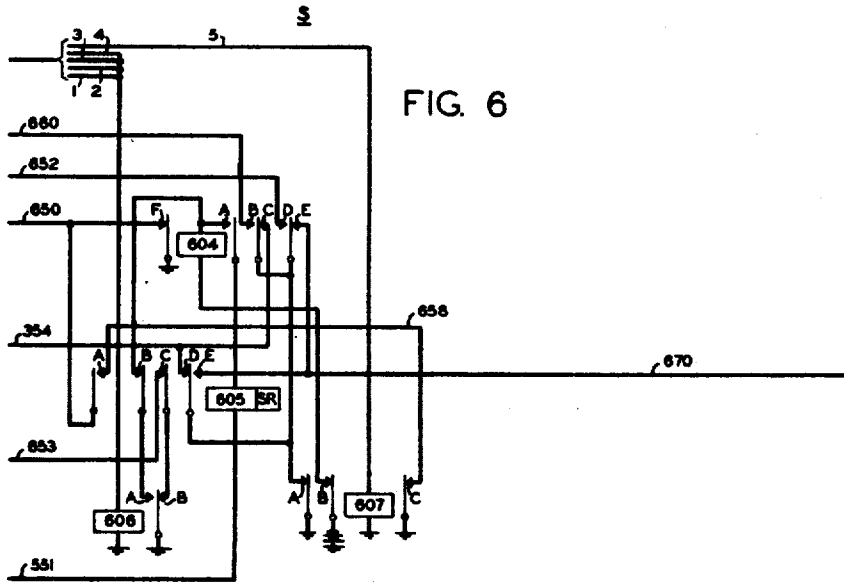


FIG. 6

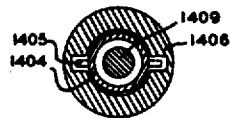


FIG. 15

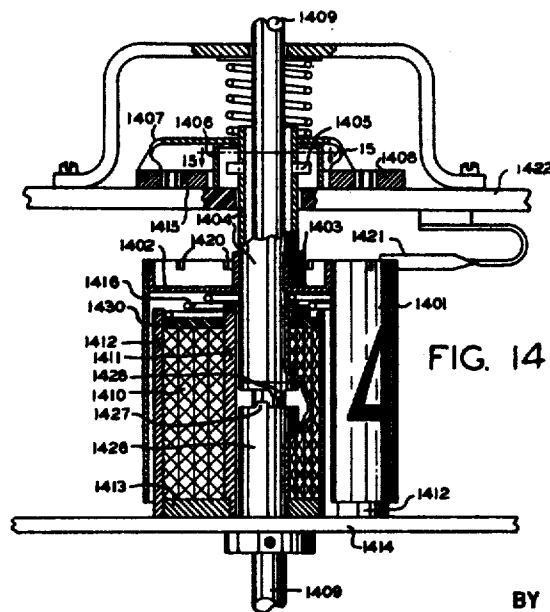


FIG. 14

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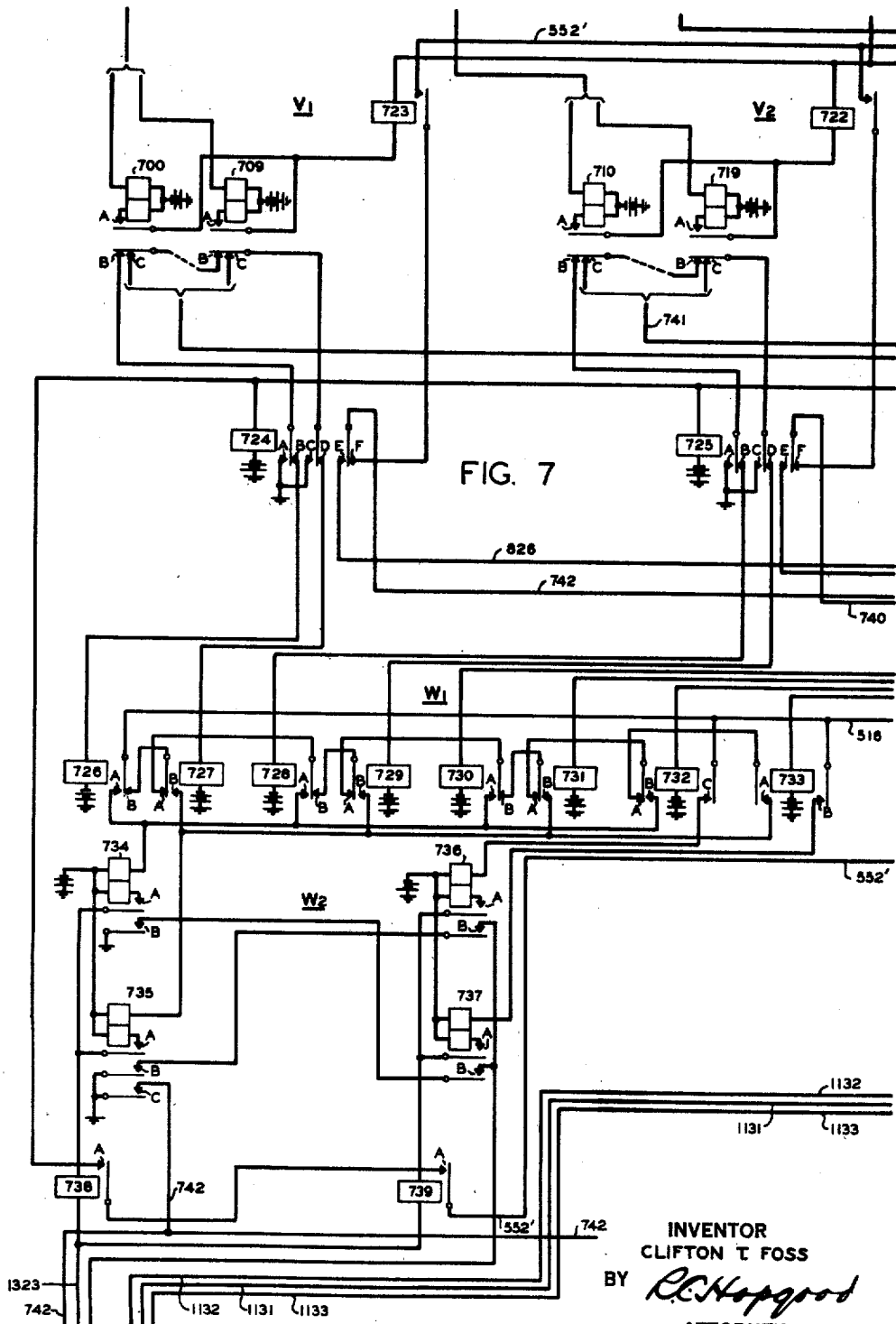
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AVERAGE PRICE COMPUTER

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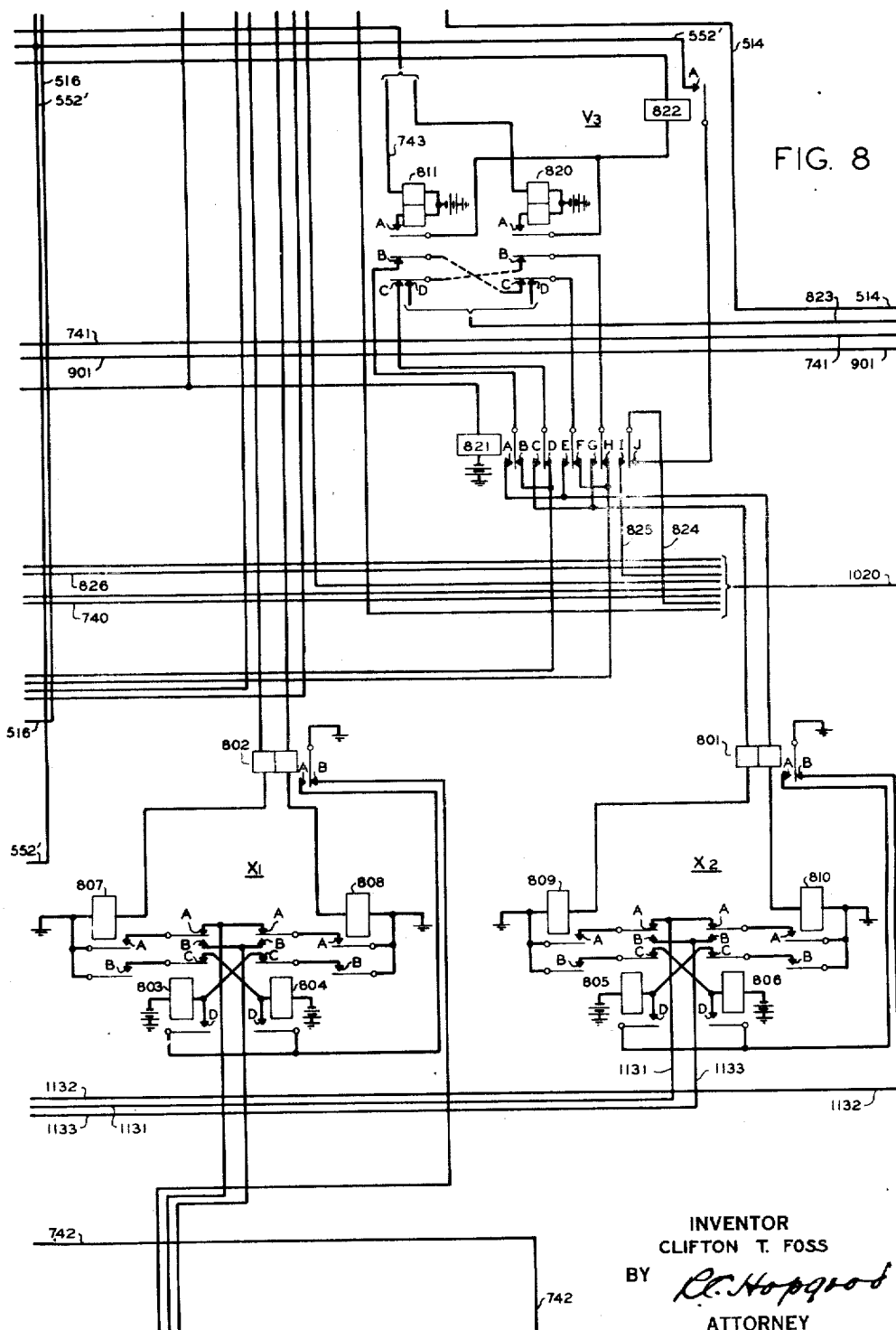
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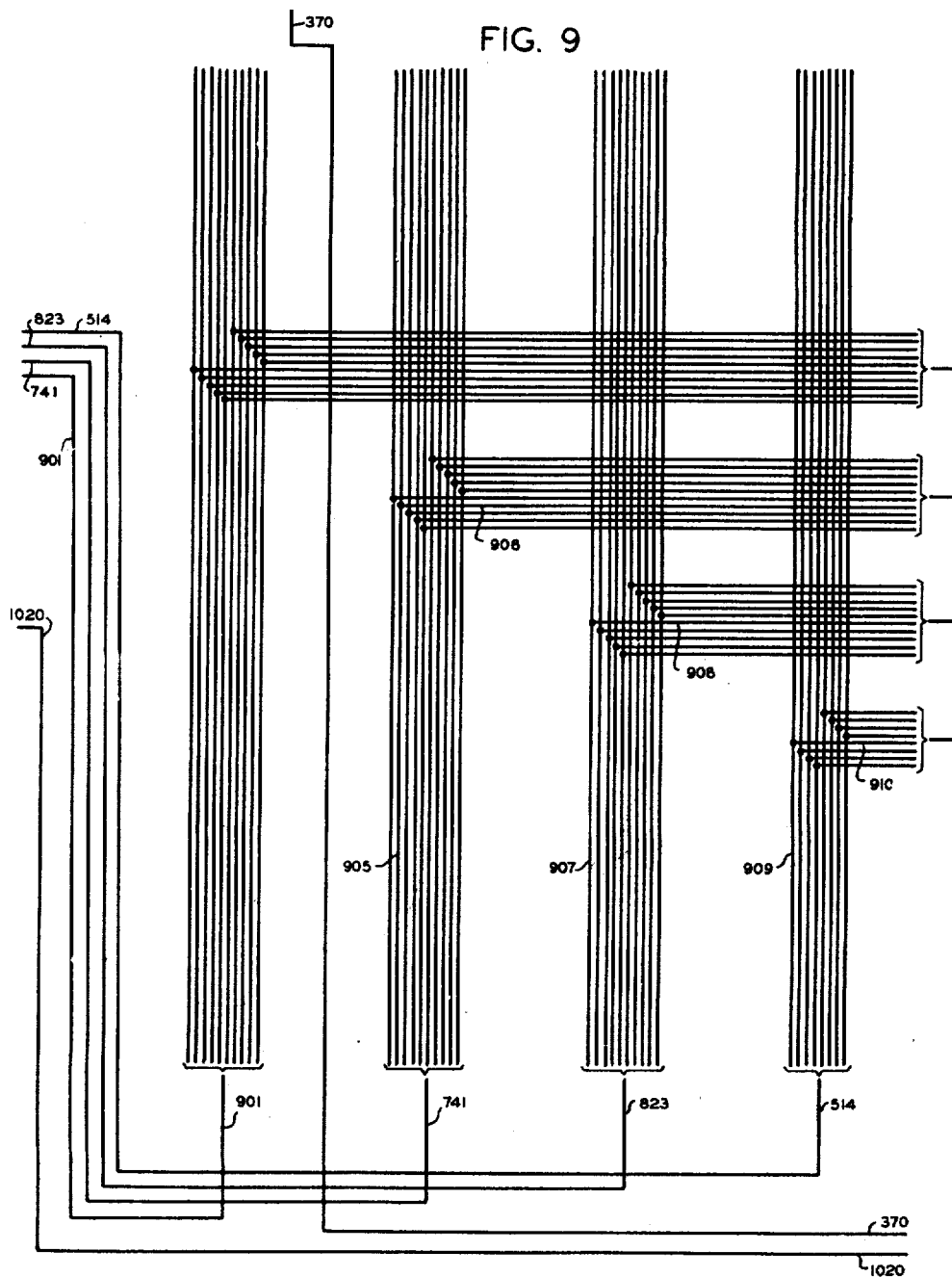
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FIG. 9



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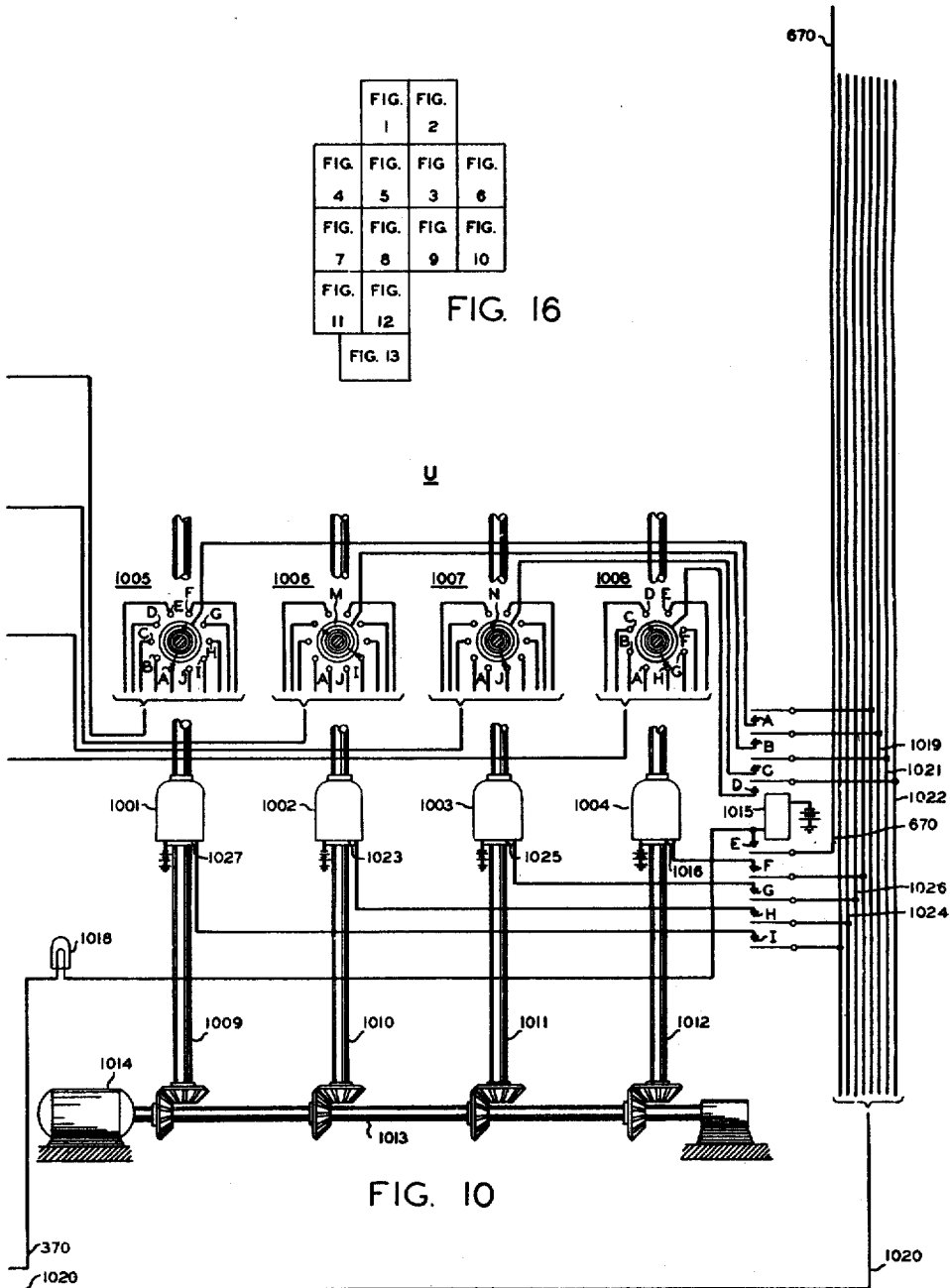
AVERAGE PRICE COMPUTER

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	FIG. 1	FIG. 2	
FIG. 4	FIG. 5	FIG. 3	FIG. 6
FIG. 7	FIG. 8	FIG. 9	FIG. 10
FIG. 11	FIG. 12	FIG. 13	

FIG. 16



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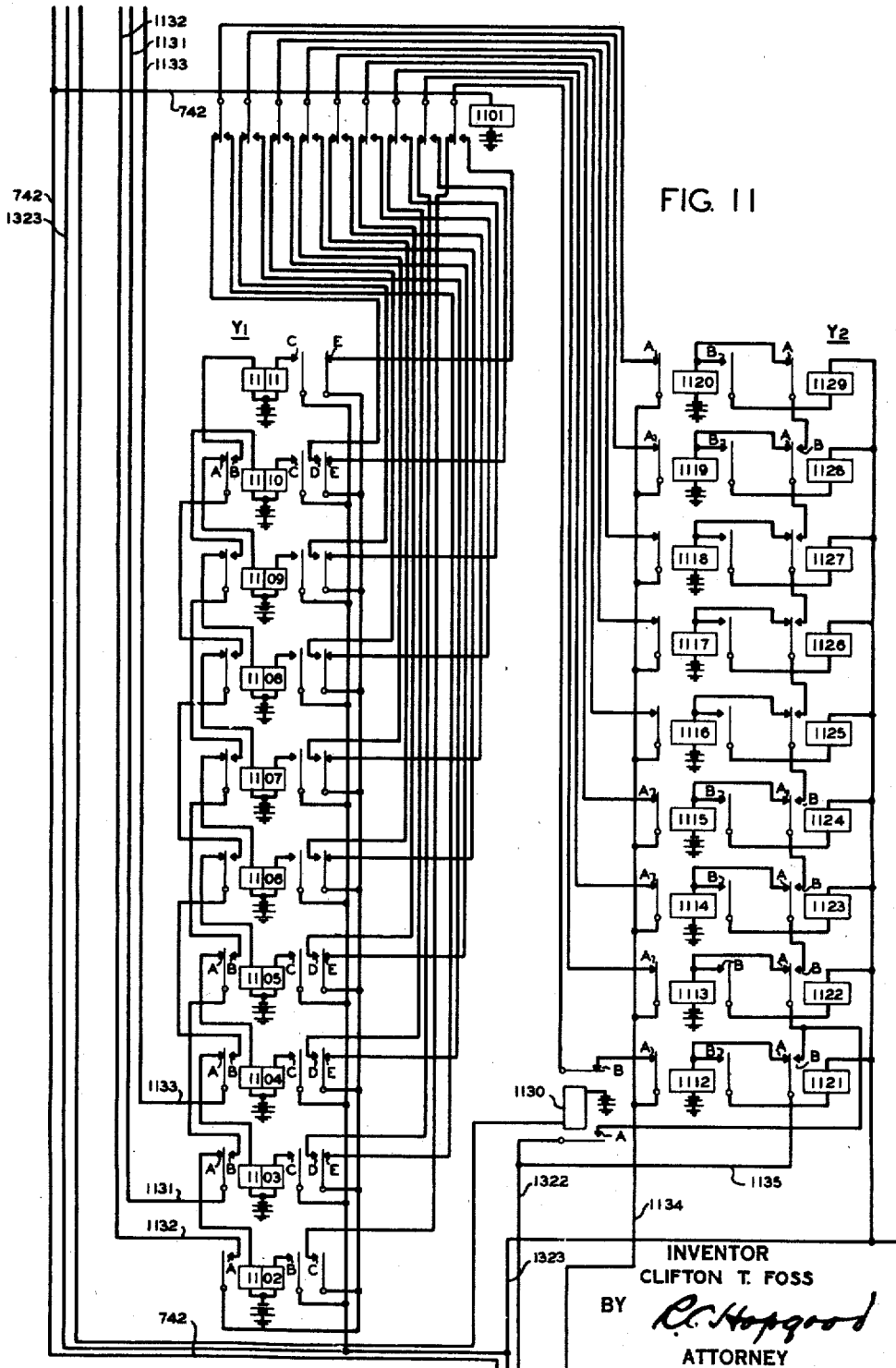
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AVERAGE PRICE COMPUTER

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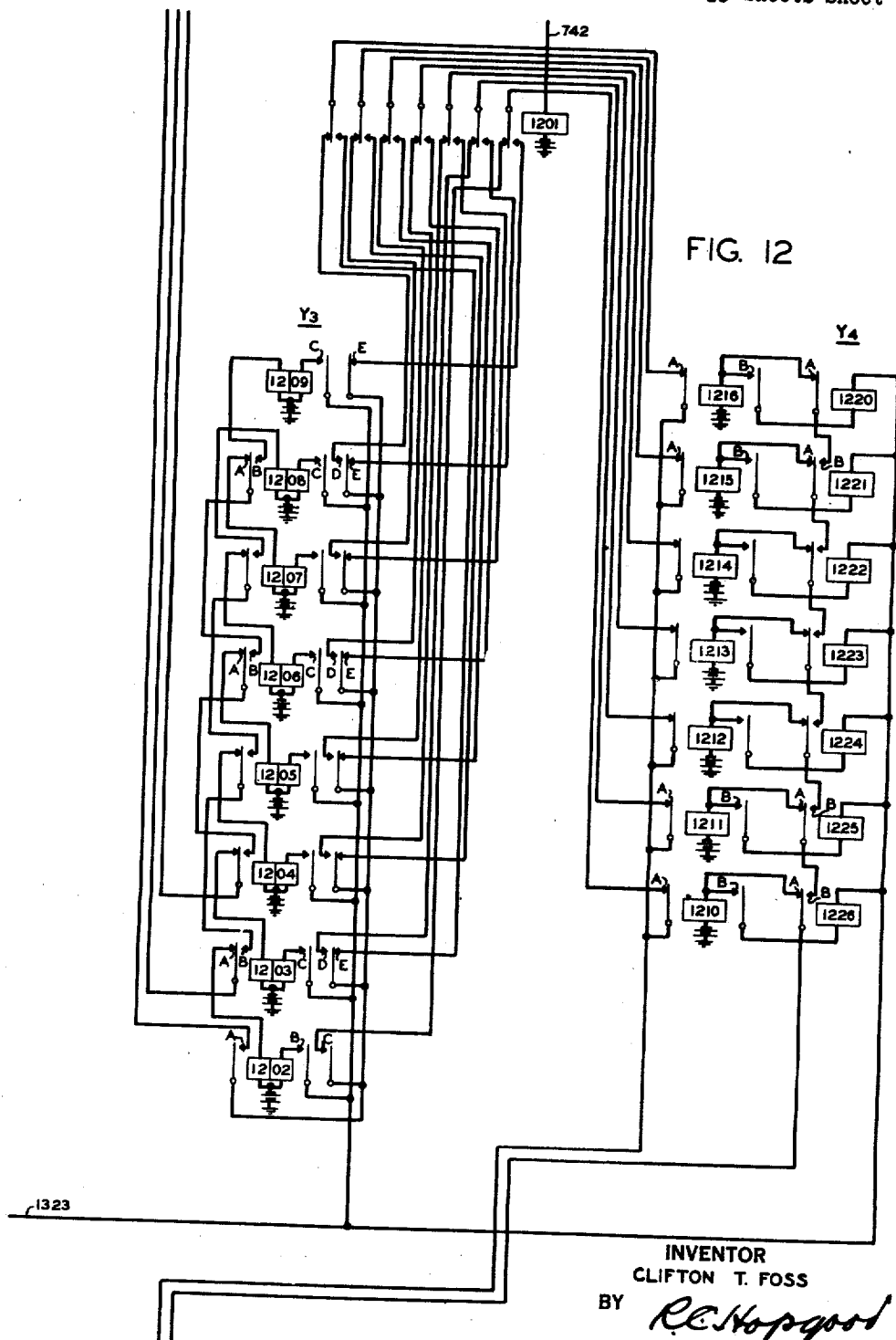
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AVERAGE PRICE COMPUTER

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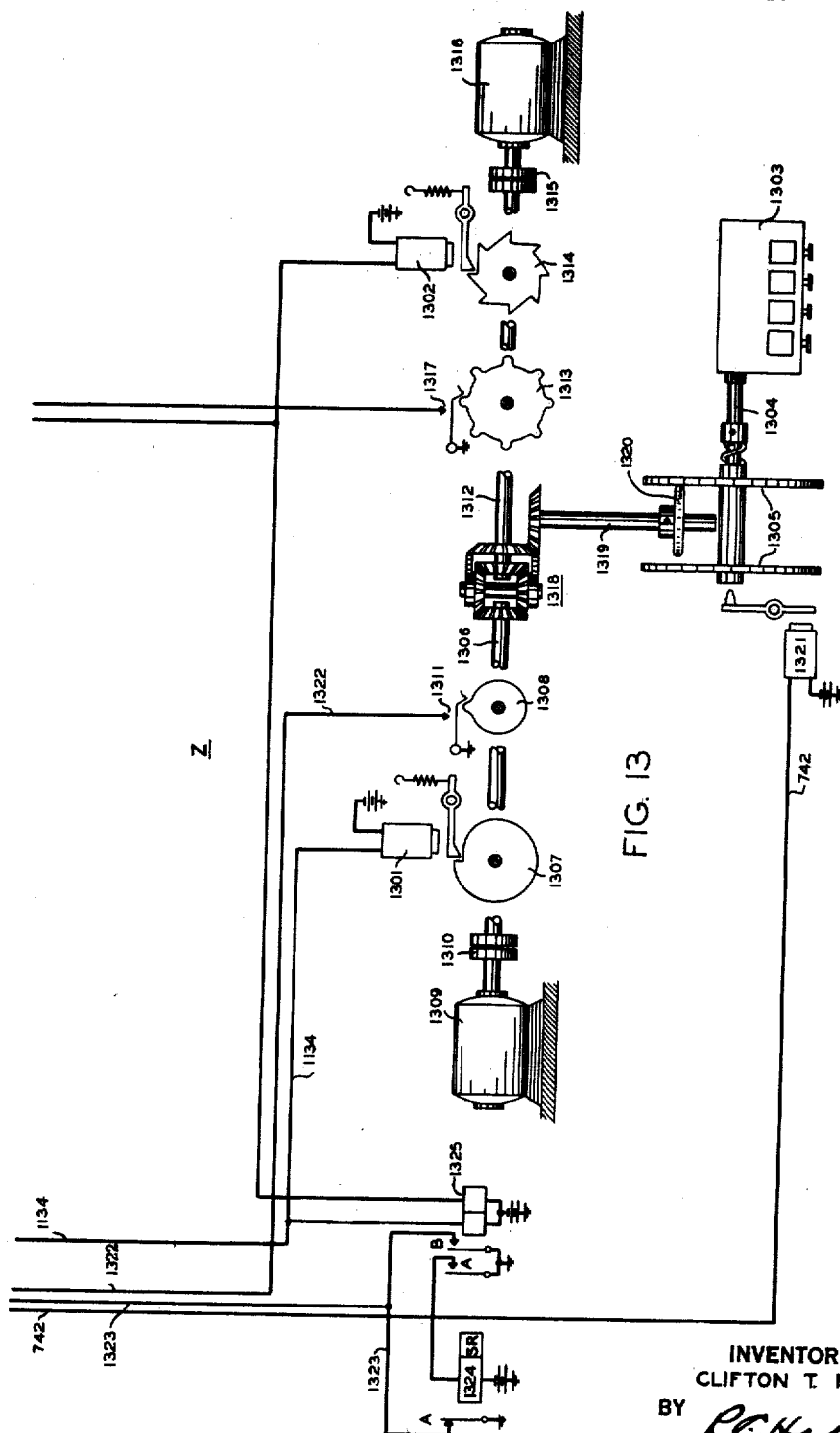
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AVERAGE PRICE COMPUTER

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UNITED STATES PATENT OFFICE

1,927,702

AVERAGE PRICE COMPUTER

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Application December 3, 1932. Serial No. 645,578

20 Claims. (Cl. 235—61)

This invention relates generally to stock quotation systems and relates more particularly to an average price computer for determining automatically and then displaying the average price of a group of representative stocks.

Many traders engaged in buying and selling stocks confine their operations chiefly to transactions involving a particular group of stocks; for example, one may deal in industrial stocks, another in public utility stocks, and still another in radio stocks. These traders are interested in the price changes in the individual stocks of the group in which they trade, but they are also interested in the average price changes of this group, for this knowledge enables them to follow the general price trend of the group.

At the present time, so far as applicant is aware, no means have been devised for automatically computing and then displaying average price quotations on a group of stocks as quotations on the individual stocks in the group are transmitted to a plurality of quotation boards.

The principal object of the present invention is to provide an average price computer for accomplishing the above-mentioned result.

Another object is to provide an average price computer that can be associated with a master board at a central station and be controlled by the selecting circuits of the master board.

An additional object is to permit the stock quotations to be transmitted as they appear on the ticker tape, and yet have the transmitted quotations control the master board and the average price computer.

Another object is to facilitate a change in the group divisor whenever stock split-ups or stock dividends are declared on any of the stocks in the group to be averaged, in order that the average price of this group can be properly obtained. The group divisor is that quantity by which each price rise or fall of any stock in the group to be averaged is divided in order to determine the amount to be added to, or subtracted from, the previous average price of the group in finding the new average price of the group.

Another object is to permit the digits and fractions of a price on any stock to be averaged simultaneously.

The present invention is designed for employment with a stock quotation system of the type disclosed in copending application, Serial No. 495,370, filed on November 30, 1930 in the names of A. A. Clokey and G. S. Vernam. This

co-pending application discloses a plurality of receiving boards located at an equal number of receiving stations on each of which quotations are simultaneously posted in response to signals received from a central or sending station.

In addition to these receiving boards, the present invention contemplates the provision at the central station of a board similar to these receiving boards and controlled, as they are, by a common transmitting means at the central station. This additional board, which may be termed a master board, provides a check on the signals transmitted by the sending operator.

The present invention further contemplates the provision of an average price computer associated with and controlled by the master board.

Accordingly, one of the principal features of the invention consists of an average price computer controlled by a master board which, in turn, is under the control of a transmitting means common to it and to a plurality of receiving boards located at an equal number of receiving stations.

In response to received signals, certain means in the master board effect the selection of an indicator unit in the average price computer for displaying quotations on the desired stock, providing, of course, that the quotation represented by the received signals relates to a stock in the group to be averaged, and, subsequently, other means in the master board repeat the price impulses into the computer.

Accordingly, another feature comprises the means in the master board for selecting the indicator units in the recorder and the additional means for repeating the price impulses into the recorder.

The price impulses received from the master board are stored by the average price computer and then the stored price, if it is the price of a stock in the group to be averaged, is compared with the previous price on the same stock for the purpose of determining, not only whether the entire stored price is a "high" or a "low", but also whether the fraction of the stored price is higher or lower than the fraction of the previous price.

Accordingly, an additional feature consists of the means for storing the price impulses received from the master board, and the additional means for comparing the stored price with the previous price on the same stock.

The average price computer then finds the difference between the stored price and the pre-

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vious price on the same stock and then this difference is stored. At the same time the stored price is posted on the previous selected indicator unit.

- 5 Accordingly, a further feature is the means for determining and then storing the price difference between the stored price and the previous price on the same stock.

- 10 If the stored price is a "high", the price difference then found is utilized to control the average price register. If, however, the stored price is a "low", this price difference is incorrect as it represents the price difference when the stored price is higher than the previous price on the same stock. When the stored price is a "low", therefore, this price difference must be modified to correspond to the real price difference between the stored and previous prices. For purposes of identifying these two price differences, the price difference when the stored price is a "high" may be said to be unmodified and the price difference when the stored price is a "low" may be said to be modified.

- 25 Accordingly, another feature of this invention is the means effective when the stored price is a "low" for modifying the previously found price difference to find the correct price difference.

- Furthermore, whenever the entire stored price is a "low" and the fraction "high", or vice versa, both the modified and unmodified price differences are adjusted to compensate for the "decimal progression" which occurs in the process of addition and subtraction, as exemplified in arithmetical addition and subtraction by the acts of "carrying forward" and "taking away".

- 30 Accordingly, a further object is the means for adjusting the price difference previously found whenever the entire price is "low" and the fraction "high", or vice versa.

- 40 When the stored price is a "high", the average price register is then advanced in accordance with the average of the unmodified price difference, compensated or not for "decimal progression", as the case may be, and when the stored price is a "low" the register is turned back in accordance with the average of the modified price difference, compensated or not, as the case may be, for "decimal progression."

- 45 Accordingly, another feature is the means for causing the average price register to be turned back whenever the stored price is a "low."

- 50 The average price register of the computer is in view of the sending operator, who can transmit the average price quotations on this group, or any other group, as often as they change. The average price is then posted on special indicator units on the master and on the receiving boards.

- 55 Other objects and features will become apparent from the following specification, the appended claims, and the attached drawings, wherein:

- Fig. 1 illustrates a transmitter, transmitting distributor, and associated sending relays for controlling the operation of the master and receiving boards and the average price computer;

- Fig. 2 illustrates a receiving and an auxiliary distributor together with a permutation unit for controlling the master board and the average price computer.

- Fig. 3 shows the stock selection circuits including the various transfer and stock selection relays.

- Fig. 4 illustrates the price selecting circuits of the master board used for integer selection;

Fig. 5 illustrates the fraction price selection circuits of the master board;

Fig. 6 illustrates certain control circuits;

Fig. 7 illustrates the hundreds and tens price storage relays, the hundreds, tens, units and fractions high and low price relays, and the high and low price relays for the entire price and for the fraction of the price of the computer.

Fig. 8 illustrates the computer units price storage relays, and the repeaters associated, respectively, with the units price storage relays and the fractions price relays;

Fig. 9 illustrates certain multiple connections between the contacts of the price storage relays and the commutator contacts of Fig. 10;

Fig. 10 illustrates the indicators of a single stock in the average price computer with their associated commutators and the indicator positioning means, together with the multiple connections between the commutators associated with different average price computer stock indicators and the common price storage relays;

Fig. 11 illustrates the units counting and control relays;

Fig. 12 illustrates the fractions counting and control relays;

Fig. 13 illustrates the register and the driving means therefor;

Fig. 14 illustrates the details of the indicator employed in the indicating mechanisms of the computer together with its associated commutator;

Fig. 15 illustrates the relation between the shaft for positioning the indicator and the brush on the commutator; and

Fig. 16 illustrates schematically the manner of associating the various figures of the drawings to form the drawing of the entire system.

It is to be noted that in the drawings the first figure of any reference character (the first two figures of the reference character if it contains four figures) is always the same as the number of the figure on which it appears.

A general description of the structure and operation of the system will be given here to facilitate an understanding of the detailed description to follow.

The apparatus disclosed in the drawings is located at a central or sending station. It comprises transmitting means O (Fig. 1), a master board (Figs. 2-6), and an average price computer (Figs. 7-13).

That portion of the master board essential to an understanding of the present invention comprises a receiving distributor P1 (Fig. 2), an auxiliary distributor P2 (Fig. 2), a permutation unit Q (Fig. 2), stock selection relays with their associated counting and transfer relays R3 (Fig. 3), digits price selection relays with their associated counting and transfer relays R1 (Fig. 4), fractions price selection relays with their associated counting and transfer relays R2 (Fig. 5), and a figure shift relay with its associated counting relays S (Fig. 6).

The average price computer comprises hundreds, tens and units price storage relays VI, V2 (Fig. 7) and V3 (Fig. 8), respectively, a plurality of indicator units each similar to that shown at U (Fig. 10) and the shafts and driving means for positioning the indicators, the individual digit and the fraction price comparing relays W1 (Fig. 7), the entire quotation and the fraction price comparing relays W2 (Fig. 7), the units repeater X2, and the fractions repeater X1 (Fig. 8), the units price

counting relays Y1 (Fig. 11), the units control relays Y2 (Fig. 11), the fractions price counting relays Y3 (Fig. 12), the fractions control relays Y4 (Fig. 12), and the register with its controlling means Z (Fig. 13).

The operation of the system just outlined is as follows. The transmitting means O (Fig. 1) sends stock selection and price selection signals simultaneously over the lines L2 to a plurality of receiving quotation boards and over the line L1 to the receiving relay 203 of the master board. As the operation of the receiving boards in response to the received signals may be understood by reference to the above-mentioned pending application, and as these boards form no part of the present invention, a description of them will be omitted herein. The signals received by the receiving relay 203 of the master board start the receiving distributor P1 (Fig. 2) which in turn causes the auxiliary distributor P2 to start. The receiving distributor P1 predetermines which of the circuits P—O, S—N, A—M and 1—5, controlled by the permutation unit Q, are to be subsequently closed. The auxiliary distributor P2 completes the pre-selected circuit through the permutation unit and also restores the permutation unit to its normal condition, upon which it is ready to receive a new set of impulses from the transmitting means O.

It is evident from the description up to this point that, by sending a plurality of signals over the line L1, the transmitting means O can successively operate the permutation unit Q to close, upon each operation, any one of the conductors in the four groups P—O, S—N, A—M and 1—5.

Before continuing with a description of the operation it should be pointed out here that the stock selection relays 310—315 are divided into three groups, namely, into one, two and three letter groups. The first three groups of conductors P—O, S—N and A—M are normally associated with corresponding stock selection relays in the one letter group.

Now, when the permutation unit Q is operated by the first received stock selection signal, the proper stock selection relay of the one letter group is operated, and the three conductor groups mentioned are associated with corresponding stock selection relays in the two letter group.

Similarly, when the permutation unit Q is operated by the second and third received stock selection signals, the proper stock selection relays in the two and three letter groups, respectively, are operated, for, upon the operation of the two letter relay, the three conductor groups mentioned are associated with corresponding relays in the three letter group.

The operated stock selection relays complete a jointly controlled operating circuit for a stock relay, as 1015, thereby selecting an indicator unit, as U (Fig. 10), of the average price computer.

After the stock selecting signals have been received, a shelf selecting signal, or a special figure shift signal, is received by the master board. Whichever of these signals is received causes the permutation unit Q to close one of the conductors 1—4, thus operating a figure shift relay 606. The operation of this relay causes the conductors P—O to be transferred into association with the hundreds price selection relays 410—419, and the conductors S—N

to be transferred into association with the fractions price selection relays 504—511. In addition, whenever either type of signal is received, certain relays of the average price computer are cleared out, as will be explained later. The clearing out of these relays conditions the recorder for another operation.

When the permutation unit Q is operated by the next received signal, the first price selecting signal, the proper price selection relay in the hundreds group 410—419 is operated, and the conductors P—O are transferred into association with the tens price selection relays 420—429.

Similarly, when the permutation unit Q is operated by the second and third received price selection signals, the proper relay in the tens and units price selection relay groups 420—429 and 430—439, respectively, is operated, for upon the operation of the tens price selection relay the conductors P—O are transferred into association with the units price selection relays 430—439.

Upon the next received price signal, the permutation unit Q is operated to close one of the conductors S—N, thus operating the proper fractions price selection relay in the group 504—511.

The foregoing description covers the operation of as much of the master board as is necessary to an understanding of the present invention. The operation of the average price computer in posting the price of a stock in the average group and in determining the new average price of the group will now be explained.

When the stock relay 1015 is operated, the wipers N of commutators 1005—1008 in the selected indicator unit are each connected to one of the groups of price storage relays V1, V2 and V3 (Figs. 7 and 8) and to the fractions price selection relays 504—511.

Assuming that a complete price has been received by the master board, a relay in each of the hundreds, tens, units and fractions price selection relay groups is operated. In this case, the operated hundreds, tens and units price selection relays will cause the operation of corresponding relays in the hundreds, tens and units price storage relay groups V1, V2 and V3.

If a partial price has been received by the master board, transfer means, to be explained in detail later, are provided so that the operated digits price selection relays will complete operating circuits for the proper digits price storage relays.

When a relay in the hundreds price storage relay group V1 is operated, an associated relay 723 completes, through the segment on which the wiper N of the hundreds commutator 1005 was last stopped and through the contacts of the hundreds price storage relays, a circuit for operating either a hundreds high relay 726 or a hundreds low relay 727; the relay operated depending upon whether the hundreds digit of the stored price is higher or lower than the hundreds digit of the previous price on the same stock.

Similarly, a relay 722 associated with the tens price storage relays V2, when operated, completes an operating circuit for either a tens high or low relay 728 or 729, depending upon whether the tens digit of the stored price is higher or lower than the tens digit of the previous price;

a relay 822 associated with the units price storage relays V3, when operated, completes an operating circuit for either a units high relay 730 or a units low relay 731, depending upon whether the units digit of the stored price is higher or lower than the units digit of the previous price on the same stock; while a relay 512 associated with the fractions price selection relays 504—511, when operated, completes an operating circuit for either a fractions high relay 732 or a fractions low relay 733, depending upon whether the fractions of the stored price is higher or lower than the fraction of the previous price on the same stock.

The operated high or low relay corresponding to the highest order of the price controls the relays 734 and 735, while the fractions high relay 732 controls the relay 736 and the fractions low relay 733 controls the relay 737.

The relays W2 serve, then, to indicate whether the entire stored price is higher or lower than the previous price on the same stock and also whether the fraction of the stored price is higher or lower than the fraction of the previous price.

After these price comparisons have been made, the four clutch magnets 1016, 1023, 1025, etc., of the indicators in the selected unit are energized, clutching the indicators and the brushes N of the associated commutators 1005—1008 to power driven shafts 1009—1012.

Each commutator brush N is then carried over its associated commutator segments until it reaches a particular segment corresponding to the operated price storage relay in the associated group. As each wiper N reaches this segment the associated clutch magnet 1016 is de-energized and the wiper comes to rest. Thus, when the stored price is "high", each commutator wiper traverses a number of segments corresponding to the number of points change in each digit and fraction and when the stored price is "low", each commutator wiper traverses a number of segments, which in the case of any digits commutator corresponds to the number that, subtracted from 10, will give the digits change and which in the case of the fractions commutator corresponds to the number that, subtracted from 1, will give the fractions change in eighths.

For each segment of the units commutator 1007 traversed by the brush N, the units repeater X2 is operated to repeat an impulse into the units counting relay group Y1. Similarly, for each segment of the fractions commutator 1008 traversed by the associated brush the fractions repeater X1 is operated to repeat an impulse into the fractions counting relay group Y3. It is, therefore, evident that the number of segments crossed by the brushes of the units commutator 1007 and the fraction commutator 1008 will be indicated by the number of operated counting relays in the units group Y1 and the fraction group Y3, respectively. It is assumed that no increment in price change will be greater than ten points, hence this change in the price of any stock in the group to be averaged can be fully recorded in the two groups of counting relays shown.

If the new price establishes a "high", that is, if the change of price is in a positive direction, the number of operated relays in the units counting relay group Y1 indicates the price change in units, and the number of operated relays in the fractions counting relay group Y3 indicates the price change in fractions. If the new price es-

tablishes a "low", that is, if the change is in a negative direction, the number of unoperated relays in the two counting relay groups, rather than the number of operated relays, indicates the price change in units and fractions. In the latter case, that is, when the entire new price is "low", the two transfer relays 1101 and 1201 operate. The operation of these relays places the register at Z (Fig. 13) under control of the unoperated, rather than the operated, counting relays in the two groups Y1 and Y3. The register will, therefore, be controlled by 10 minus the number of operated units counting relays and by 1 minus the number of operated fractions counting relays.

The operated or unoperated units counting relays, as the case may be, complete multiple operating circuits for the units start magnet 1301 which releases the units shaft 1306. This shaft turns one or more revolutions corresponding to the change in the units part of the price. For each revolution made by the shaft 1306, a control relay of the group Y2 is operated to disable one of the multiple operating circuits for the units start magnet 1301. Consequently, when the units shaft 1306 has made a number of revolutions equal to the number of operated units counting relays, in one case, and equal to the number of unoperated units counting relays, in the other case, the units start magnet 1301 is released and the units shaft 1306 is stopped.

Similarly, the operated or unoperated fractions counting relays, as the case may be, complete multiple operating circuits for the fractions start magnet 1302, which releases the fractions shaft 1312. This shaft turns through a part of a revolution proportional to the fractional change in price, after which it is brought to rest by the release of the fractions start magnet 1302, which occurs when its last operating circuit is opened by the operation of a selection control relay in the group Y4.

The motion of the two shafts 1306 and 1312 is transmitted through the differential gearing 1318 to the shaft 1319, and the shaft 1319, in turn, causes a corresponding motion of the revolution indicator shaft 1304. Thus, the changes in price in both units and fractions are transformed into a corresponding rotary motion, which, in turn, effects the setting of the revolution indicator.

It should be noted that before the system is put into operation, the revolution indicator or register 1303 is manually set to the figures indicating the average price of the groups of stocks to be averaged. The wipers N of the commutators 1005—1008 associated with this group of stocks are also positioned to indicate the current price of each stock.

Turning now to the description of the apparatus employed in carrying out the invention, Fig. 10 illustrates schematically an indicator mechanism of the average price computer for displaying the usual "last" price quotations on a single stock in the group to be averaged. In actual practice the computer would be provided with as many indicating mechanisms as there are stocks in the group to be averaged by this recorder. The indicating mechanism for each stock can be operated independently of the indicating mechanism for the other stocks, though as will be described later, the indicating mechanism for the several stocks are operated from the same transmitting device.

As every indicating mechanism in the average price computer is similar to the one shown in

Fig. 10, a description of this one will serve for all. The indicating mechanism comprises four indicators, one, 1001, adapted to indicate the hundreds digits of the price, another, 1002, the tens digits, a third, 1003, the units digit, and the last, 1004, the fraction. Associated with the indicators 1001—1004 are commutators 1005—1008, respectively.

The indicators of each mechanism are arranged side by side, and in practice, all of the indicators of the recorder are arranged behind a board or partition (not shown) which has windows therein through which a portion of the periphery of each indicator is visible. On the peripheries of the hundreds, tens and units indicators appear the figures 0 and 1-9, and on the fractions indicators appear the quantities 0 and $\frac{1}{8}$ - $\frac{7}{8}$. Whenever a quotation is to be posted, the transmitting means, provided the transmitted quotation relates to a stock in the group to be averaged, sets in operation the selecting mechanism and the indicator operating mechanism of the computer, as will be described later, with the result that predetermined indicators in a selected indicating mechanism of the computer are turned until the quotation to be indicated is visible to the sending operator through the windows in the front of the board (not shown).

Corresponding indicators in the different indicating mechanisms of the computer are mounted on one of four shafts 1009—1012 or on other shafts (not shown) driven thereby. For example, every hundreds indicator 1001 is mounted on shaft 1009, every tens indicator 1002 on shaft 1010, every units indicator 1003 on shaft 1011, and every fractions indicator 1004 on shaft 1012. These shafts are arranged to be driven through shaft 1013 by a continuously operating motor 1014.

The construction of the indicators, the method of positioning them by rotating the shafts, and the construction of the commutators will now be explained by reference to Figs. 14 and 15.

Referring to Fig. 14, the indicator drum 1401 is a thin metal cylinder about $1\frac{1}{2}$ " in diameter and $1\frac{3}{8}$ " long, which carries, as previously pointed out, the numerals 0 and 1-9 on its periphery if the indicator is a digit indicator and the quantities 0 and $\frac{1}{8}$ - $\frac{7}{8}$ if the indicator is a fractions indicator. The cylinder is attached at the top to a metal disc 1402 which carries a flange 1403, into which is inserted a tube 1404. Tube 1404 carries a drive tooth 1405 (see also Fig. 15) co-operating with a sleeve 1406. Attached to this sleeve but insulated from it is a double-ended wiper 1407 adapted to wipe over a plurality of commutator segments 1408 and a common ring 1415. A vertical shaft 1409, continuously rotated by the motor 1014, extends through tube 1404 without touching it.

Disc 1402 is the armature of an iron-clad electro-magnet comprising coil 1410, the core of which is a split metal tube 1411. Coil 1410 and the outer portion of tube 1411 are cut away to show shaft 1409 and other portions of the mechanism more clearly. The magnetic circuit consists of a split metal tube 1412, surrounding the coils, and a metal disc 1413 at the bottom of the coil.

The entire magnet comprising coil 1410, core 1411, casing 1412, and disc 1413 is supported by an external support 1414 through which shaft 1409 extends. The indicator drum 1401 and the wiper 1407 are, thus, free to rotate, while the

indicator, though not the wiper 1407, is free to move vertically. The vertical travel of the indicator is limited by stops to be described later. As shown by Figs. 14 and 15, the drive tooth 1405 is positioned in a vertical slot extending from the top to the bottom of the sleeve 1406. It is thus apparent that the vertical movement of the sleeve 1404 will not be transferred to the wiper 1407.

Inserted above coil 1410 between tubes 1411 and 1412 is a fibre piece 1430, on which rests a helical spring 1416 which presses upwards and against disc 1402 and thus tends to move the disc and the indicator drum 1401 upward. Around the outer edges of drum 1401 and the flange of disc 1402 are the uniformly spaced slots 1420. On the fixed support 1422, which carries the commutator segments 1408, is mounted a stop spring 1421 which engages these slots to prevent rotation of the indicator drum 1401 when it is in the upper position. When the coil 1410 of the magnet, hereinafter called the clutch magnet, is energized, the drum 1402 is driven downward and the slots clear the stop spring 1421, freeing the indicator drum 1401 for rotation.

A metal tube 1426 provided with a hub extends through magnet support 1414 and the lower part of magnet core 1411. The hub of this tube is attached to shaft 1409 and rotates with it. A tooth 1427 is formed on the upper part of the tube and is adapted to engage a similarly shaped tooth 1428 on the lower edge of the tube 1404.

The commutator consists of the wiper 1407, which rotates in a plane perpendicular to the axis of the shaft 1409, a common ring 1415, and segments 1408. One end of the wiper is adapted to make contact with the common ring and the other to make contact with any one of the segments. If the indicator is to be used in either the hundreds, tens or units position, the associated commutator is provided with ten segments 1408, each corresponding to one of the ten digits on the periphery of the drum 1401; while if the indicator is to be used in the fractions position, the associated commutator is provided with eight segments 1408, each corresponding to one of the eight quantities on the periphery of this drum. These segments are mounted in an insulated strip 1422 which is externally supported and maintained in a fixed position.

When the indicator clutch magnet 1410 is energized, the indicator drum 1401 is attracted, thereby vertically aligning teeth 1427 and 1428, after which tooth 1427 strikes tooth 1428 causing rotation of the indicator drum 1401 and the wiper 1407 of the associated commutator. When the circuit of the clutch magnet is broken, in a manner that will be described later, the indicator drum 1401 is released and tooth 1428 is moved out of engagement with tooth 1427. When this occurs, as previously explained, the stop 1421 engaging one of the slots 1420 causes the indicator drum 1401 to stop in the position of release.

Likewise, when the indicator clutch magnet 1410 is energized and the tube 1404 rotated, wiper 1407 is rotated, wiping over both the common ring and the segments of the commutator until it is brought to rest by the arresting of the indicator drum 1401. At this point it is proper to mention that the wiper 1407 is so mounted on tubing 1404 as to be in phase with tooth 1428, and consequently, when the tooth 1427 is driven

ing tooth 1428 and the digit 1 on the indicator drum 1401 is in the display position, wiper 1407 will rest on the commutator segment 1408 corresponding to the numeral 1.

Consequently, when the clutch magnet 1410 of the indicator is released and the indicator drum 1401 is locked in the position of release, the brush 1407 of the associated commutator is brought to rest on the segment corresponding to the digit or fraction displayed by the indicator.

Associated with each indicating mechanism in the computer, as the one illustrated in Fig. 10, is a stock relay 1015. When operated this relay serves to condition for selection the clutch magnets of all the indicators in the associated mechanism and to prepare circuits which are to be subsequently extended through the commutators 1005—1008 for the purpose of controlling the average price computer.

Before describing the means for selecting the various stock relays, and also before describing the means for determining what control circuits are to be extended through the commutators 1005—1008, the transmitter and the associated permutation unit for controlling both of these means will be described.

Referring to Fig. 1, a transmitting means O controls the operation of the master board and all of the receiving boards (not shown), as well as the operation of the average price computer.

The transmitting means O is located at the sending operator's position. It comprises a tape sending distributor 101, a keyboard transmitter 131, a tape printer 130, a key 126, a master sending relay 104, a local record relay 105, and sending relays 106 and 107.

The tape sending distributor unit 101 comprises a motor driven brush arm 110 (the motor not shown) arranged to be driven over a distributor face having a common ring 111 and a segmented ring having seven segments 112—118. The tape sending unit includes a transmitter, similar to those used for multiplex transmission, having five armatures 119—123 arranged to make contact with grounded common contact strip 124, which is connected to segment 112 of the distributor ring, or to make contact with common contact 125 which is open. The armatures 119—123 are connected to the segments 114—118, respectively, of the distributor ring.

The position of the armatures 119—123 depends upon the perforations in the prepared tape. Associated with each armature is a pin (not shown). If there is a perforation in the tape above this pin, the armature makes contact with contact strip 124; if there is no perforation above this pin, the armature makes contact with contact strip 125. The perforated tape is stepped ahead mechanically by a cam (not shown) on the brush arm driving shaft (not shown), rather than by a magnet, as is usual in multiplex transmitters. Brush arm 110 is driven through a friction clutch (not shown) and may be stopped by lifting tape stop lever 126. The lifting of this lever opens the circuit of the clutch magnet 127, thereby releasing stop arm 128 which brings brush arm 110 to rest on segment 112. When the tape stop lever 126 is down brush arm 110 rotates continuously.

The tape controlled distributor 110 is employed only during the busy hours of the market day. At other times the keyboard transmitter 131 is used to transmit the selection sig-

nals. By operating the key 103 the tape controlled distributor 110 can be disconnected from, and the keyboard transmitter 131 connected into, the transmitting circuit.

The master sending relay 104 is a polarized relay and has a right-hand or operating winding and a left-hand or biasing winding through which a current of approximately 30 milliamperes flows. When the operating winding is open, the biasing winding serves to hold the relay armature on the S contact, but when the operating winding is closed the relay armature is moved to the M contact.

The sending relays 105—107 are arranged to operate in unison with the master relay. That is, when the armature of master relay 104 rests on contact M, battery flows through the sending relay windings in such a direction that these relays move their armatures to their M contacts; and when the armature of relay 104 rests on its S contact, battery flows through the sending relay windings in the opposite direction, thus causing these relays to move their armatures to their S contacts.

As previously stated, the receiving boards controlled by sending relay 107 over line L2 are similar to the boards disclosed in the previously mentioned co-pending application, and their operation will not be described here. Sending relay 105 controls the local printer 130, thus giving the sending operator a record of the signals transmitted. Sending relay 106 controls the master board. It is obvious that additional sending relays, also controlled by the master relay 104, might be added to control any desired number of additional receiving boards.

It is evident from the foregoing description that a perforated tape fed through the transmitter or the operation of the keyboard transmitter 131 will cause the master relay 104 to be operated in accordance with the perforations in the tape, and that the sending relays 105—107 will follow the operations of the master relay.

The permutation unit Q, which is controlled by the sending relay 106 and which, in turn, controls the master board, will now be described. Referring to Fig. 2, a receiving relay 203 is controlled over line L1 by sending relay 106. Associated with the relay 203 is a receiving distributor P1, and controlled by the receiving distributor is an auxiliary distributor P2. The receiving distributor P1 is maintained in synchronism with the sending distributor of Fig. 1 by the start-stop method; that is, the motor driven brush arm 210 of the receiving distributor is rotated about 12% faster than the motor driven brush 110 of the sending distributor and is arranged to be stopped at the end of one revolution and to be started at the beginning of the next revolution, in phase with the transmitting brush.

Rigidly mounted on the drive shaft (not shown) of brush arm 210 are cams 221 and 223. The cam 221 has a projection which is adapted to be engaged by an armature 220 of a start relay 219. When this occurs the friction clutch (not shown) is disengaged, and the brush arm 210, which is driven through the friction clutch, is brought to rest. When relay 203 closes its S contacts on the receipt of a start signal, start relay 219 is energized, disengaging its armature 220 from the projection on the cam 221, thus allowing the brush arm 210 to be driven through the friction clutch (not shown). The other cam 223, co-operating with spring contacts 222, serves

to prevent any further energization of start relay 219 until after the brush arm 210 has completed this revolution.

The auxiliary distributor P2 is likewise of the start-stop type. It also has associated with it a start relay 247, having an armature 248 which co-operates with a cam 249, in the manner previously described, to start and stop the rotation of brush arm 260.

Associated with these two distributors is the permutation unit Q. The function of the permutation unit Q, as previously pointed out, is to associate any one of four groups of conductors P—O, S—N, A—M and 1—5 with conductor 241, which is controlled by the auxiliary distributor P2. The permutation unit comprises two groups of relays 250—255 and 270—274 and 276, which jointly control the connection of any one of the four groups of conductors to conductor 241. During each revolution of the distributor brush 210, predetermined relays in the group 250—254 are operated in accordance with received signals. The operation of any of the relays 250—254 prepares an operating circuit for a corresponding relay in group 270—274. During each revolution of the auxiliary distributor brush 260, the conditioned relays in group 270—274 are operated, and then relay 255 is operated to effect the release of the operated relays in group 250—254. The operation of predetermined relays in group 270—274 connects one of the thirty-two conductors in the four groups to conductor 241. Following this, the auxiliary distributor brush 260 connects battery to the selected conductor connected to conductor 241 and also to conductor 277, and finally completes the circuit of relay 273 which effects the release of the operated relays in group 270—274.

It is thus evident that the permutation unit can be selectively operated by signals sent from the transmitting means O to select a predetermined one of the four groups of conductors, and that parallel circuits including this conductor and conductor 277 can be closed and the permutation unit then released to await the reception of the next signal.

The first group of conductors P—O and the second group S—N are joint stock and price selecting circuits. The third group A—M are stock selecting circuits only, and the fourth group 1—5 are "stunt" circuits whose function will be explained later.

The means for selecting the indicating mechanisms of the master board adapted to display quotations on the various stocks and the indicating mechanisms of the computer adapted to display quotations on the stocks in the group to be averaged will now be described. All of these indicating mechanisms, as previously stated, are divided into three groups, one comprising indicating mechanisms for displaying quotations on stocks designated by one letter, another comprising indicating mechanisms for displaying quotations on stocks designated by two letters, and the last comprising indicating mechanisms for displaying quotations on stocks designated by three letters.

The stock selection relays shown in Fig. 3 are located in the master board and serve to select the indicating mechanisms of the master board as well as those of the average price computer. They, like the indicating mechanisms themselves, are divided into three groups of one, two and three letter stock selection relays. The one letter group, the two letter group in co-operation

with the one letter group, and the three letter group in co-operation with the one and two letter groups, serve to select corresponding stock relays in the one, two and three letter groups, respectively, in both the master board and in the average price computer. Consequently, by means of these stock selection relays, any indicating mechanism for displaying quotations on a stock designated by one, two or three letters, and located within the master board or in the average price computer, can be selected.

Each of the three groups of stock selection relays may be provided with twenty-six relays, in which case the one letter group can select any one of twenty-six stock relays, the two letter group can select any one of 676 stock relays, and the three letter group can select any one of 17,576 stock relays. As each stock relay serves to select a particular indicating mechanism, and each indicating mechanism is adapted to display quotations on a particular stock, it is evident that in this case any one of 18,278 different stock indicating mechanisms can be selected in either the master board or the average price computer. Since it is unnecessary, in actual practice, to select this large number of stock indicating mechanisms in the master board, and unnecessary to select more than thirty or forty stock indicating mechanisms in the average price computer, each of the three groups of price selection relays would be provided with a smaller number of relays than twenty-six.

In the drawings, only two stock selection relays are shown in each group, as this number is sufficient to illustrate the stock selecting operation. Relays 310 and 311 are the M and P relays, respectively, in the one letter group; relays 312 and 313 are the M and P relays, respectively, in the two letter group; and relays 314 and 315 are the M and P relays, respectively, in the three letter group.

The three groups of conductors P—O, S—N and A—M controlled by the permutation unit Q, are normally connected to corresponding stock selection relays in the one letter group. For example, conductor P is normally connected to relay 311, which is the P relay in the one letter groups, and conductor M is normally connected to relay 310, which is the M relay in the same group.

Since the one letter group of selection relays is normally the only group conditioned for election, means must be provided for subsequently conditioning the stock selection relays in the two and three letter groups for selection. In other words, means must be provided for consecutively connecting the three groups of conductors P—O, S—N and A—M, controlled by the permutation unit Q, to the stock selection relays in the second and third groups. These means comprise three pairs of counting relays 305 and 305', 306 and 306', 307 and 307', a pulsing relay 304 and three transfer relays 301—303. The pulsing relay 304, which is connected to conductor 277 under control of the auxiliary distributor P2, is operated whenever a stock selection relay is energized. The pairs of counting relays serve to count the number of operations of the pulsing relay 304, which is in effect to count the number of stock selection relay groups in which a relay is selected. It should be noted that, upon the receipt of the first price or a shelf selecting signal, the circuit of the pulsing relay is opened, in a manner to be explained later, thus preventing a false stock selection

should another letter signal be inadvertently transmitted. The first pair of counting relays 305 and 305' are operated upon the first operation of the pulsing relay 304, the second pair 306 and 306' and the third pair 307 and 307' are successively operated upon the second and third operations, respectively, of the pulsing relay. It is to be noted that, when the pulsing relay operates, the first relay of the pair of counting relays, as 305 in the first pair, is operated and the second relay, as 305', conditioned for operation. The second relay does not operate at this time as both terminals of its winding are grounded, but upon the release of the pulsing relay 304 the second relay, as 305', then energizes. The transfer relay 301, which is responsive to relay 305', serves to connect each of the stock selection relays in the two letter group to a corresponding conductor in the first three groups controlled by the permutation unit Q. For example, conductor M is connected to relay 312 which is the M relay in the two letter group, and conductor P is connected to relay 313 which is the P relay in the same group.

The transfer relay 302, which is responsive to relay 306', serves to connect each of the stock selection relays in the three letter group to a corresponding one of the first three groups of conductors controlled by the permutation unit Q. For example, conductor M is connected to relay 314 which is the M relay in the three letter group, and conductor P is connected to relay 315 which is the P relay in the same group. The transfer relay 303, which is responsive to relay 307', serves a function to be presently described.

When one of the single letter stock selection relays, as 310, is operated, a stock relay associated with an indicating mechanism adapted to display quotations on a stock designated by a single letter, as M, is selected in the master board and in the average price recorder, the latter selection, of course, depending upon whether the stock M is in the group to be averaged. When one of the single letter stock selection relays, as 311, and one of the two letter selection relays, as 312, are operated, a stock relay associated with an indicating mechanism, adapted to display quotations on a stock designated by two letters, as PM, is selected in the master board and in the average price recorder, the latter selection likewise depending upon whether the stock PM is in the group to be averaged. When one of the single letter stock selection relays, as 310, one of the two letter stock selection relays, as 312, and one of the three letter relays, as 314, are operated, a stock relay, as 1015, associated with an indicating mechanism adapted to display quotations on a stock designated by three letters, as MMM, is selected in the master board and in the average price computer, the latter selection also depending upon whether the stock MMM is in the group to be averaged. When the transfer relay 303 is de-energized, the selecting circuits for the group of two letter stock relays extend through one set of its contacts; and when this relay is energized, the selecting circuits for the group of three letter stock relays extend through another set of its contacts.

It is evident from the foregoing description that, by successively operating the permutation unit Q, a stock selection relay in any one of the three stock selection groups can be selectively operated, and any stock relay in any one of

three groups in both the master board and the average price computer thereby selected. The means for effecting the selection of the stock relays in the master board are, of course, not shown in the drawings. But by reference to the above-mentioned co-pending application these means and the method of controlling them by the joint operation of the one, two and three letter stock selection relays will be understood.

The means for repeating the price impulses received from the transmitter into the proper storage relay groups in the average price computer will now be explained. In Fig. 4 three groups of integer price selection relays, and in Fig. 5 a group of fraction price selection relays, are shown. The three groups of integer price selection relays comprise a group of hundreds relays, as 410 and 419, a group of tens relays, as 420 and 429, and a group of units relays 430 and 439. In the drawings only two relays are shown in each of these three groups, but in practice each group would be provided with eight additional relays, making ten in all; that is, one relay for each of the numerals on the peripheries of the hundreds, tens and units indicators, and for each of the contacts A—J on the commutators 1005—1007 associated with the digit indicators of each indicating mechanism. In the fraction group eight relays 504—511 are shown, one for each of the quantities on the periphery of each of the fraction indicators, and for each of the contacts A—H on the commutators 1008 associated with the fractions indicators.

It was previously explained that the first two groups of conductors P—O and S—N, controlled by the permutation unit Q, are joint stock and price selecting circuits and are normally connected to corresponding stock selection relays in the one letter group, and then are successively connected to corresponding stock selection relays in the two and three letter groups. The price selection relays, consequently, are not normally conditioned for selection, and means must be provided for associating them with the two groups of conductors mentioned. These means comprise two transfer relays, one 401 associated with the integer price selection relays, and the other 501 associated with the fractions price selection relays. The relays 401 and 501 are adapted to be simultaneously operated in a manner to be described later. Relay 401, when operated, serves to connect each of the first group of conductors P—Q to a corresponding price selection relay in the hundreds group. Relay 501, when operated, serves to connect each of the second group of conductors S—N to a corresponding price selection relay in the fractions group.

Additional means are provided for successively connecting each of the conductors in the first group P—O to a corresponding price selection relay in the tens group and to a corresponding price selection relay in the units group. These means comprise three pairs of counting relays 405 and 405', 406 and 406', and 407 and 407', a pulsing relay 404 and two transfer relays 402 and 403. The pulsing relay 404 is operated whenever any one of the hundreds, tens or units price selection relays is energized. The counting relays serve to count the number of operations of the pulsing relay, which is in effect to count the number of digit price selection groups in which a relay is selected. When a hundreds price selection relay is operated, the

first pair of counting relays 405 and 405' is energized, and they in turn cause transfer relay 402 to operate, thus connecting each of the first group of conductors P—O to a corresponding relay in the tens group 420—429. Similarly, the selection of a tens relay is followed by the operation of the second pair of counting relays 406 and 406' and the transfer relay 403, with the result that each of the first group of conductors P—O is connected to a corresponding relay in the units group 430—439; while the selection of a units relay is followed by the operation of the third pair of counting relays 407 and 407', with the result, among other things to be described later, that the operating circuit of the pulsing relay 404 is opened. The opening of this circuit prevents any further operation of the counting relays by a false operation of the pulsing relay.

Upon the operation of the transfer relay 501, the fraction relays 504—511, as previously stated, are conditioned for selection by the permutation unit Q. Associated with the fractions relays pair are two counting relays 503 and 503' which are adapted to be operated under control of a pulsing relay 502. The pulsing relay is operated when a fraction price selection relay is operated. The first relay 503 of the pair is energized upon the operation of the associated pulsing relay 502, and at the same time the second relay of the pair 503' is prepared for operation but is not then operated since both terminals of its winding are grounded. However, upon the release of the pulsing relay the second relay 503' of the pair is operated.

A digression is necessary here to describe the price storage relays V1—V3 (Figs. 7 and 8) of the average price computer. Relays 700—709 are the hundreds price storage relays, 710—719 are the tens, and 811—820 are the units price storage relays. Only two relays are shown in each group of storage relays, as this number is sufficient to explain the operation of these relays. It is to be understood, however, that each of the digits groups includes eight additional relays, making ten relays in all in each group, one for each of the digits on the corresponding indicators of the recorder. There are no fractions price storage relays, as such, for the fractions price selection relays 504—511 perform the double functions of price selection and price storage relays. They can perform this double function because the fractions price selection relays are invariably operated by the fraction price signals, and never by a price signal of a higher order, as are the digits price selection relays.

To return, it should be observed here that in the system disclosed by the above-mentioned co-pending application and also in the present system, the price is transmitted in a straightforward manner, that is, the highest order of the price is transmitted first and then the lesser orders are transmitted consecutively. If, for example, the entire price $128\frac{1}{2}$ is to be transmitted, the 1 is transmitted first, and then the 2, 8 and $\frac{1}{2}$ are successively transmitted. Furthermore, in posting a new quotation the entire price is not transmitted, but instead the highest order of the new price that differs from the previous price on the same stock is transmitted first, and then the lesser orders, if any, of the new price are transmitted consecutively thereafter. If, for example, a previous price is $128\frac{1}{2}$ and the new price is $138\frac{1}{2}$, the 3 is transmitted first since it is the highest order of the new price differing from the previous price, and then

the 8 and $\frac{1}{2}$ are successively transmitted. It may be remarked here that, for a reason that will be given later, the fraction of a price is invariably transmitted.

When it is remembered that the hundreds group of price selection relays is selected first, and then the tens and units groups successively thereafter, it is apparent that when the units digit is the highest order of the new price differing from the previous price, two price selecting signals will be transmitted, of which the first will cause one of the hundreds group and the second will cause one of the fractions group to be selected; when the tens digit is the highest order of the new price differing from the previous price, three price selecting signals will be transmitted, of which the first will cause one of the hundreds group, the second will cause one of the tens group, and the last will cause one of the fractions group to be selected; and when the hundreds digit is the highest order of the price differing from the previous price, four price selecting signals will be transmitted, of which the first will cause a relay in the hundreds group, the second will cause a relay in the tens group, the third will cause a relay in the units group, and the last will cause a relay in the fractions group to be selected.

From the foregoing explanation it is apparent that means must be provided for determining whether the hundreds price selection relays are to control the selection of the hundreds, tens or units price storage relays, and whether the tens price selection relays are to control the selection of the tens or units price storage relays. These means comprise the three pairs of counting relays 405 and 405', 406 and 406', 407 and 407', and the pulsing relay 404, certain functions of which have been previously described.

When a hundreds price selection relay is alone operated, the first pair of counting relays, 405 and 405', is actuated by the pulsing relay 404 with the result, as will be presently explained, that the operated hundreds relay is caused to control the selection of the corresponding units price storage relay; when a hundreds and a tens price selection relay are operated the first pair of counting relays, 405 and 405', and the second pair, 406 and 406', are successively operated, with the result that the operated hundreds price selection relay is caused to control the selection of the corresponding tens price storage relay and the operated tens price selection relay is caused to control the selection of the corresponding units price storage relay; and when a hundreds, tens and units relay are operated, then the three pairs of counting relays are operated, causing the operated hundreds, tens and units relays to control the selection of the corresponding hundreds, tens and units price storage relays, respectively.

Each of the price selection relays in the hundreds group serves, therefore, to prepare an operating circuit for the corresponding price storage relay in either the hundreds, tens or units price storage relay groups; each of the price selection relays in the tens group serves to prepare an operating circuit for the corresponding price storage relay in either the tens or units price storage relay groups; and each of the price selection relays in the units and fractions groups serves to prepare a circuit for the corresponding price storage relays in the units and fractions groups, respectively.

The operating circuits for the selected price

storage relays are completed upon the operation of counting relay 503 associated with the fractions price selection relays. The purpose of thus delaying the operation of the selected price storage relays is to permit all of the stored digits and fractions of the new price to be compared simultaneously with the digits of the corresponding orders and the fractions of the previous price on the same stock; this comparison of course taking place only if the stored price is on a stock in the group to be averaged.

Upon the operation of the storage relay in any group it locks up, completing an operating circuit for the associated relay, as 723, 722, 822 and 512, locking these up to ground through contacts of relay 604. The latter relays prepare circuits for comparing the several digits and fractions of the stored price.

It will be understood by reference to the above-mentioned co-pending application that the counting relays 405-407' control over conductors 440 the clutch magnets for the indicators in the selected indicating mechanism of the master board, while over conductors 441-443 and 544 the price selection relays ground the proper segments of the control commutators (not shown), thus controlling the position to which the various indicators in the selected indicating mechanism of the master board are to be set. As the means for thus setting the desired indicators on the master board form no part of the present invention, any mention thereof will be omitted here.

It was explained above that the present system is arranged so that the same selecting means, namely, the permutation unit Q, is effective to select both the stock selection relays of Fig. 3 and the price selection relays of Figs. 4 and 5, and that the transfer relays 401 and 501 serve to transfer the first two groups of conductors P-O and S-N, which are controlled by permutation unit Q, into association with the digits and fractions price selection relays. The control of these transfer relays and of certain other elements now to be pointed out are the functions of the pulsing relay 606 which co-operates with a pair of counting relays 604 and 605. The pulsing relay 606 is operable over any conductor 1-4 of the group of "stunt" conductors.

When relay 606 is operated, it opens the circuit of the stock selection pulsing relay 304 and effects the operation of relay 604. In operating, relay 604 first opens the locking conductor 650, thus releasing the previously locking price selection and storage relays, opens conductor 670, thus releasing any previously locked stock relays in the master board or in the average price computer, then completes an operating circuit for the transfer relays 401 and 501, and finally completes an operating circuit for the selected stock relays in the master board and average price computer. Relay 605, operating when relay 606 releases, opens the locking conductor 354, thus releasing the stock selection, counting and transfer relays, and closes the locking conductor 670, thus locking the selected stock relays. When the fractions counting relay 503 operates, relay 604 releases and after an interval relay 605, being slow releasing, also releases. Upon this release, these relays reverse the effects caused by their operation, as will be described in detail later. It should be noted here, however, that when relay 605 releases, which is after the price selection relays have been selected but

before the indicators selected by these relays have been positioned, the circuit of the stock pulsing relay 304 and the locking conductor 354 of the stock selection and counting relays are again closed. It is thus evident that the present invention provides overlap, in that the stock selection relays are conditioned for another stock selection while the indicators of the stock previously selected are being positioned in accordance with the prior quotation.

After the foregoing general description of the structure and operation of the transmitter and master board apparatus, insofar as it is necessary to an understanding of the operation of the average price recorder and of the price storage relays of the computer, a general description of the remaining structure of the computer, as well as its operation, will now be given.

The means in the average price computer for comparing the stored price with the previous price on the same stock will now be described. The purpose of comparing these two prices is to determine whether the entire stored price and also the fraction of this price is higher or lower than the entire previous price and fraction of this price, respectively. As will be explained in more detail later, whether the entire price is "high" or "low" must be determined, because the difference between the previous and stored prices is found in one manner when the stored price is high and in a different manner when the stored price is low, while, in addition, the computer register is advanced when the stored price is high and turned back when it is low. The additional determination must be made as to whether the fraction is high or low, because the difference between the two prices is adjusted to compensate for "decimal progression", whenever the entire stored price is "high" and its fraction "low" and whenever the entire stored price is "low" and its fraction "high".

The comparing means comprise a high and a low relay, 726 and 727, associated with each group of price storage relays, as the hundreds group 700-709, and an indicator, as 1001, for each order of digits and the fraction of the price, and a commutator, as 1005, associated with each indicator. Of the other high and low relays, 728 and 729 are associated with the tens price storage relays 710-719; 730 and 731 are associated with the units price storage relays 811-820; and 732 and 733 are associated with the fractions price storage relays 504-511.

It will be remembered at this point that the brush N of each commutator is always stopped on a segment corresponding to the digit or fractions displayed by the associated indicator. The brush N of each commutator, as 1005, is, therefore, resting on a segment, as A, corresponding to the digit of the previous price displayed by the associated indicator, as 1001.

Assuming that the stock relay 1015 and the hundreds price storage relay 700 have been operated and the wiper N of the commutator 1005 rests on any of the segments B-J, the hundreds low relay 727 is operated. Assuming also that the stock relay 1015 and the hundreds price storage relay 709 have been operated and the wiper N of commutator 1005 rests on any one of the segments A-I, the hundreds high relay 726 is operated. As the hundreds price storage relays 700 and 709 store the 0 and 9 hundreds digit respectively, and the wiper N of the commutator 1005 is on any one of the segments A-J when the indicator 1001 displays the numerals

0—9, respectively, it is evident from the foregoing that, when the wiper N rests on a segment lower than the segment corresponding to the operated storage relay, then the hundreds high relay 726 is operated, but when the wiper N rests on a segment higher than the segment corresponding to the operated storage relay, then the hundreds low relay 727 is operated.

Similarly, the high and low relays associated with each of the other integer price storage relay groups or with the fractions price selection relay group are operated when the wiper N of the proper commutator rests on a segment lower or higher, respectively, than the segment corresponding to the operated price storage relay in that group or to the operated price selection relay, as the case may be.

The operated high and low relays 726—733, corresponding to the different orders of digits and the fractions of the price, selectively complete a circuit for operating either a high entire price relay 734 or a low entire price relay 735, and a fractions high relay 736 or a fractions low relay 737. This is accomplished by means of a chain circuit for controlling either the relay 734 or 735 and individual operating circuits for the relays 736 and 737 multiplied to a conductor 516 grounded by the operation of relay 503' of the fractions counting relays. The high or low relay of the highest order extends the chain circuit through an operating winding of the relays 734 and 735, respectively, and the operation of either the fractions high relay 732 or the fractions low relay 733 completes an operating circuit for the relays 736 or 737, respectively.

The operation of the entire price high or low relays 734 or 735, and the operation of one of the fractions high or low relays 736 and 737, completes an operating circuit for the hundreds test relay 724, the tens test relay 725, the units test relay 821 and the fractions test relay 513. The relays 724 and 725 place ground on both ends of the hundreds and tens storage relay chain circuits and complete the circuit of the hundreds and tens indicator clutch magnets of the selected indicator mechanism, provided the commutator brushes associated with these indicators are not resting on a segment corresponding to the operated hundreds and tens price storage relays, in which case the clutch magnets are not operated. Assuming that the last condition is not met, the hundreds and tens commutator wipers traverse the segments of commutators 1005—1006 until they reach the segment corresponding to the operated price storage relays. When this occurs the hundreds clutch magnet 1027 and the tens clutch magnet 1023 release, and, in the manner previously explained, stop the hundreds and tens indicators and the commutator brushes in their positions of release.

The operation of the units test relay 821 connects the units indicator clutch magnet 1025 alternately in series with the left-hand winding of relay 801 and the winding of relay 809 and with the right-hand winding of relay 801 and the winding of relay 810. Whether the units clutch magnet is connected first with the winding of relay 809 or first with the winding of relay 810 depends upon whether the commutator wiper N is resting on an even or odd segment when the units clutch magnet is energized. The units indicator clutch magnet is thus energized until the units commutator wiper N reaches the

segment corresponding to the operated units storage relay, upon which it releases.

The operation of the fraction test relay 513 likewise causes the fractions clutch magnet 1016 to be connected alternately in series with the left-hand winding of 802 and the relay 807 and with the right-hand winding of relay 802 and the relay 808, the sequence of these connections depending upon whether the fractions commutator wiper N rests on an even or odd segment when the fractions clutch magnet is energized. When the wipers of the units and fractions commutators 1007 and 1008 reach the segments corresponding to the operated units and fractions price storage relays, the units and fractions clutch magnets 1025 and 1016 release and the indicators are brought to rest.

The relays 809 and 810 control the units price counting relays 1102—1111 and the relays 807 and 808 control the fractions price counting relays 1202—1209.

If the clutch magnet 1025 of the units indicator is energized when the units commutator wiper N is on an even segment, relay 809 is first energized, causing relay 806 to operate. Consequently, relay 809 repeats into the odd units counting relays 1102, 1104, etc., while the units pulsing relay 810 repeats into the even units counting relays 1103, 1105, etc. If the clutch magnet of the units indicator is energized when the units commutator wiper N is on an odd segment, relay 810 is first energized, causing relay 805 to pull up. Consequently in this case, relay 810 repeats into the odd units counting relays 1102, 1104, etc., and the relay 809 repeats into the even units counting relays 1103, 1105, etc.

It is evident from the foregoing that a number of units counting relays 1102—1111 will be energized corresponding to the segments passed over, before the units clutch magnet 1025 releases, by the wiper N of the units commutator 1007. Similarly, a number of fractions counting relays will be energized equal to the number of segments passed over by the wiper N of the fractions commutator 1008 before the fractions clutch magnet 1016 releases. The effect of operating these counting relays will be explained later.

The register of the computer and its driving means will be described before explaining the manner in which the operated units and fractions counting relays control the setting of the register. The register 1303 is of the usual counting type with a carry-over arrangement (not shown) between the different orders of indicators therein. It is arranged to count the revolutions in either direction of the shaft 1304. Splined to shaft 1304 is a friction wheel 1305 having a right- and a left-hand driving face.

A units shaft 1306, broken away in order to illustrate the shape of the cams 1307 and 1308, is driven by a continuously operating motor 1309 through a friction clutch 1310. Mounted on shaft 1306 is a stop cam 1307 having a spring retracted detent controlled by the start magnet 1301, and a pulsing cam 1308 having a grounded follower which grounds contacts 1311 once per revolution of shaft 1306. The fractions shaft 1312, also broken away in order to illustrate the shape of cams 1313 and 1314, is driven by a continuously operating motor 1316 through a friction clutch 1315. The stop cam 1314, mounted on shaft 1312, has eight stop positions and has co-operating with it a spring retracted detent controlled by the fractions start magnet

1302. A pulsing cam 1313, also mounted on shaft 1312, has eight projections and is provided with a grounded follower which grounds contacts 1317 eight times during each revolution of the shaft 1312.

The motion of the shafts 1306 and 1312 is transmitted through the differential gearing 1318 to shaft 1319. Slidably mounted on shaft 1319 is a friction wheel 1320 normally in connection with the right-hand face of the friction wheel 1305. The motion of the shaft 1319 is thus transmitted to shaft 1304 which positions the register 1303. Associated with the friction wheel 1305 is a reversing magnet 1321. When this magnet is energized, a pivoted latch is pressed against the friction wheel 1305 moving it to the right until the wheel 1320 is in engagement with the left-hand face of the wheel 1305. In this case, any rotation of the shaft 1319 will turn the register 1303 back. The means for energizing reversing magnet 1321 will be described later.

The ratio of transmission between the shafts 1306 and 1312 and the register shaft 1304 is so selected as to introduce a proper divisor in each increment of price change that is registered on the register 1303. For example, if the average price of thirty stocks is to be indicated, the increment in price change of any one stock should effect a change of $1/30$ of this amount on the register. In this case, the ratio of transmission, as determined by the differential gearing 1318 and the position of drive wheel 1320 on shaft 1319 would be 30:1. Different gearing may obviously be provided for coupling the shaft 1319 to the differential gearing in order to change the divisor by regular increments. For smaller changes in the divisor than those that can practically be obtained by means of gear changes, the position of drive wheel 1320 on shaft 1319 may be shifted with respect to the axis of the friction wheel 1305.

It should be pointed out that the divisor used to obtain the average price of a group of stocks is not necessarily equal to the reciprocal of the number of stocks, but usually is some smaller number that has been selected to provide compensation for "stock split-ups" and "stock dividends" which would otherwise disturb the even trend of the average. Adjustment to take care of such instances may necessitate a divisor that is fractional. For this reason, the friction coupling 1320 on the shaft 1319 may be shifted along the shaft to permit the adjustment of the divisor by fractional increments.

A digression is necessary here to explain the functions of the control relays Y2 and Y4. These relays comprise the units control relays 1112—1129 and the fractions control relays 1210—1226. Without going into details it may be said that when the stored price is a new high, the operated relays in the units counting relay group 1102—1111 complete multiple operating circuits for the units start magnet 1301 through the contacts of certain relays in the units control relay group 1112—1120 and the operated relays in the fractions counting relay group 1202—1209 complete multiple operating circuits for the fractions start magnet 1302 through the contacts of certain relays in the fraction control relay group 1210—1216. When the stored price is a "low" the unoperated relays in the units and fractions counting relay groups complete these multiple operating cir-

cuits. In either case, the function of the units control relays is to disable one of the multiple operating circuits for the units start magnet 1301 after each rotation of the units shaft 1306, while the function of the fractions control relays is to disable one of the multiple operating circuits for the fractions start magnet 1302 after each one-eighth of a revolution of the fractions shaft 1312.

To return, when the units start magnet 1301 is energized, as explained above, the cam 1307 is released, allowing the motor 1309 to drive the units shaft 1306. During each revolution of the units shaft contact 1311 is grounded once, thus energizing the first pair of units control relays 1112 and 1121. As the operation of 1121 extends conductor 1322 to the winding of 1113, the next pair of control relays 1113 and 1122 are operated during the next revolution of shaft 1306. Consequently, as long as any one of the multiple operating circuits for the units start magnet 1301 is completed through an unoperated contact of any units control relay 1112—1120, then the units shaft 1306 continues to rotate. But when the last multiple operating circuit is opened by the operation of the proper control relay, the units magnet 1301 releases the detent which stops the cam 1307, thus bringing the units shaft to rest. Similarly, when the last multiple operating circuit established for the fractions start magnet 1302 is opened by an operated fractions control relay, the fractions shaft 1312 comes to rest. It is to be noted that the units shaft 1306, as it is required to make several revolutions during one revolution of the fractions shaft, must be driven at a greater speed.

From the foregoing description of the register 1303 and its driving means it is evident that the number of revolutions made by shaft 1306 determines the number of units change in the register 1303, while the portion of a revolution made by the shaft 1312 determines the fractions change in the register.

The means for controlling the reversing magnet 1321 to turn the register 1303 back when the price change to be averaged is a "low", will now be described. Associated with the units counting relay group 1102—1111 is a transfer relay 1101, and associated with the fractions counting relay group 1202—1209 is another transfer relay 1201. Now, as previously explained, the relay 735 is operated when the entire stored price is a new low. The operation of relay 735 causes the operation of transfer relays 1101 and 1201 and the operation of the reversing magnet 1321. The effect of the operation of the transfer relay 1101 is to complete multiple operating circuits for the units start magnet 1301 through the contacts of the unoperated units counting relays. Similarly, the effect of the operation of the transfer relay 1201 is to complete multiple operating circuits for the fractions start magnet 1302 through the unoperated contacts of the fractions counting relays. At the same time the reversing magnet 1321 operates to cause the register 1303 to be turned back instead of being advanced. The transfer relays 1101 and 1201 are necessary because the commutator brushes always advance over the commutator segments, and when the stored price is "low" the brush N of the units commutator 1007, for example, passes over ten segments minus the difference between the previous units digit and the stored units digit.

Assuming that the previous units digit is 5, and the stored units digit four, the difference being one, the brush N of the units commutator passes over 9 segments, and nine units counting relays 1102—1110 are operated. Now it is evident that if the unoperated units counting relay 1111 is allowed to control the units start magnet 1301, then the proper price difference of 1 will be averaged on the register 1303. A similar explanation applies to the necessity for using the fractions transfer relay 1201. Consequently, the transfer relays 1101 and 1201, and the reversing magnet 1321, when operated by relay 735, serve the function of permitting the register 1303 to be turned back by an amount equal to the drop in price divided by the group divisor when the entire stored price is a "low."

The means for compensating for the "decimal progression" will now be described. Whenever the entire stored price is a "high" and the fraction a "low", and whenever the entire stored price is a "low" and the fraction a "high", it is evident from the procedure of arithmetical subtraction that a single unit must be "taken away" from the units of the price difference in order that the proper difference in units and fractions between the stored and the previous price may control the new setting of the register 1303.

Now ordinarily, as previously explained, the multiple operating circuits for the units start magnet 1301 are disabled, one by one, by the operation of the control relays 1112—1120 and the control relays are operated, pair by pair, upon each grounding of conductor 1322 by the follower of pulsing cam 1308 during each revolution of the units shaft 1306. If the first two pairs of units counting relays 1112, 1121 and 1113, 1122 are arranged to operate together when it is desired to compensate for the "decimal progression", it is evident that the units control relays will permit one less revolution of the units shaft 1306 than would ordinarily be caused by the operated units control relays when the stored price is low. The relay 1130 is provided for the purpose of causing the first grounding of conductor 1322 by the pulsing cam 1308 to operate both the first and second pairs of units control relays, thus compensating for the "decimal progression". The relay 1130 is operated when both the relay 735 and the relay 736 are operated together, and also when both the relay 734 and the relay 737 are operated together.

Releasing means are provided for releasing simultaneously the operated price selection relays 410—419, 420—429, 430—439 and 504—511; the associated pairs of counting relays 405—407' and 503—503', the operated price storage relays in the groups 700—709, 710—719, 811—820; and the associated relays 722, 723, 822 and 512. All of these relays, when operated, are locked over conductor 650 to ground at contacts F of relay 604. When a figure shift signal is received over any of the stunt conductors 1—4 (Figs. 2 and 6) the figure shift relay 606 is operated. This relay causes the operation of counting relay 604 and the latter relay causes relay 605 to be prepared for subsequent operation on the release of relay 606. As relay 604 is operated and relay 605 released, ground is removed from conductor 650 with the result that the above-mentioned relays release, conditioning the price selection relays of the master board and the storage relays of the average price recorder for

another selection. It is thus evident that when a new figure shift signal is received over the "stunt" conductors 1—4 the master board is conditioned to receive the new price and the average price recorder to store this price. It may be noted that when relay 606 releases relay 605 operates in series with relay 604, closing, through its contact A, an alternative ground for conductor 650 at contact C of relay 607. The grounding of conductor 650 prepares the price selection relays and the price storage relays with their associated relays for selection. Upon the operation of the fractions counting relay 503, relays 605 and 604 are released. But 605 being slow-releasing maintains ground on locking conductor 650 until another ground is connected to this conductor through contact F of relay 604. Consequently, upon the release of these relays the ground on the locking conductor 650 is not affected.

The release of the operated relays in the group 726—733 is effected when the relays 724, 725, 821 and 513 are operated, and the last-mentioned relays are released when the entire quotation, high or low relays 734 and 735, and the fraction high or low relays 736 and 737, are deenergized, or when the fractions counting relay 503 is released. The indicator clutch magnets, as 1016, the relays as 802 and 801, and the 803—809 relays forming the units and fractions repeaters, are released when the commutator brushes, as N, reach a segment corresponding to the operated storage relay of the proper group.

Means are also provided for releasing the high and low relays 734—737, the units price counting relays 1102—1111, the units control relays 1112—1120 and 1121—1129, the fractions counting relays 1202—1209, and the fractions control relays 1210—1216 and 1226—1220. All of these relays lock when operated to the grounded contacts of relay 1324. Associated with relay 1324 is a relay 1325 which has one winding multiplied to the operating circuit of the units start magnet 1301 and another winding multiplied to the operating circuit of the fractions start magnet 1302. When relay 1325 operates, it completes an alternate ground for locking conductor 1323, and also completes an operating circuit for relay 1324 which then opens the normal ground for this locking conductor. Upon the release of the units and fractions start magnets the relay 1325 is also released, thereby opening the alternative ground for the locking circuit 1323 and also opening the operating circuit of relay 1324. But as relay 1324 is slow to release, the locking conductor 1323 is ungrounded for a moment during which the above-mentioned relays, dependent upon the locking conductor, release.

As in many cases the sending operator may discover he has sent an incorrect selection signal, it seems desirable to provide means for releasing any portion of the apparatus incorrectly selected. This means comprises relay 607 which is adapted to be operated over a release circuit 5, which is one of the "stunt" circuits. This relay removes ground from conductor 650, restoring the stock selection relays and associated counting relays, the price selection relays and associated counting relays, and the recorder price storage relays and their associated relays, mentioned above.

The operation of the system, just described, in averaging a new price that is "high" and another that is "low", will now be described. Let

it be assumed that a tape has been prepared for transmitting the letter M and that this tape is inserted in the transmitter so that the perforations corresponding to the letter M will be above

the pins (previously mentioned but not shown on the drawings) after the next stopping action. Then, when the tape stop lever 126 is closed, brush arm 110 is released and begins rotating. While the brush arm passes over segment 112 a circuit is completed from battery, operating winding of relay 104, common ring 111, brush arm 110, and segment 112 to ground. Relay 104 moves its armature to its M contact, thus causing relays 105—107 to move their armatures to their M contact. When the brush arm 110 reaches segment 113 ground is removed from common ring 111 and, consequently, master relay 104 and sending relays 105—107 move their armatures to their S contacts. Also at this time the stepping mechanism operates and the tape assumes a position such that the perforated code for "M" is directly above the transmitter pins. This allows armatures 119 and 120 to lie against ungrounded contact strip 125, and armatures 121, 122 and 123 to lie against grounded contact strip 124.

The brush arm 110 reaches segment 114, at which time no ground is connected to the common ring 111 and the master relay 104 and the sending relays 105—107 retain their armatures on their S contacts. Likewise, when brush arm 110 reaches segment 115, the common ring 111 is ungrounded and the armatures of the master and sending relays are retained on the S contacts. When the brush arm 110 reaches segment 116 a circuit is established from battery, operating winding of relay 104, common ring 111, brush arm 110, segment 116, transmitter armature 121 and contact strip 124 to ground. The armatures of the master and sending relays are then moved to their M contacts. Likewise, when the brush arm 110 passes over segments 117 and 118 the circuit through the operating winding of the master relay 104 is completed, and the armature of this relay as well as the armatures of the sending relays 105—107 are retained on their M contacts. Finally, the brush arm 110 again returns to segment 112 and, regardless of the position of the transmitter armatures 119—123, the armature of the master relay and the armatures of the sending relays are either returned to or retained on their M contacts. By operating the release arm 126, the clutch magnet 127 can be released, thereby causing its retracted armature 128 to engage and stop the brush arm 110.

It is evident that during the transmission of the letter M the same signal has been transmitted over line L2 to the receiving boards through the printer magnets 130 of a local printer and over line L1 to the receiving relay 203. As the M contacts of the sending relays 105—107 are connected to negative battery and their S contacts are connected to positive battery, this signal comprises one interval of positive battery (the start signal), two intervals of positive battery (1st and 2nd pulses); three intervals of negative battery (3rd, 4th and 5th pulses) and a final longer interval of negative battery (the stop pulse).

Likewise the same signal can be sent from the keyboard transmitter 131 after the tape controlled distributor has been disconnected by the operation of key 103.

It is evident from the foregoing that any desired signal or series of signals can be sent si-

multaneously over conductor 151 and lines L1 and L2 by operating the transmitting means O in a suitable manner, and that when transmission has ended the transmitting distributor brush 110 can be brought to rest.

The operation of the permutation unit Q in accordance with signals transmitted over line L1 will now be described. Let it be assumed that signals corresponding to the letter M are being transmitted by sending relay 106 over line L1. Receiving relay 203 is adapted to move its armature to its S contact when a positive pulse is received and to move its armature to its M contact when a negative pulse is received. Accordingly, the first impulse which is of positive polarity causes relay 203 to close its S contact. A circuit is thereby established from battery, through contact S of relay 203, conductor 224, contact 222 associated with cam 223 and start magnet 219 to ground. Start magnet 219 is energized, pulling up its armature 220 and freeing cam 221. The release of cam 221 allows brush 210 to be driven through the previously mentioned friction clutch (not shown). Cam 223, which is driven by the same shaft as cam 221, causes contact 222 to open, thus preventing further energization of start magnet 219 until the brush arm 210 has completed one revolution.

The next impulse received, which is also of positive polarity, causes the armature of relay 203 to be retained on its contact S. At the same time brush arm 210 is bridging the common ring 211 and segment 213, but as the armature of relay 203 is now on its S contact, the circuit or relay 250 is open.

The next impulse is received while the brush arm 210 is traversing segment 214, but since this signal is also positive no operation occurs.

The next or third impulse is received while the brush arm 210 is passing over segment 215. This impulse is of negative polarity and, consequently, the armature of relay 203 moves to contact M. A circuit is then completed from battery, through contact M of relay 203, common ring 211, brush arm 210, segment 215, conductor 228, and winding of relay 252 to ground. Relay 252 is, therefore, energized and locks over a circuit comprising battery, contact A of relay 255, conductor 252, conductor 235, contact A of relay 252 and winding of relay 252 to ground.

The fourth impulse, which is received as the brush 210 is traversing segment 216 and is of negative polarity, causes the armature of relay 203 to remain on its contact M. A circuit is then established from battery through contact M of relay 203, common ring 211, brush arm 210, segment 216, conductor 229, and winding of relay 253 to ground. Relay 253 operates and locks over an obvious circuit extending through contact A of relay 255.

The fifth impulse, which is also of negative battery and is received as brush 210 is traversing segment 217, likewise causes the armature of relay 203 to remain on its M contact. A circuit is thus completed from battery, through contact M of relay 203, common ring 211, brush arm 210, segment 217, conductor 230 and winding of relay 254 to ground. Relay 254 then operates and locks over an obvious circuit extending through contact A of relay 255.

Brush arm 210 now passes to segment 218. At this time an impulse of negative polarity is received. This is a stop pulse and, as previously stated, is always negative regardless of the sig-

nal combination transmitted. Upon receipt of this impulse relay 203 operates to retain its armature on contact M, which is without effect at this time since the circuit from contact M of relay 203 is open at the common ring 211. However, a circuit is established from battery through segment 209, brush arm 210, segment 218, conductor 231 and start magnet 247 to ground. Upon energizing, start magnet 247 attracts its armature 248, allowing cam 249 and, consequently, brush arm 260 to be rotated through a friction clutch (not shown).

Brush arm 260 first passes over segment 262, upon which a circuit is completed from battery through common ring 261, brush arm 260, segment 262, conductor 239, to contact B of relays 250—254 and thence through certain parallel circuits from the armatures of the operated relays in this group. The parallel circuits established from conductor 239 under the conditions assumed are: contact B of relay 252, conductor 244, left-hand or operating winding of relay 272 to ground; contact B of relay 253, conductor 245, left-hand or operating winding of relay 273 to ground; and contact B of relay 254, conductor 246, left-hand or operating winding of relay 274 to ground.

Relays 272—274 operate over the circuits just traced and lock over obvious circuits to ground on the armature of locking relay 276.

During this interval brush 210 in the receiving distributor has traversed segment 218 and cam 221 has returned to the normal position, as shown. Since at this time the circuit to start magnet 219 is open at contact S of receiving relay 203, the brush arm 210 is retained in its normal position by means of retracted stop arm 220 which engages the projection in the cam 221.

Likewise, brush arm 260 of the auxiliary distributor has reached segment 263, upon which a circuit is completed from battery through common ring 261, brush arm 260, segment 263, conductor 240 and winding of relay 255 to ground. Relay 255 thereupon operates, opening the locking circuits of the operated relays in group 250—254. These relays consequently release and the receiving distributor is restored to normal in readiness for the reception of the next signal.

When brush arm 260 reaches segment 264, a circuit is completed from battery through the common ring 261, segment 264, conductor 241, and thence over two parallel circuits. The parallel circuits are: from conductor 241 to contact B of unoperated relay 270, contact D of unoperated relay 271, contact G of operated relay 272, contact M of operated relay 273 and contact M of operated relay 274; and from conductor 241 through conductor 277.

Brush arm 260, upon reaching segment 265 which is multiplied to segment 264, serves merely to prolong the impulse over the parallel circuits mentioned above. It is, of course, evident that segments 264 and 265 might be combined into a single long segment. The brush arm now reaches segment 266 which is multiplied with segment 267, so that, while brush arm 260 brushes the segments 266 and 267, a circuit is closed from battery through common ring 261, brush arm 260, segment 266 or 267, conductor 269 and winding of relay 276 to ground. Relay 276 operates, thereby opening the locking circuit of the operated relays in group 270—274. The operated relays in this group thereupon release, disconnecting the conductor M from con-

ductor 241 controlled by the auxiliary distributor P2. When the brush arm 260 leaves segment 267, it is brought to rest before it reaches the first segment 262 by means of the retracted stop arm 248 which engages a projection on cam 249, since start relay 247 is then de-energized.

Thus, upon the transmission of the signal M from sending relay 106, the following operations occur: the receiving relay 203 co-operates with the receiving distributor P1 and the auxiliary distributor P2, to selectively operate the permutation unit Q in accordance with the received impulses thereby connecting the conductor M to conductor 241; after this, the auxiliary distributor P2 applies battery to conductor M and also to conductor 277; also both the receiving distributor P1 and the auxiliary distributor P2, as well as the permutation unit Q, are restored to normal awaiting the next selecting signal.

It is, therefore, obvious that the permutation unit Q can be selectively operated in accordance with signals received by relay 203 to connect any conductor of the four groups of conductors P—O, S—N, A—M and 1—5 with conductor 241, after which battery is applied to the selected conductor and to conductor 277 by the auxiliary distributor P2.

It should be noted that, except for certain "stunt" contacts 1—5 which are numerically designated, the contacts of relay 274 are designated so as to correspond to the letter which must be transmitted to connect the conductor 241 thereto. For example, it has just been shown that the letter M must be transmitted to connect the conductor M to conductor 241.

It is to be understood that the transmitting means O and the permutation unit Q are merely a preferred embodiment of the means for controlling the selecting circuits whose operation is presently to be described, and that the invention is not to be limited by the transmitting means and the permutation unit particularly described, as it is apparent that the operation of the selecting circuits might be accomplished by other means.

Now that the operation of the transmitting means O and the permutation unit Q have been described, the operation of the price and stock selection relays of the master board will be set forth. Let it be assumed that a quotation for stock MMM is to be posted on the master and receiving boards by means of the apparatus in these boards, disclosed in the above-mentioned co-pending application, and that the stock MMM is one of the stock group the price of which is to be averaged. Let it be further assumed that the quotation for the stock MMM is a new high and is 90%. It has been previously mentioned that, in transmitting quotations under the present system, the signals corresponding to the letters of a stock abbreviation are transmitted first, a "stunt" signal, which may be either a figure shift or a figure shift in combination with an open selection signal, is transmitted next, and then from one to four signals corresponding to the price of the quotation are finally transmitted.

Consequently, the first three code signals prepared for transmission by the sending operator will be those for the letters MMM. It is clear, from the description just given of the transmitting means O and the permutation unit Q, that the transmission of the signals corresponding to these letters will cause the auxiliary distributor P2 to apply battery to both conductors M and 277 three successive times.

When battery is first applied to conductor M, a circuit is completed for operating relay 310 which is the M relay in the one-letter group. The operating circuit for this relay may be traced from battery, common ring 261 of auxiliary distributor P2, brush arm 260, segments 264 or 265, conductor 241, contact B of relay 270, contact D of relay 271, contact G of relay 272, contact M of relay 273, contact M of relay 274, contact M of transfer relay 301, conductor 350, winding of relay 310, conductor 351, contact B of counting relay 307', conductor 354, and through either contact D of relay 605 or contact C of relay 604 to ground on contact A of relay 607. Relay 310, upon operating, locks over a circuit extending from battery, winding and contact A of relay 310, conductor 352, conductor 354 to the ground previously mentioned. At the same time that battery is applied to conductor M battery is also applied to conductor 277, causing the operation of pulsing relay 304 over a circuit which may be traced from battery, common ring 261 of auxiliary distributor P2, brush arm 260, either segment 264 or 265, conductor 277, winding of pulsing relay 304, conductor 653, contact C of relay 605 to ground on contact B of figure shift relay 606.

The operation of the pulsing relay 304 completes a circuit for operating relay 305, one of the first pair of counting relays, which may be traced from battery, winding of relay 305, contacts A of relay 305' to ground on contacts of pulsing relay 304. Upon pulling up, relay 305 prepares a circuit for operating relay 305' but, as ground on the armature of pulsing relay 304 is connected through contact A of relay 305 to one terminal of the winding of relay 305' and the previously mentioned ground on conductor 354 is connected to the other terminal of the winding of relay 305', this relay does not operate until pulsing relay 304 releases. When the pulsing relay does release, however, which occurs when distributor brush 260 leaves segment 265, a circuit is completed from battery, winding and contact A of relay 305, winding of relay 305' to grounded conductor 354. Relay 305 locks and relay 305' operates over this circuit. At its A contact relay 305' opens the operating circuit for relay 305, thus preventing relay 305' from being shunted by the subsequent operation of pulsing relay 304; at its B contact relay 305' prepares an operating circuit for relay 306; the effect of closing contact C of relay 305' will be mentioned later; at its D contact relay 305' completes an obvious circuit over conductor 356 to operate transfer relay 301 which, as previously stated, connects each of the conductors P—O, S—N and A—M to one of the relays in the two-letter stock selection group.

Consequently, when battery is next applied to conductor M relay 312, which is the M relay in the two-letter group, is operated over a circuit which extends from battery, common ring 261, brush arm 260, segments 264 or 265, conductor 241, contact B of relay 270, contact D of relay 271, contact G of relay 272, contact M of relay 273, contact M of relay 274, conductor M, contact M' of transfer relay 301, contact M' of transfer relay 302, conductor 357, winding of relay 312, conductor 358, contact C of relay 305', contact B of relay 307' to grounded conductor 354. Upon operating, relay 312 locks over a circuit from battery, winding and contact A of relay 312, conductor 352 to grounded conductor 354. Upon the second application of

battery to conductor 277, pulsing relay 304 is again operated over the circuit previously traced. The operation of pulsing relay 304 closes a previously prepared circuit for relay 306 which may be traced from battery, winding of relay 306, contact A of relay 306', contact B of relay 305' to ground at armature of relay 304. Relay 306 then operates and when the pulsing relay is released a circuit is completed from battery, winding and contact A of relay 306, winding of relay 306' to grounded conductor 354. Relay 306 locks and relay 306' operates over this circuit. At its A contact relay 306' opens the operating circuit of relay 306, thus preventing relay 306' from being shunted by a subsequent operation of pulsing relay 304; at its B contact relay 306' prepares a circuit for operating relay 307; the effect of closure of contact C will be described presently; at its D contact relay 306' completes an obvious circuit over conductor 362 for operating transfer relay 302. As previously mentioned, the operation of transfer relay 302 connects each of the first three groups of conductors P—O, S—N and A—M to one of the stock selection relays in the three-letter group.

Upon the third application of battery to conductor M, relay 314, which is the M relay in the three-letter group is operated over a circuit which may be traced from battery, common ring 261, distributor brush 260, segments 264 and 265, conductor 241, contact B of relay 270, contact D of relay 271, contact G of relay 272, contact M of relay 273, contact M of relay 274, contact M' of transfer relay 301, contact M' of transfer relay 302, conductor 363, winding of relay 314, conductor 366, contact C of relay 306', contact B of relay 307' to grounded conductor 354. Upon operating, relay 314 locks over a circuit that may be traced from battery, winding and contact A of relay 314, conductor 352 to grounded conductor 354.

Also upon the third application of battery to conductor 277, pulsing relay 304 is again operated over the circuit previously traced. Operation of pulsing relay 304 causes the operation of relay 307 over a circuit that may be traced from battery, winding of relay 307, contact A of relay 307', contact B of relay 306', contact B of relay 305' to ground on the armature of relay 304. Again, when the pulsing relay 304 releases, a circuit is completed from battery, winding and contact A of relay 307, winding of relay 307' to grounded conductor 354, over which circuit relay 307 locks and relay 307' operates. At its A contact relay 307' opens the operating circuit of relay 307, thus preventing relay 307' from being shunted by a subsequent operation of the pulsing relay; at its B contact relay 307' opens the operating circuits of stock selection relays 310, 312 and 314 but, as these relays are locked, the opening of their operating windings is without effect; at its C contact relay 307' completes an obvious operating circuit over conductor 365 for transfer relay 303.

As a result of the operation just described, a circuit is prepared for operating the stock relay 1015 which is associated with the indicating mechanism in the average price recorder adapted to post quotations on the stock designated by the three letters MMM. This circuit may be traced from battery, winding of relay 1015, conductor 1017, lamp 1018, conductor 370, contact C of relay 314, conductor 369, contact M''' of transfer relay 303, contact C of relay 312, con-

tact C of relay 310, conductor 361, contact A of transfer relay 302, conductor 660 to a normally open contact B of relay 604.

The "stunt" conductors 1-5 are the fourth group of conductors controlled by the permutation unit Q and comprise conductors 1-4, over which the shelf selection on the master board or a figure shift operation are effected, and conductor 5, over which a release of the apparatus of the master board and the average price computer is effected. The means controlled over the conductors 1-4 which effect the shelf selection on the master board are not disclosed herein for they are unnecessary to an understanding of the present invention. These means are disclosed, however, in the above-mentioned co-pending application. In the drawings, the stunt conductors 1-4 are shown multiplied to the figure shift relay 606, while the stunt conductor 5 is shown connected to the winding of a release relay 607. Controlled by the figure shift relay 606 is the pair of counting relays 604 and 605.

To return, the next signal transmitted, as will be understood by reference to the co-pending application, will be that for selecting the high shelf on the master board and on the receiving boards. It may be seen from Fig. 6 of the co-pending application that stunt conductor 2 is the "high" shelf conductor. In response to this signal, relay 606 is operated over a circuit from battery, a common ring 261 of the auxiliary distributor P2, brush 260, segments 264 and 265, conductor 241, contact B of relay 270, contact D of relay 271, contact H of relay 272, contact O of relay 273, contact 2 of relay 274, winding of relay 606 to ground.

The operation of relay 606 causes relay 604 to operate over a circuit from battery, contact B of relay 607, winding of relay 604, contact B of relay 605 to ground at contact A of relay 606. Upon its operation relay 604 closes contacts A, B and D and opens contacts C, E and F. Closure of contact A prepares an operating circuit for relay 605 and a locking circuit for relay 604, which may be traced from battery, contact B of relay 607, winding and contact A of relay 604, winding of relay 605, conductor 551 and contact C of unoperated relay 503 to ground. This circuit is not yet effective since the other terminal of the winding of relay 605 is grounded over a circuit that may be traced from ground, contact A of relay 606, contact B of relay 605, contact A of relay 604 to the terminal of the winding of relay 605. Closure of contact B of relay 604 supplies ground over conductor 660 and then through the contacts of the operated letter transfer and stock selection relays, as previously traced, to operate the selected stock relay 1015; opening of contact C removes one source of ground from conductor 354 but without effect as ground continues to be applied to this conductor over contact D of relay 605; closure of contact D of relay 604 completes a circuit from battery through the winding of relay 401, conductor 475, winding of relay 501, conductor 652, contact D of relay 604 and contact A of relay 607 to ground, operating relays 401 and 501 and transferring the first two permutation unit circuit groups P-O and S-N to the price selection relays; opening of contact E of relay 604 removes ground from conductor 670 and the locking windings of the stock relays to assure clearing out of the previous selection, and the opening of contact F removes ground from locking conductor 650, re-

lay 605 being now unoperated. The effect of removing ground from the locking conductor, as will be explained in detail later, is to release the price selection relays of the master board and the price storage relays as well as certain other relays of the computer.

At this time, brush arm 260 leaves segment 265 opening the circuit through the permutation unit to relay 606, which releases and removes the short circuit mentioned from the winding of relay 605. Relay 604 locks up and relay 605 operates over the circuit traced above. The closure of contact A of relay 605 reconnects ground at contact C of relay 607 to the locking conductor 650, thus preparing the price selection relays and the price storage relays of the computer for a new selection; the opening of contact B of relay 605 breaks the short circuit path to relay 604, thus assuring that it will not again be short-circuited during this cycle of operation; the opening of contact C of relay 605 breaks again the circuit to the winding of the letter pulsing relay 304 to prevent its operation during the price reception; the opening of the contact D of relay 605 removes ground from conductor 354 and the locking windings of the letter selection relays and letter counting relays, thus releasing them; while the closing of contact E of this relay restores ground to conductor 670 and the locking winding of the stock relay 1015, just operated, to retain it in its operated position.

The figure signals are now transmitted and, due to the transfer mentioned above, become effective on the price selection relay groups.

The price assumed was 90% and, consequently, the first signal received at the master board is that for the figure 9. This closes a circuit from battery through the permutation unit to contact O of relay 274 and thence over conductor O, contact 9 of operated relay 401, conductor 467, contact 9 of unoperated relay 402, conductor 464, operating winding of relay 419, winding of pulsing relay 404, conductor 451, contact B of unoperated relay 407', conductor 650, contact A of relay 605, and contact C of relay 607 to ground. Relays 404 and 419 now operate and relay 419 locks over a locking circuit common to all the price selection relays, that is from battery, locking winding of relay 419, its contact A, conductor 462, to grounded conductor 650. The closure of the remaining contacts of relay 419 is without effect at this time and, therefore, will be considered hereinafter.

The closure of contact A of pulsing relay 404 completes a circuit from battery through the winding of relay 405, contact A of relay 405' and contacts A of relay 404 to ground. Relay 405, operates and its contacts A and B close. The closure of its A contact completes a circuit from battery through the winding and contact A of relay 405 and the winding of relay 405' to grounded conductor 650. Relay 405' does not operate, however, until brush arm 260 leaves segment 265, releasing relay 404 and removing the short circuit to ground at the contacts of relay 404 from the winding of relay 405'. The closure of contacts B of relay 405 is without effect at this time.

Upon the operation of relay 405' the opening of contact A of that relay prevents any subsequent short-circuiting of the winding of relay 405', closure of contacts B prepares relay 406 for operation, and closure of contacts C com-

pletes a circuit from battery through the winding of relay 402, conductor 463 and contact C of relay 405' to ground. Relay 402 now operates, transferring the permutation unit circuit to the second group of integer relays.

The signal corresponding to the second figure of the price is now received. The second figure of the assumed price is zero; the corresponding circuit of the permutation unit is closed, completing a circuit from battery through the permutation unit to conductor P and thence through contacts O of relay 401, conductor 460, contacts O' of relay 402, contacts O' of relay 403, conductor 465, winding of relay 420, conductor 450, winding of relay 404, conductor 451 and contact B of relay 407' to grounded conductor 650. Relay 420 operates and locks up over conductor 462 to grounded conductor 650. Pulsing relay 404 again operates, closing a circuit from battery, winding of relay 406, contact A of relay 406', contact B of relay 405' and contact A of relay 404 to ground. Relay 406 operates over the circuit traced; upon the cessation of the impulse relay 406' operates. The closure of contact B of relay 405 is without effect at this time. The opening of contact A of relay 406' prevents the subsequent short-circuiting of relay 406' upon the operation of the pulsing relay 404. The closure of contact B of relay 406' prepares an operating circuit for relay 407 and the closure of contact C operates transfer relay 403 over an obvious circuit through conductor 466.

The signal corresponding to the last figure of the price is now received. This figure is the fraction $\frac{1}{2}$ and, consequently, a circuit is completed from battery through the permutation unit, conductor B, contact $\frac{1}{2}$ of operated relay 501, conductor 559, operating winding of relay 509, conductor 550 and the winding of relay 502 to ground. Relays 502 and 509 now operate, relay 509 locking to grounded conductor 650, as explained in connection with the other price selection relays, over a circuit including the winding of relay 512. Closure of contact A of relay 502 causes relay 503 to operate over a circuit from battery, winding of relay 503, contact A of relay 503' and contacts of relay 502 to ground. The closure of contact A, of relay 503 prepares an operating circuit for relay 503'; closure of its contact B prepares a number of circuits to be described presently; and the opening of its contact C removes ground from conductor 551 and the windings of relays 604 and 605. Relays 604 and 605 accordingly release, but as relay 605 is slow-releasing, relay 604 restores first.

Upon de-energizing, relay 604 opens its contacts A, B and D and closes its contacts C, E and F. The opening of contact A opens another point in the operating circuit of relay 605; the opening of contact B opens the operating circuit of the stock magnet 1015, but this is without effect as the locking circuit of this magnet is closed to ground at contact A of relay 607 through contact E of relay 605; the closure of contacts C reconnects ground at contact A of relay 607 to conductor 354, thus restoring the locking circuits for the stock selection and their associated counting relays; the opening of contact D removes ground from conductor 652 thus releasing the transfer relays 401 and 501, and re-associating the permutation unit controlled conductors P—O, S—N and A—M with the one letter stock selection relays 310, 311, etc.; the

closure of contact E connects ground at contact A of relay 607 to the stock relay locking conductor 670 over an alternative circuit extending through contact E of relay 604; and the closure of its contact F connects an alternative ground to the locking conductor 650.

When relay 605 restores it reconditions pulsing relay 304 for operation by connecting ground at contact B of relay 606 to conductor 653 through its contact C, but its restoration is otherwise without effect since the de-energization of relay 604 has already served to prepare the stock selection and counting relays for a new selection and to hold the stock relay 1015 locked up.

Upon the release of relay 502, relay 503' operates. At its contact C relay 503' grounds conductor 551 in order that relay 604 can be locked and relay 605 operated upon the reception of the next figure shift signal. By opening its A contact relay 503' prevents any further short-circuiting of its winding by the operation of relay 502. At its B contact relay 503' applies ground to conductor 516 for a purpose to be described later.

It should be noted at this point that the stock selection relays are now prepared for a further selection under control of the permutation unit Q and the price impulses for the quotation under consideration are stored in the operated integer and fraction price selection relays. The overlap previously mentioned is consequently provided, for while the stored price impulses of the quotation under consideration are being used to control the average price recorder the stock selection relays can be operated in accordance with a new stock selection.

Closure of contact B of relay 503 completes a number of parallel circuits, as follows:

(1) From ground at contact B of relay 503, conductor 552, contact B of relay 405, contact B of relay 406, contacts C and D of relay 407, contact C of hundreds relay 419, conductor 474, winding of tens price storage relay 719 to grounded battery;

(2) From ground at contacts B of relay 503, conductor 552, contact B of relay 405, contact B of relay 406, contact C of relay 407, contact C of relay 420, conductor 473, winding of the units price storage relay 811 to grounded battery;

(3) Ground is also applied to conductors 552 and 552' for a purpose to be explained later.

The tens price storage relay 719 operates over the circuit traced, and then locks over a circuit from grounded battery, its locking winding and contact A, winding of relay 722, conductor 650, to ground at contact F of relay 604 (now released). The units price storage relay 811 likewise operates over the circuit traced and locks over a circuit including battery, its locking winding and contact A, winding of relay 822 and grounded conductor 650.

The stock relay 1015 and the relays 722, 822 and 512 being now operated, a circuit is prepared for comparing the tens and units digits and the fractions of the price previously posted with the digit of the corresponding orders and the fraction of the stored price. Let it be assumed that the previous price is 89%, as the stored quotation is a new high. With a price of 89%, the wiper N of the tens commutator 1006 rests on segment I, the wiper N of the units commutator 1007 rests on segment J, and the wiper N of the fractions commutator 1008 rests on segment H. Assuming that the stock MMM has

never reached 100, the wiper N of the hundreds commutator rests on segment A which is the segment on which it was set at the time the average price recorder was put in operation.

However, as no hundreds price storage relay in the group 700—709 has been operated, the relay 723 is unoperated, with the result that no ground is placed on this segment A. Consequently, for a reason that will be explained later, the hundreds digit of the previous and stored prices are not compared.

Before describing the results of the operation of relays 722, 822 and 512, it is necessary to describe the chain circuits controlled by each group of storage relays. Associated with the fractions price selection relays 504—511, which also serve as price storage relays, are two chain circuits which are shown in detail.

One of these chain circuits, termed herein the first chain circuit, is connected to the lowest contact C of the "even" fractions relays 504, 506, 508 and 510, and to the upper contact B of the odd fractions relays 505, 507, 509 and 511. The fractions high relay 732 is connected to the left-hand end of this chain circuit, and the fractions low relay 733 is connected to the right-hand end of this chain circuit.

The other chain circuit, termed herein the second chain circuit, is connected to the upper contact B of the even price selection relays and the lowest contact C of the odd price selection relays. The left-hand end of this second chain circuit is multiplied to the left-hand end of the first chain circuit and is thus also connected to the winding of the high fractions relay 732, while the right-hand end of the second chain circuit is multiplied to the right-hand end of the first chain circuit and is thus connected to the winding of the low fractions relay 733.

Each even segment on the fractions commutator 1008 is connected to the first chain circuit through the contact D of a corresponding even price selection relay. For example, segment A which is the zero, and an even, segment of the fractions commutator, is connected through contact D of relay 504, which is the zero, and an even, relay of the fractions price selection relays, to the first chain circuit; and segment H, which is the $\frac{7}{8}$, or an odd, segment, is connected through contact D of relay 511, which is the $\frac{7}{8}$, or an odd, price selection relay to the second chain circuit.

The units price storage relays are likewise provided with two chain circuits of the same type, and each of the segments of the units commutator 1007 is connected through the contact D of a corresponding units price storage relay to the first or the second chain circuit controlled by these relays. Likewise, the left-hand ends of the unit chain circuits are connected in multiple to the units high relay 730 and the right-hand ends of the same chain circuits are multiplied to the units low relay 731.

The hundreds and tens price storage relays are provided with only a single chain circuit similar to the first one associated with the fractions price selection relays, namely, the one connected to the lower contacts C of the even relays in this group and connected to the upper contacts B of the odd relays. Likewise, the left-hand end of each chain circuit is connected to the high hundreds or tens relays 726 or 728, and the right-hand end is connected to the low hundreds or tens relays 727 or 729. In addition, each segment on the hundreds and tens commutators

1005 and 1006 is connected to the proper chain circuit through the lower contact C of the corresponding hundreds or tens price storage relay.

Turning from this digression, the operation of the relay 722 completes a circuit for operating the tens high relay 728 which may be traced from battery, winding of relay 728, contact B of tens test relay 725, contact B of tens storage relay 710, the chain circuit extending through contacts of the intervening relays 711—718, the latter not shown, contact C of relay 719, conductor 741, conductor 905, conductor 906, segment I of the tens commutator 1006, wiper N, common ring M, contact B of stock relay 1015, conductor 1019, conductor 1020, conductor 740, contact F of relay 725, contact A of relay 722, conductor 552' to ground at contact B of relay 503.

The operation of relay 822 completes a circuit for operating the units low relay 731 which may be traced from battery, winding of relay 731, contact F of the units test relay 821, contact D of relay 820, conductor 823, conductor 907, conductor 908, segment J of the units commutator 1007, wiper N, common ring M, contact C of stock relay 1015, conductor 1021, conductor 1020, conductor 824, contact J of relay 821, contact A of relay 822, conductor 552' to ground at contact B of relay 503.

The operation of relay 512 completes a circuit for operating low fractions relay 733 which may be traced from battery, winding of relay 733, contact F of fractions test relay 513, contact D of relay 511, conductors 515, 514, 909, 910, segment H of the fractions commutator 1008, wiper N, common ring M, contact D of stock relay 1015, conductors 1022 and 1020, contact J of relay 513, contact A of relay 512 to ground at contact B of relay 503.

In connection with the three circuits just traced, it should be noted that the tens commutator wiper is resting on segment I corresponding to 8, while the tens price storage relay operated is the relay 719, corresponding to 9, and representing a new tens digit that is higher than that of the previous quotation. In this case, the operating circuit of the "tens low" relay 729 is open at contact B of relay 719, but the circuit to the "tens high" relay 728 is left closed as traced. The units commutator wiper is resting on segment J, corresponding to 9, and the units price storage relay that is operated is the relay 811, corresponding to zero and representing a new units digit that is lower than that of the previous quotation. In this case, the operating circuit of the "units high" relay 730 is open at contacts B and C of relay 811, but the circuit to the "units low" relay 731 is left closed as traced. Finally, the fractions commutator wiper is resting on segment H, corresponding to $\frac{7}{8}$, and the fractions price selection relay that is operated is relay 509, corresponding to $\frac{5}{8}$, and representing a fraction lower than the previous quotation. In this case, the operating circuit of the "fractions high" relay 732 is open at contacts B and C of relay 509 but the circuit to the "fractions low" relay 733 is left closed as traced. In short, the circuits of the hundreds high and low relays 726 and 727, the "tens low" relay 729, the "units high" relay 730, and the "fractions high" relay 732 are open; and the circuits of the "tens high" relay 728, the "units low" relay 731 and the "fractions low" relay 733 are left closed.

It was pointed out above that when relay 503' 150

- operated it placed ground on conductor 516. Now conductor 516 extends to the tongues of relays 726, 732 and 733. From tongue of relay 726 it is extended through contact B of relay 726, contact A of relay 727, contact A of operated "tens high" relay 728, winding of entire stored quotation "high" relay 734 to grounded battery. From the tongue of operated "fractions low" relay 733 it is extended through winding of low fractions relay 737 to grounded battery. Relay 734 then operates and locks over a circuit which may be traced from battery, locking winding and contact A of relay 734, winding of relay 738, conductor 1323, to ground through contact A of relay 1324. Relay 737 likewise operates and locks over a circuit which may be traced from battery, locking winding and contact A of this relay, winding of relay 739, to ground at contacts of relay 1324. The operation of relay 728 opens the ground circuit which would otherwise extend to the tongues of relays 729—733 and thus renders the circuits extending from the contacts of these relays ineffective.
- It may be pointed out here that the arrangement of the relays 726—733 is such that the only relay effective in causing the operation of either relay 734 or relay 735 is the relay corresponding to the highest order of the stored quotation that differs from the previous quotation on the same stock. For example, the tens digit of the price under consideration is the highest order differing from the previous price, and, as it is higher than the tens digit of the previous price, the tens high relay 728 controls the operation of relay 734. In cases where the fraction of the stored price is the only part of the stored price that differs from the previous price, either the fractions high relay 732 controls the relay 734 or the fractions low relay controls the relay 735, depending upon whether the fraction is higher or lower than the fraction of the previous price.
- As both relays 738 and 739 are operated, test relays 724, 725, 821 and 513 are now operated over parallel circuits that may be traced from ground, contact B of relay 503, conductors 552 and 552', contacts of relays 739 and 738, and over four parallel circuits through the windings of the four test relays 724, 725, 821 and 513 to battery.
- Operation of relay 724 disconnects the windings of relays 726 and 727 from the chain circuit that extends through the contacts of the ten "hundreds" price storage relays 700—709 and at its contacts A and C, connects ground to both ends of this chain circuit. However, the operation of relay 724 is without effect as relays 723, 726 and 727 are unoperated.
- The operation of relay 725 disconnects the windings of relays 728 and 729 from the chain circuit that extends through the contacts of the ten "tens" price storage relays 710—719, and at its contacts A and C, connects ground to both ends of this circuit. Relay 728 releases at this time, though without effect on relay 734 which is now locked. Relay 725 also establishes an operating circuit for the clutch magnet 1023 of the tens indicator 1002 which may be traced from battery, clutch magnet 1023, contact H of stock relay 1015, conductor 1024, conductor 1020, conductor 826, contact E of relay 725, conductor 740, conductor 1020, conductor 1019, contact B of stock relay 1015, common ring M of the tens commutator 1006, wiper N, segment I, conductors 906, 905 and 741, contact C of relay 718 (not shown), the chain circuit, contact B of relay 710, to ground on contact A of relay 725. The clutch magnet 1023 being energized causes the wiper N of the tens commutator 1006 to start rotating. When the wiper reaches segment J of the commutator, which does not carry ground as the tens price storage relay 719 is operated, the clutch magnet 1023 is released. As the J segment corresponds to 9, and the wiper N is in phase with the tooth driving the indicator, the wiper N has moved over the single segment I and has been brought to rest on the segment J, while the digit 9 is displayed by the tens indicator 1002.
- Operation of relay 821 disconnects the windings of the units high and low relays 730 and 731 from the two chain circuits which extend through the contacts of the ten "units" relays 811—820, thus releasing relay 731 and extending connections from both ends of each of these chain circuits as follows:
- (1) From both ends of the first chain circuit, which includes the bottom contacts C of the even "units" price storage relays, through contacts C and G of relay 821, and thence over a common wire, through the left-hand winding of relay 801, winding of relay 809 to ground; and
 - (2) From both ends of the second chain circuit, which includes the bottom contacts C of the odd units price storage relays, through contacts A and E of relay 821, and thence over a common wire, through the right-hand winding of relay 801, winding of relay 810 to ground.
- Relay 821 also completes a circuit for operating the units clutch magnet 1025 of the units indicator 1003, which may be traced as follows: from the common ring of commutator 1007, contact C of the stock relay 1015, conductors 1021 and 1020, conductor 824, contact I of relay 821, conductors 825, 1020, 1026, contact G of stock relay 1015, winding of clutch magnet 1025 to battery. The circuit from the common ring is extended over wiper N, segment J, conductors 908, 907, 823 to the contacts D of relay 820.
- The action of the clutch magnet 1025 in causing rotation of the wiper N of the commutator 1007 is similar to that of the tens indicator clutch magnet just described. Upon the energization of the clutch magnet the wiper is rotated. As the wiper is carried over the grounded commutator segments the ground circuit for clutch magnet 1025 extends alternately through the left-hand winding of relay 801 and the relay 809 and through the right-hand winding of relay 801 and the relay 810.
- In the example chosen, wherein the last price was $90\frac{5}{8}$ and the previous price $89\frac{7}{8}$, the units commutator wiper N starts rotation on the odd numbered segment J corresponding to the units digit 9. Consequently, at the time the circuit through the clutch magnet 1025 is closed, relay 810 and relay 801 operate. Operation of relay 810 operates relay 805 over an obvious circuit. Relay 805 then operates and locks to ground through contact A of relay 801.
- Relay 810 also completes an operating circuit for the first units counting relay 1102 which may be traced from battery, operating winding of relay 1102, contact A of relay 1103, conductor 1131, contact A of relay 806, contact A of relay 810 to ground. Relay 1102 operates over this circuit and locks over conductor 1323 to

ground at contacts of relay 1324. When the wiper N of the units commutator 1007 leaves segment J and contacts with segment A, from which ground has been removed by the operation of units price storage relay 811, the circuit through relay 810 and 801 is opened and, likewise, the circuit of the clutch magnet 1025 is opened and the units clutch magnet 1025 is released. The release of the clutch magnet brings the units indicator 1025 to rest displaying 0 and likewise brings the wiper N of the units commutator 1007 to rest on segment A which corresponds to 0. The release of relay 801 opens the locking circuit of relay 805 with the result that this relay releases. Upon its release relay 801, at its B contact, places ground on conductor 1132 that extends to the contact A of units counting relay 1102, for a purpose that will be explained later.

Although a special case has been described, namely, one in which the units price change is a single unit, the operation of the units counting relays 1102—1111 when the price change is greater than a unit will be briefly pointed out. Assuming a price change of three units, the new units digit will be 2 since the previous units digit was 9. The units price storage relay 813 (not shown) will, therefore, be operated and the segment C of the units commutator 1007 will be ungrounded. It will be evident from the foregoing description that the ground circuit for the units clutch magnet 1025 will be alternately closed through the righthand winding of relay 801 and the winding of relay 810 and through the left-hand winding of relay 801 and the winding of relay 809, as the wiper N of the units commutator 1007 rotates over the segments J—B. It is also apparent that when the wiper N reaches ungrounded segment C the units clutch magnet 1025 will be released. Thus, relay 810 will be energized twice, once when the brush traverses the segment J and once when it traverses the segment B; while the relay 809 will be energized once only, which occurs when the wiper N traverses the segment A.

Upon the first operation of relay 810, the units counting relay 1102 will be energized and locked, in the manner previously described. Upon the operation of relay 809, the second units counting relay 1103 is operated over a circuit that may be traced from battery, winding of relay 1103, contact A of relay 1104, conductor 1133, contact B of relay 805, contact A of relay 809 to ground. Relay 1103 locks up over conductor 1323 to ground at contacts of relay 1324. The operation of relay 1103 transfers the pulsing circuit 1131, controlled by relay 810, into connection with the winding of relay 1104. Upon the next and last operation of relay 810, relay 1104 is operated over a circuit which may be traced from battery, operating winding of relay 1104, contact A of relay 1105, contact B of relay 1103, conductor 1131, contact A of relay 806 to ground at contact A of relay 810. The operation of relay 1104 transfers the pulsing circuit 1133, controlled by relay 809, into connection with the winding of relay 1105. In the present case, however, the relay 809 does not operate again and only the three units counting relays 1102, 1103 and 1104 are operated. Relay 1104 locks up over conductor 1323 to the ground on the contacts of relay 1324.

From the foregoing description it is obvious that as the wiper N of the units commutator

1007 traverses the commutator segments, a number of units counting relays 1102—1111 are operated corresponding to the number of commutator segments crossed, and the clutch magnet 1025 is held operated while the wiper N is traversing the grounded segments, but is released as soon as the wiper reaches an ungrounded segment.

In the examples just given, the wiper N of the commutator 1007 started rotation on the odd segment J. If it starts rotation on an even segment, such as A, C, etc., the initial closure of the clutch magnet circuit causes the left-hand winding of relay 801 and relay 809 to energize. In this case, relay 809 effects the operation of relay 806 over an obvious circuit. Relay 806 likewise locks to ground through contact A of relay 801. Under this condition the pulsing relay 809 sends impulses over the conductor 1131 to operate units counting relays 1102, 1104, 1106, etc., and the pulsing relay 810 sends impulses over conductor 1133 to operate units counting relays 1103, 1105, 1107, etc.

The operation of the fractions commutator and indicator 1008 and 1004, respectively, and the associated pulsing and fractions counting relay circuits is similar to the operation of the units indicator and commutator 1003 and 1007, respectively, and the pulsing and units counting relay circuits associated therewith. In the example chosen, the wiper N of the fractions commutator 1008 moves from segment H, corresponding to $\frac{7}{8}$, to segment F, corresponding to $\frac{5}{8}$, the fractions of the stored price, and hence the fractions counting relays 1202—1207 inclusive are obviously operated and locked.

In the example chosen, the price change is in a positive direction (as the "tens" digit increased) and, as previously explained, the number of relays in the units counting group which are operated is indicative of the increase of the price in the units place. Likewise in the fractions counting group the number of relays operated is indicative of the increase in the fractions place.

In the case of the last price assumed—90%—the entire price is "high" and the fraction "low." Consequently, adjustment must be made for "decimal progression".

It will facilitate an understanding of this adjustment if a description is first given of the manner in which the units counting relays 1102—1111 and the units control relays 1112—1129 control the rotation of the units shaft 1306 when no adjustment for "decimal progression" is required.

In the example given, where the units counting relay 1102 is alone operated, the release of relay 801 causes operating circuits for the units start magnet 1301 and the relay 1325 to be completed. These circuits may be traced from battery, winding of the start magnet 1301, and winding of the relay 1325 in multiple, contact A of the first units control relay 1112, contact B of the relay 1130, normal contacts of relay 1101, contacts C and A of relay 1102, conductor 1132 to ground at contact B of relay 801. The function of relay 1325 will be explained later. The operation of the units start magnet 1301 releases the units shaft 1306. As this shaft rotates, cam 1308 actuates its follower which applies ground to contacts 1311, thus operating the control relay 1112 over a circuit that may be traced from battery, winding of relay 1112, contact A of relay 1121, conductor 1135 to ground on contact 1311.

While the grounded cam follower is in engagement with contact 1311, the winding of relay 1121 is shunted, but when the follower is disengaged from this contact, relay 1112 locks at its B contact and relay 1121 operates over a circuit from battery, winding and locking contacts of relay 1112, winding of relay 1121, to ground on contact B of relay 1325, which operated at the same time as the units start magnet 1301. The operation of relay 1121 extends the pulsing conductor 1135, controlled by pulsing cam 1308, through its B contact, the contact A of relay 1122, and the windings of relay 1113 to battery. The relay 1113 is then prepared for actuation upon the next revolution of shaft 1306. The operation of relay 1121 opens the operating circuit for the units start magnet 1301 previously traced through its A contacts. As no additional units counting relay is operated in this case, the units start magnet 1301 is thus released and the units shaft brought to rest after a single revolution.

Let it be assumed that a greater number of units counting relays, for example, four, are operated. When relay 801 releases connections are extended through the contact C of the relay 1102 and contacts D of relays 1103—1105, the corresponding normal contacts of relay 1101, contact A of relays 1112—1115, start conductor 1134, and in multiple to battery through one winding of relay 1325 and the units start magnet 1301. The units start magnet is then energized, and the units shaft 1306 starts to rotate in a clockwise direction under the drive of friction clutch 1310. Rotation of shaft 1306 causes the closure of cam controlled contact 1311, which causes the units control relay 1112 to operate over the circuit previously traced. After the operation of relay 1112, and after contacts 1311 are opened, relay 1121 operates and relay 1112 locks over a circuit previously traced. The operation of relay 1112 opens the operating circuit for the units start magnet extending through the contacts of units counting relay 1102. The operation of relay 1121 extends the pulsing circuit controlled by cam 1308 into connection with the winding of relay 1113. During the next revolution of the shaft 1306, the units control relay 1113 operates over a circuit from battery, winding of relay 1113, contact A of relay 1122, contact B of relay 1121, to ground at contacts 1311. When the short circuit is removed from its winding relay 1122 operates and relay 1113 locks over an obvious circuit at its B contact. The operation of relay 1113 opens the operating circuit for the units start magnet extending through the contacts of units counting relay 1103. The operation of relay 1122 extends the pulsing circuit into connection with the winding of relay 1114. It is evident from the foregoing that, upon the next revolution of shaft 1306, the relays 1114 and 1123 will be locked up to open the start magnet circuit extending through the contacts of relay 1104 and to extend the pulsing circuit into connection with the winding of relay 1115; while, upon the fourth and last revolution of the shaft 1306, the pair of control relays 1115 and 1124 will be operated, the last of the start magnet operating circuits opened, and the pulsing circuit extended into connection with the winding of relay 1116.

If more than one units relay is operated, the operated relays complete an equal number of operating circuits for the units start magnet 1301, and then for each revolution of the units shaft 1306 a pair of control relays is operated

with the result that one of the multiple operating circuits is opened. The units shaft 1306 is consequently allowed to make a number of revolutions equal to the number of units counting relays operated when no adjustment for "decimal progression" is made.

Returning now to the consideration of the adjustment for "decimal progression", at the time that relays 734 and 707 operate, the relay 1130 is operated over a circuit from battery, winding of relay 1130, contact B of relay 737 to ground at contact B of relay 734. The operation of the relay 1130 effects the desired adjustment by opening the units start magnet operating circuit prepared by the first units counting relay 1102 and by preparing for the operation of the first two pairs of control relays 1112, 1121 and 1113, 1122 upon the first revolution of the units shaft 1306.

With the last price assumed, the relay 1102 is alone operated in the units counting relay group. Normally, as previously pointed out, the operation of this relay would prepare an operating circuit for the units start magnet 1301 so that, when the relay 801 released, the shaft 1306 would be allowed to make one revolution. But with relay 1130 operated, the prepared operating circuit for the units start magnet 1301 is opened at contact B of this relay (1130) and, consequently, the units shaft 1306 remains at rest when relay 801 releases. Also, since the units shaft fails to rotate, the prepared circuit for causing the simultaneous operation of the first two pairs of control relays is without effect at this time.

If an adjustment is to be made, and more than one units counting relay is operated, it is evident that with relay 1130 operated, the number of multiple operating circuits for the start magnet 1301 completed upon the release of relay 801 will be one less than the number of operated units counting relays, and that as the first two pairs of control relays are operated over obvious circuits upon the first revolution of the units shafts 1306, that shaft will be allowed to make a number of revolutions equal to one less than the number of operated units counting relays.

In the foregoing description, the "decimal progression" adjustment has been described for the case when the entire price is "high" and the fraction "low". It is evident, without discussion, that this adjustment can be made equally well for the case when the entire price is "low" and the fraction "high", though in this case the units shaft 1306 will be allowed to make a number of revolutions equal to one less than the number of unoperated units counting relays.

Returning to the operation of the system, when the wiper N of the units commutator 1007 comes to rest, relay 801 releases and connects ground to one end of an operating circuit for the units start magnet 1301 extending through the contacts of an operated units counting relay 1102, but as this operating circuit is open at the contacts of a relay 1130 and as no other units counting relays are operated, the units start magnet remains de-energized and the units shaft 1306 at rest.

At the time that the wiper N of the fractions commutator 1008 comes to rest on the selected segment, the relay 802 releases, establishing a circuit which extends from ground, through contact B of relay 802, contact A of the first fractions counting relay 1202, to all bottom

tongues of the fractions counting relays. As the first six relays 1202—1207 of this group are operated, while the transfer relay 1201 is unoperated, this ground is extended over parallel circuits through contacts C of relay 1202 and contact D of relays 1203—1207, through corresponding normal contacts of relay 1201, to contact A of the first six relays of the fractions control group 1210—1215. This ground is extended through tongues of these relays, through the winding of the fractions start magnet 1302 to battery, and over a circuit parallel with the fractions start magnet, through a second winding of relay 1325 and to battery. The fractions start magnet then energizes, releasing shaft 1312, which now revolves in a clockwise direction under the drive of the friction clutch 1315. The shaft 1312 carries the cam 1313 which, as previously explained, is arranged to close and open the contact 1317 eight times per revolution. At each make and break of the contact 1317, one pair of the counting relays of the fractions control group 1210—1226 is operated in a manner similar to the operation of the units counting relays. Thus, after six-eighths of one revolution of the shaft 1312, the first six pairs of control relays 1210, 1226 to 1215, 1221 are energized, ground is removed from the fractions start magnet 1302 and this magnet releases its armature to arrest the motion of shaft 1312 after it has turned through six-eighths of one revolution.

The motion of the shaft 1312 which, in the example given, is the only shaft that turns, is transmitted through the differential gearing 1318 to the shaft 1319. Since the reversing magnet 1321 is de-energized, the right-hand driving face of the friction wheel 1305 is in contact with the drive wheel 1320 and the shaft 1319 causes rotation of the shaft 1305 in a positive direction. The revolution indicator then registers this motion and displays the new average price. The ratio of transmission between the shafts 1306 and 1312 and the revolution indicator shaft 1304, as has previously been stated, is so selected as to introduce a proper divisor in the price change.

In the example given, where the previous price was 89% and the last price 90%, the last price was a new high and, consequently, the reversing magnet 1321 is not operated.

The average price recorder is also designed to take care of cases in which the last price is a new low. Let it be assumed that the digit of the previous price is 8 and the digit of the last price is 2. It will then be understood from the preceding description that the first four units counting relays 1102—1105 inclusive and the relay 735 will be operated. Let it also be assumed that the fraction of the previous price is 6/8 and that of the last price is 2/8. In this case, it will be understood that the relay 737 and the first four fractions counting relays 1202—1205 will be operated.

The following description will be confined to the operation of the relay 735 in controlling the relays 1101 and 1201 and the reversing magnet 1321, and the operation of the units and fractions counting relays in controlling the setting of the register 1303. An understanding of the other portions of the average price computer participating in the final result may be obtained from the preceding description.

Upon the operation of relay 735 the relays 1101 and 1201 and the reversing magnet 1321

are operated over a circuit from ground at contact C of relay 735, conductor 742, and to battery over parallel circuits through the windings of relays 1101 and 1201 and of the reversing magnet 1321. The relays 1101 and 1201 close their alternate contacts. Consequently, upon the release of relay 801, the six unoperated units counting relays 1106—1111 inclusive become effective to control the units start magnet 1301 and the last four unoperated fractions counting relays 1206—1209 inclusive become effective to control the fractions clutch magnet 1302. For example, an operating circuit for the units start magnet will be completed from ground, contact B of relay 801, conductor 1132, contact A of relay 1102, normal contacts of relay 1106, corresponding alternate contact of relay 1101, contact A of control relay 1117, start lead 1134, start magnet 1301 to ground. Similar operating circuits for the units start magnet 1301 are completed through the normal E contacts of the other five unoperated units counting relays 1107—1111 inclusive. It should be noted that the operating circuit for the units start magnet extending through the normal E contacts of relay 1111 extends through contacts B of relay 1130. An operating circuit for the fractions start magnet 1302, for example, is completed from ground, contact B of relay 802, contact A of relay 1202, normal contact E of relay 1206, corresponding alternate contact of relay 1201, contact A of relay 1213, to battery through the fractions start magnet 1302. Similar operating circuits for the fractions start magnet are completed through the normal E contacts of the other three unoperated fractions counting relays 1207—1209 inclusive. From the previous description of the operation of the control relays when the last price was high, it will be understood that the unoperated units and fractions counting relays cause the units shaft 1306 to make six revolutions, and the fractions shaft 1312 to make four revolutions.

In this case, however, the reversing magnet 1321 is operated, and consequently the register 1303, in the manner previously pointed out, is caused to be turned back an amount proportional to the rotation of both the units and fractions shafts.

The functions of relays 1324 and 1325, which are used for clear-out purposes, will now be described. At the time that the units start magnet 1301 energizes, a parallel circuit is extended through one winding of the relay 1325, and at the time that the fractions start magnet 1302, is energized, a parallel circuit is extended through a second winding of this relay. Relay 1325 then operates at any time that either one or both of the start magnets are energized. Operation of relay 1325 establishes a shunt circuit around the contacts of relay 1324 and also establishes a circuit from ground, through the winding of relay 1324 to battery. Relay 1324 operates but without effect at this time, since its contacts are shunted. When the rotation of the shafts 1306 and 1312 has been completed, the circuits through both of the windings of relay 1325 are open and this relay releases, removing the shunt around the contacts of relay 1324. At this time, the winding of relay 1324 de-energizes but, as this relay is of the slow-release type, it will remain operated for an appreciable time. During this period the ground circuit which extended through contacts of relays 1325 and 1324 is opened to release the relays whose

locking circuits have been previously traced to this ground. It will be noted that relays 503 and 503' and the operated price selection and storage relays are not released at this time, as their locking circuit extends over conductor 650 to ground at contact F of relay 604. These relays remain locked until such time as the figure shift signal of the next quotation is received.

The price quotations assumed in the previous description contained at least two digits. The effect of quotations containing only a fraction will now be briefly indicated.

In the case of a quotation where only the fractions part of the price is received, the relays 723, 722 and 822 are not operated and, in turn, none of the relays 726-731 inclusive can be operated. The fractions of the price alone indicates, in this case, whether the whole price is high or low and also whether the fractions part of the price is high or low.

Assume that a new high quotation is received, which includes only the fractions signal. Relay 732 is then operated and, as relay 503' is operated, ground is extended through contact B of relay 503', conductor 516, contact C of relay 732, winding of relay 736 to battery. At the same time a circuit is extended from ground at the same contacts of relay 503' through tongues and back contacts of relays 726-731 in series, contact B of relay 732, winding of relay 734 to battery. Relays 736 and 734 then operate but, in this case, they are without further effect since the price change is in a positive direction and the number of segments traversed by the wiper of the fractions switch indicates directly the change in price.

In general, the highest order of received digit differing from the the corresponding digit of the previous last price is effective in determining whether the whole price is "high" or "low"; if the whole price is "high" the relays 1101 and 1201 are not operated and the change in price is indicated by the number of operated relays in the units and fractions counting groups; and if the whole price is "low" the relays 1101 and 1201 are operated and the price change is indicated by the number of unoperated relays in the units and fractions counting groups.

The functions of relay 1130 will now be described. This relay is operated under the following two conditions:

- (1) When the whole price is "low" and the fractions part of the price is "high", and
- (2) When the whole price is "high" and the fractions part of the price is "low".

The second of these conditions is present in the example given in the foregoing description, wherein the last previous price was 89% and the new price is 90%. In this case the price change is plus 6/8 points, and the number of operated relays in the units and fractions counting groups is 1 and 6, respectively. The units count of 1 must, therefore, be cancelled if the price change is to register properly. To reduce the units count is the function of the relay 1130. This relay, when operated, opens one of the two parallel ground connections which extend between the contacts of the units counting relays and the units control relays. Relay 1130 connects also the operating circuits of relays 1112 and 1113 in parallel so that they are both operated upon the first closure of contact 1311. Under these conditions the units shaft 1306 will evidently not be started.

To exemplify the first of the above-named conditions, assume that the previous price was 90% and that the new price is 89%. In this case the price change is minus 6/8 points, but the number of operated relays in the units and fractions counting groups is 1 and 2, respectively. In this case the relay 1130 acts in the same manner to prevent any revolution of the units shaft 1306.

In general, the function of the relay 1130 is to take care of the "decimal progression" which occurs in the processes of addition and subtraction, as exemplified by the acts of "carrying forward" and "taking away" which occur in arithmetical addition and subtraction.

The average price computer has been described as co-operating with a master board which is, in common with a plurality of receiving boards, controlled by a single transmitting means. It is, of course, evident that the average price computer might be employed alone, in which case it would be controlled by the transmitting means co-operating with the permutation unit Q, the stock selection relays, etc., R3, the price selection relays R1 and R2, and the figure shift relays, etc., U.

The embodiment of the invention set forth in the foregoing specification has been described in connection with a stock price averaging device. It is to be understood, however, that this invention is not limited to this particular use, but is to be construed as broadly as the state of the art and the appended claims permit.

What is claimed is:

1. In a computing system, the combination of a transmitter for sending signals tabularly characterizing an item and indicating the quantity of said item, and means controlled by signals received from said transmitter for automatically computing the average quantity of the transmitted items without regard to their tabular characterization.

2. In a computing system, the combination of a transmitter for sending signals tabularly characterizing an item and indicating the quantity of said item, and means controlled by signals received from said transmitter for automatically computing the average quantity of only the transmitted items of a predetermined tabular characterization.

3. In a computing system, the combination of a transmitter for sending signals tabularly characterizing an item and indicating the quantity of said item, and means controlled by signals received from said transmitter for automatically computing the average quantity of the transmitted items without regard to their tabular characterization and for displaying the quantities of the individual items according to their tabular characterization.

4. In a stock quotation system, the combination of a transmitter and an average price computer for automatically computing the average price of a plurality of stocks in response to stock quotation signals received from said transmitter.

5. In a stock quotation system, the combination of a transmitter, and an average price computer for automatically computing the average price of a plurality of stocks and for displaying the individual prices on each stock in response to stock quotation signals received from said transmitter.

6. In a stock quotation system, the combination of a transmitter, a master board associated therewith for displaying quotations on a plu-

ality of stocks, an average price computer associated with the master board for automatically computing the average price of a selected group of said stocks, and selecting means include in said master board and operable by said transmitter for controlling the posting of stock quotations on the master board and also for controlling the operation of said average price computer in computing the average price of the stocks in the selected group.

7. In a stock quotation system, the combination of a transmitter, a master board for displaying quotations on a plurality of stocks, an average price computer, associated with the master board, for automatically computing the average price of a selected group of said stocks, selecting means in the master board under control of said transmitter for controlling the posting of quotations on the master board and for repeating into said computer price impulses received from said transmitter, said computer having means for storing said repeated price impulses, means for comparing the stored price of a stock in the group to be averaged with the previous price on the same stock, a register, driving means normally conditioned to advance said register to increase the average price indicated thereby, and means responsive to the operation of said comparing means, when the last price is a low, for causing said driving means to actuate said register in the reverse direction to decrease the average price indicated thereby.

8. In a stock quotation system, the combination of a transmitter, a master board for displaying quotations on a plurality of stocks, an average price computer, associated with the master board, for automatically computing the average price of a selected group of said stocks, selecting means in the master board under control of said transmitter for controlling the posting of quotations on the master board and for repeating into said computer price impulses received from said transmitter, said computer having means for storing said repeated impulses, means for comparing the stored price on a stock in the group to be averaged with the previous price on the same stock to determine whether the last price is a high or low, means for determining the difference between said stored price and said previous price, a register, and means for adding said difference divided by a predetermined factor to, and subtracting said difference divided by said factor from, said register when said comparing means finds the last price a high and a low, respectively.

9. In a stock quotation system, the combination of a transmitter, a master board for displaying quotations on a plurality of stocks, an average price computer, associated with the master board, for automatically computing the average price of a selected group of said stocks, selecting means in the master board under control of said transmitter for controlling the posting of quotations on the master board and for repeating into said computer price impulses received from said transmitter, said computer having means for storing said repeated price impulses, means for comparing the stored price on a stock in the group to be averaged with the previous price on the same stock, a register, means for determining the arithmetical difference between said prices, and means for adding said difference divided by a predetermined factor to said register when said comparing means finds the last price a high.

10. In a stock quotation system, the combination of a transmitter, a master board for displaying quotations on a plurality of stocks, an average price computer, associated with the master board, for automatically computing the average price of a selected group of said stocks, selecting means in the master board under control of said transmitter for controlling the posting of quotations on the master board and for repeating into said computer price impulses received from said transmitter, said computer having means for storing said repeated price impulses, means for comparing the units and fractions of the stored price on a stock in the group to be averaged with those of the previous price on the same stock, a register, means for determining the arithmetical difference between the units and fractions of said prices, and means controlled by the price comparing means when it finds the last price a low for subtracting from said register 10 minus the units difference divided by a predetermined factor and $1 \frac{8}{8}$ less the fractions difference divided by said factor.

11. In a stock quotation system, a transmitter, a master board for displaying quotations on a plurality of stocks, an average price computer for automatically computing the average price of a group of said stocks, selecting means in said master board under control of said transmitter for controlling the posting of stock quotations on said master board and for controlling the operation of said computer in averaging said stock prices, and means for changing at will the increment added to or subtracted from said computer upon each point rise or fall, respectively, in the price of any one of the averaged stocks.

12. In a stock quotation system, the combination of a transmitter, a master board for displaying quotations on a plurality of stocks, an average price computer, associated with said master board, for automatically computing the average price of a selected group of said stocks, selecting means in the master board under control of said transmitter for controlling the posting of quotations on the master board and for repeating into said computer price impulses received from said transmitter, said computer having means for storing said repeated price impulses, means for comparing the stored price on a stock in the group to be averaged with the previous price on the same stock, means for determining the difference between said prices, a register, and driving means therefor having a predetermined transmission ratio, and means for operatively associating said driving means with said register for a period determined jointly by said comparing and difference determining means.

13. In a stock quotation system, the combination of a transmitter, a master board for displaying quotations on a plurality of stocks, an average price computer, associated with said master board, for automatically computing the average price of a selected group of said stocks, selecting means in the master board under control of said transmitter for controlling the posting of quotations on the master board and for repeating into said computer price impulses received from said transmitter, said computer having means for storing said repeated price impulses, means for comparing the stored price on a stock in the group to be averaged with the previous price on the same stock, means for determining the difference between said prices, a register, and driving means therefor having a

predetermined transmission ratio and arranged to advance said register for a period determined by said difference determining means when the comparing means find the stored quotation to be high and to turn said register back for a period determined jointly by said difference determining means and said comparing means when said comparing means find the stored quotation to be low.

14. In a stock quotation system, the combination of a transmitter, a master board for displaying quotations on a plurality of stocks, an average price computer, associated with said master board, for automatically computing the average price of a selected group of said stocks, selecting means in the master board under control of said transmitter for controlling the posting of quotations on the master board and for repeating into said computer impulses received from said transmitter, said computer having means for storing said repeated impulses, means for comparing each digit and the fraction of the stored price on a stock in the group to be averaged with the digits of the corresponding order and the fraction of the previous price on the same stocks, a register, and driving means therefor having a predetermined transmission ratio, said driving means being arranged to advance said register when the highest order of the stored price that differs from the previous price is higher than the corresponding order in the latter price.

15. In a stock quotation system, the combination of a transmitter, a master board for displaying quotations on a plurality of stocks, an average price computer, associated with said master board, for automatically computing the average price of a selected group of said stocks, selecting means in the master board under control of said transmitter for controlling the posting of quotations on the master board and for repeating into said computer impulses received from said transmitter, said computer having means for storing said repeated impulses, means for comparing each digit and the fraction of the stored price on a stock in the group to be averaged with the digits of the corresponding order and the fraction of the previous price on the same stock, a register, and driving means therefor having a predetermined transmission ratio, said driving means being arranged to turn said register back when the highest order of the stored price that differs from the previous price is lower than the corresponding order in said previous price.

16. In a stock quotation system, the combination of a transmitter, a master board for displaying quotations on a plurality of stocks, an average price computer, associated with said master board, for automatically computing the average price of a selected group of said stocks, selecting means in the master board under control of said transmitter for controlling the posting of quotations on the master board and for repeating into said computer price impulses received from said transmitter, said computer having means for storing said repeated price impulses, means for comparing the stored price on a stock in the group to be averaged with the previous price on the same stock, means effective after the operation of said comparing means for determining the difference between said prices, counting relays for storing the impulses corresponding to said difference, a register, driving means therefor effective to advance said

register for a period determined by the operated counting relays when the comparing means finds the stored price to be high, said driving means being also effective to turn said register back for a period determined by the unoperated counting relays when the comparing means finds the stored price to be low.

17. In a stock quotation system, the combination of a transmitter, a master board for displaying quotations on a plurality of stocks, an average price computer, associated with said master board, for automatically computing the average price of a selected group of said stocks, selecting means in the master board under control of said transmitter for controlling the posting of quotations on the master board and for repeating into said computer price impulses received from said transmitter, said computer having means for storing said repeated price impulses, means for comparing the stored price on a stock on the group to be averaged with the previous price on the same stock, means effective after the operation of said comparing means for determining the difference in units and fractions between said prices, units and fractions counting relays for storing the impulses corresponding to said units and fractions differences, a register, driving means therefor effective to advance said register for a period determined by the operated units and fractions counting relays when the coming means finds the stored unit to be high, said driving means being also effective to turn said register back for a period determined by the unoperated units and fractions counting relays when the comparing means finds the stored price to be low.

18. In a stock quotation system, the combination of a transmitter, a master board for displaying quotations on a plurality of stocks, an average price computer, associated with the master board, for automatically computing the average price of a selected group of said stocks, selecting means in the master board, under control of the transmitter, for controlling the posting of quotations on the master board and for repeating into said computer price impulses received from said transmitter, said computer having means for storing said repeated price impulses, means for comparing the stored price on a stock in the group to be averaged with the previous price on the same stock to determine whether both the entire stored price and the fractions of the stored price are high or low, means for determining the arithmetical difference between said prices, and means controlled by said price comparing means for compensating for the decimal progression in ascertaining said difference when the entire price is high and the fraction low and also when the entire price is low and the fraction high.

19. In a stock quotation system, the combination of a transmitter, a master board for displaying quotations on a plurality of stocks, an average price computer, associated with the master board, for automatically computing the average price of a selected group of said stocks, selecting means in the master board, under control of the transmitter, for controlling the posting of quotations on the master board and for repeating into said computer price impulses received from said transmitter, said computer having means for storing said repeated price impulses, means for comparing the stored price on a stock in the group to be averaged with the previous price on the same stock to determine

whether both the entire stored price and the fractions of the stored price are high or low, means for determining the arithmetical difference between said prices, and means controlled by said price comparing means for compensating for the decimal progression in ascertaining said difference when the entire price is high and the fraction low.

20. In a stock quotation system, the combination of a transmitter, a master board for displaying quotations on a plurality of stocks, an average price computer, associated with the master board, for automatically computing the average price of a selected group of said stocks, selecting means in the master board, under control of the transmitter, for controlling the post-

ing of quotations on the master board and for repeating into said computed price impulses received from said transmitter, said computer having means for storing said repeated price impulses, means for comparing the stored price on a stock in the group to be averaged with the previous price on the same stock to determine whether both the entire stored price and the fractions of the stored price are high or low, means for determining the arithmetical difference between said prices, and means controlled by said price comparing means for compensating for the decimal progression in ascertaining said difference when the entire price is low and the fraction high.

CLIFTON T. FOSS.

20	95
25	100
30	105
35	110
40	115
45	120
50	125
55	130
60	135
65	140
70	145
75	