

July 8, 1941.

W. F. QUINBY

2,248,822

SIGNALING SYSTEM

Original Filed Dec. 21, 1935 20 Sheets-Sheet 1

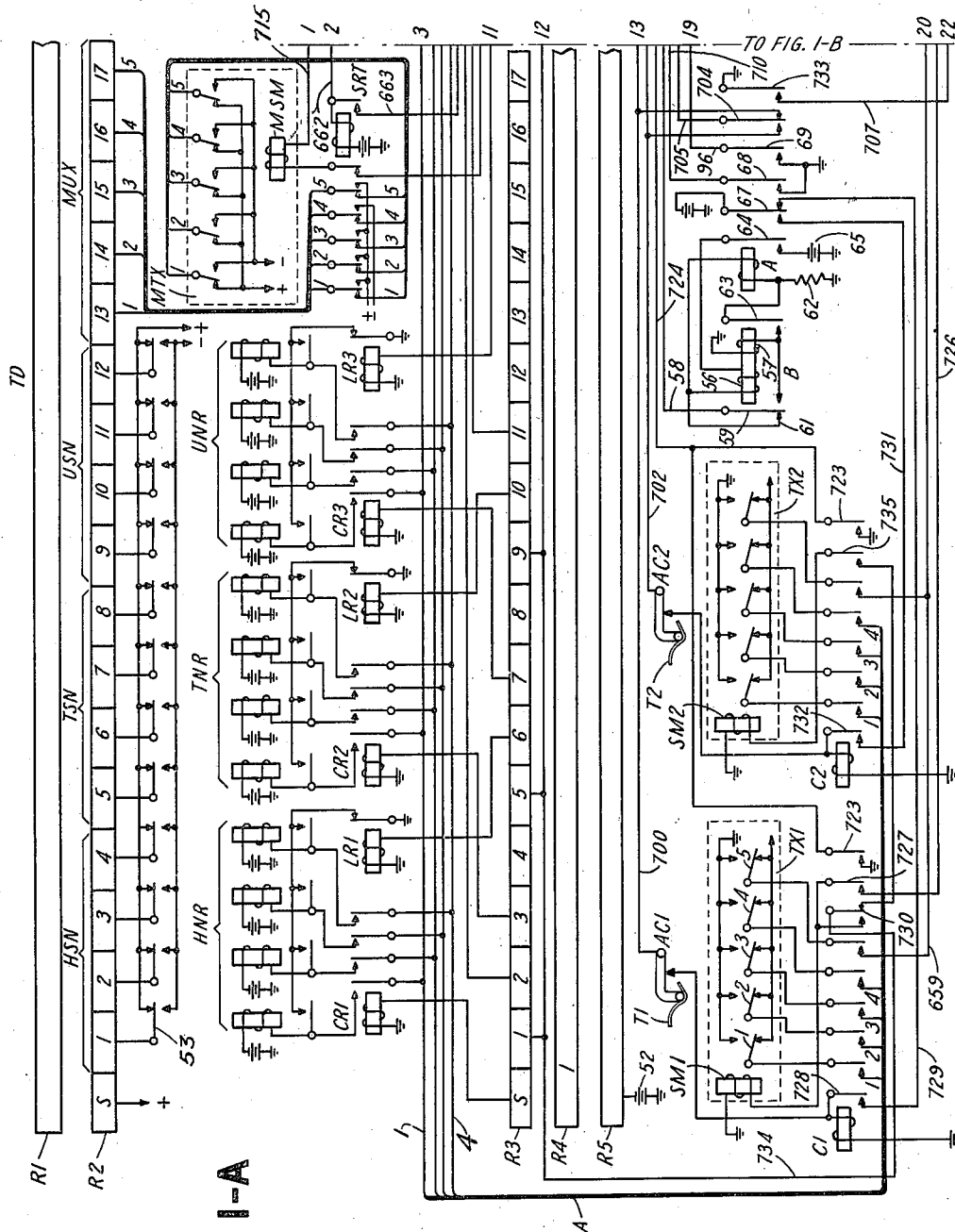


FIG. 1-A

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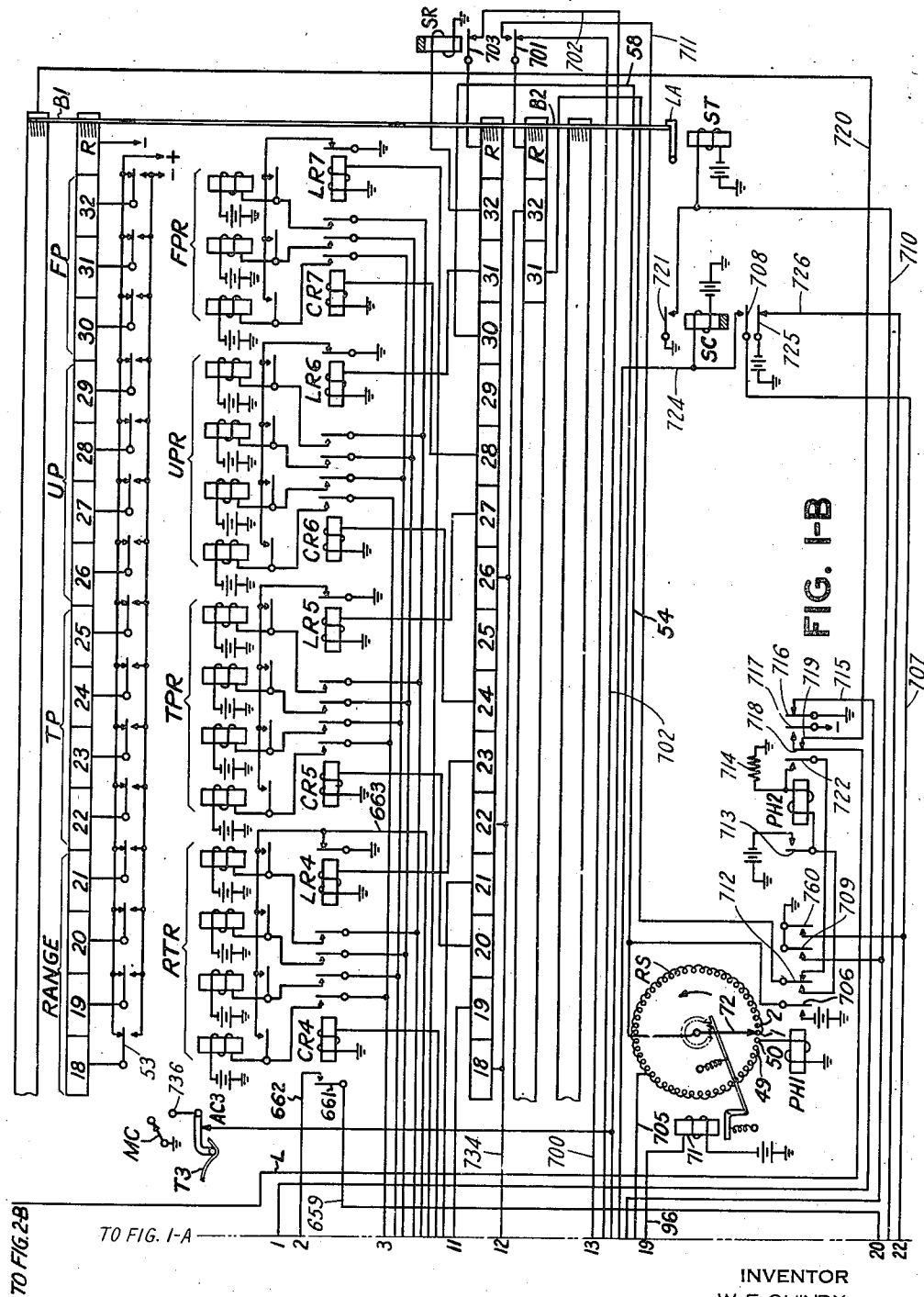
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SIGNALING SYSTEM

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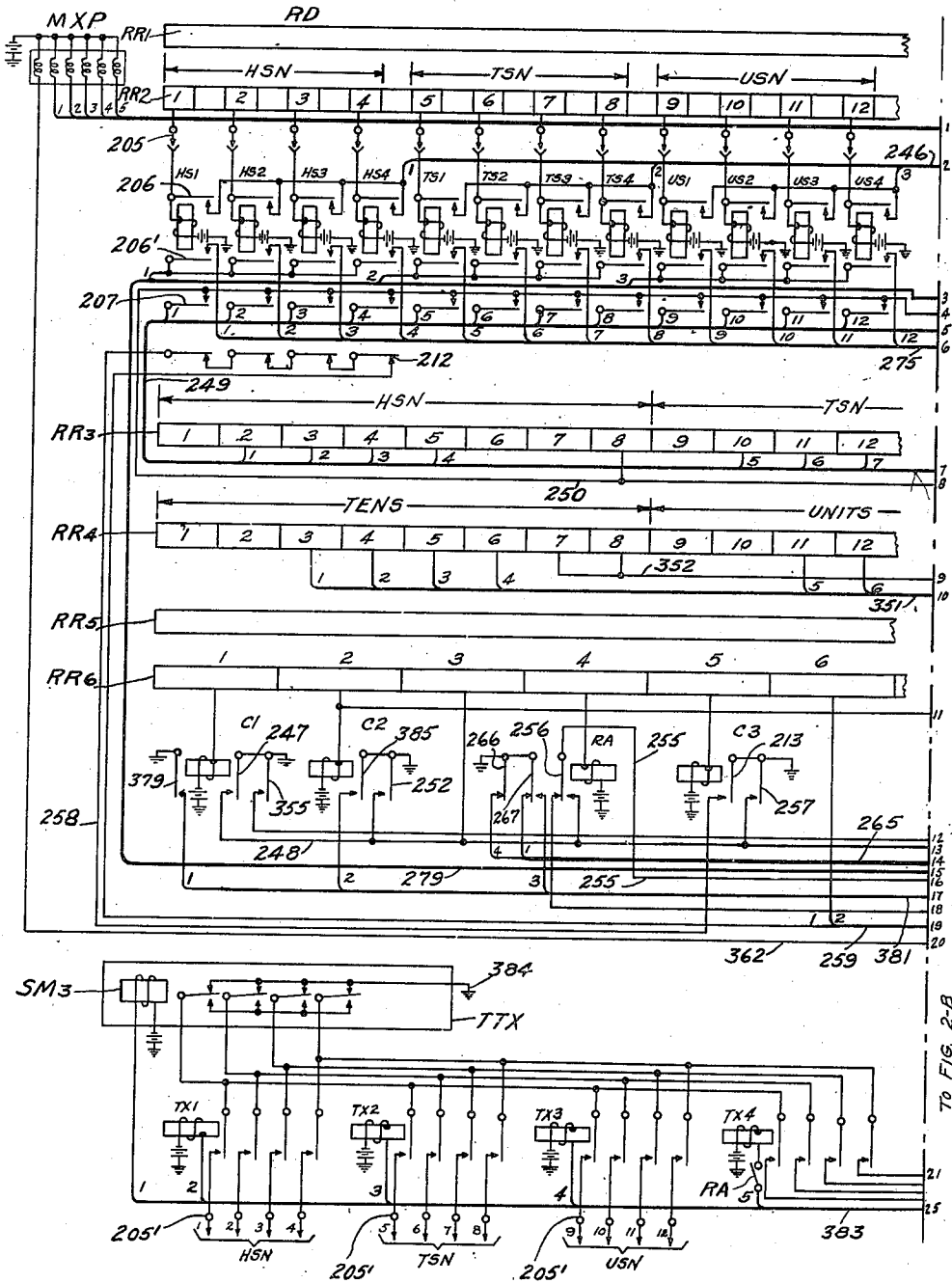


FIG. 2-A

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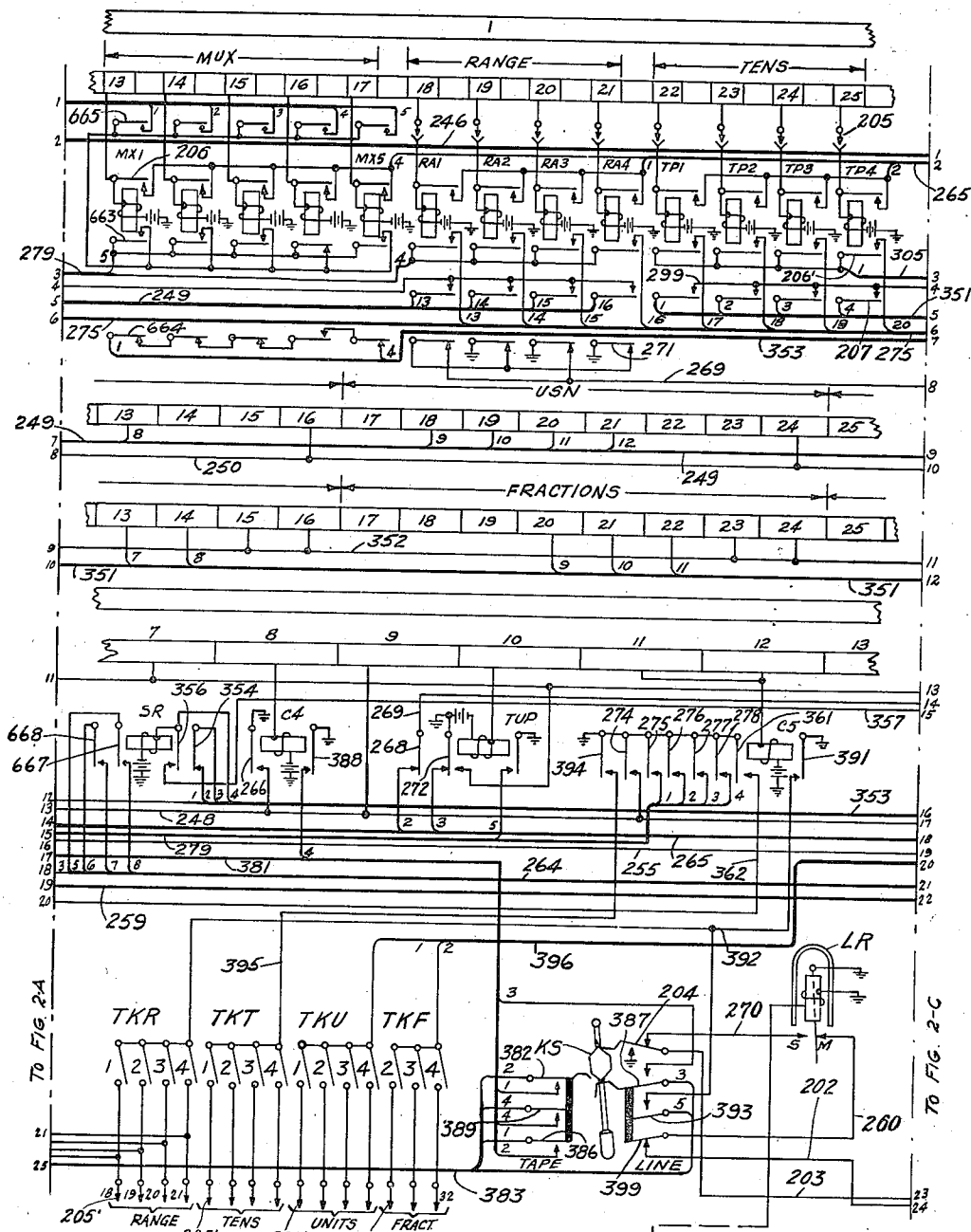


FIG. 2-B

To FIG. 1-B

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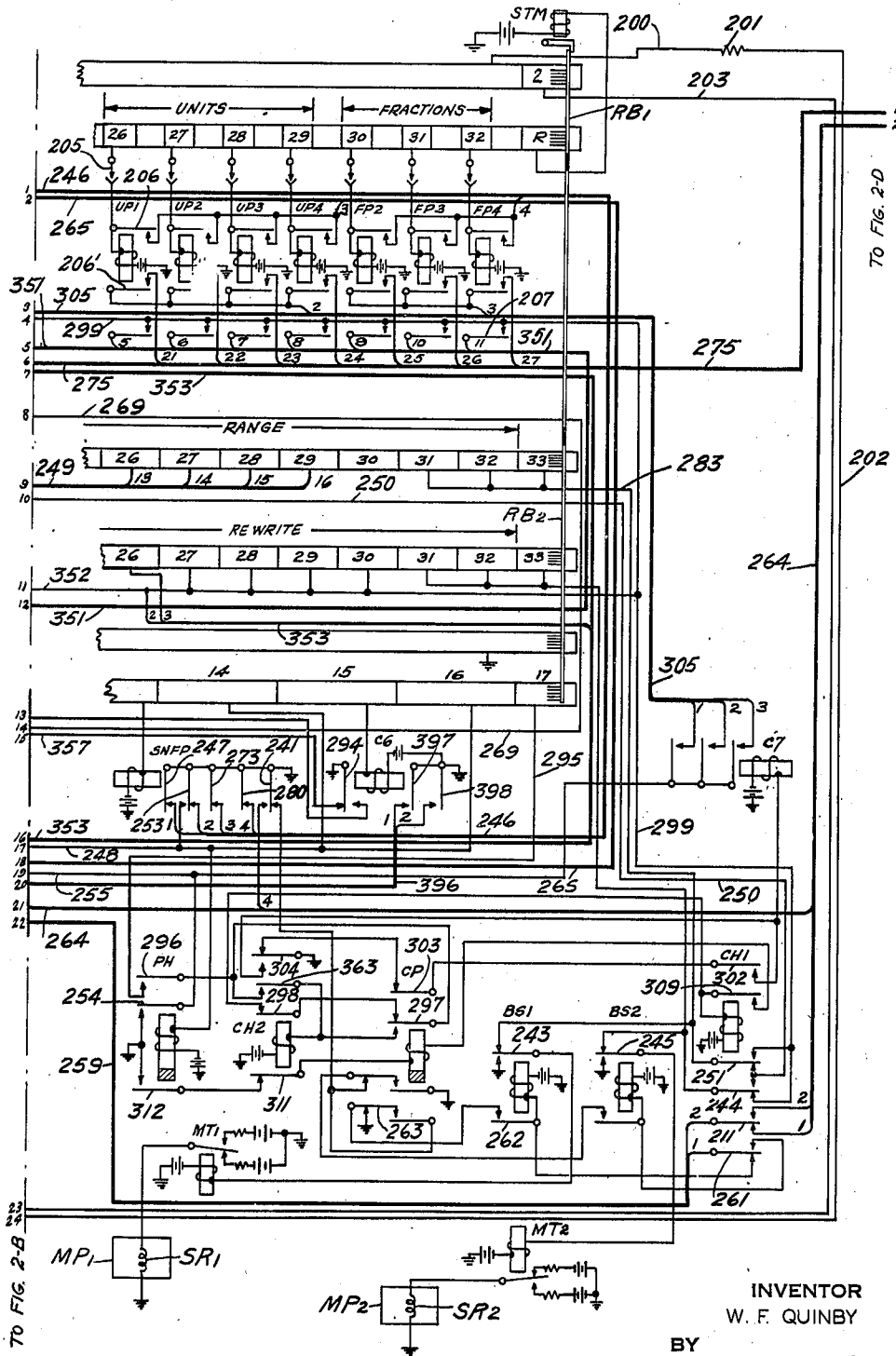


FIG. 2-C

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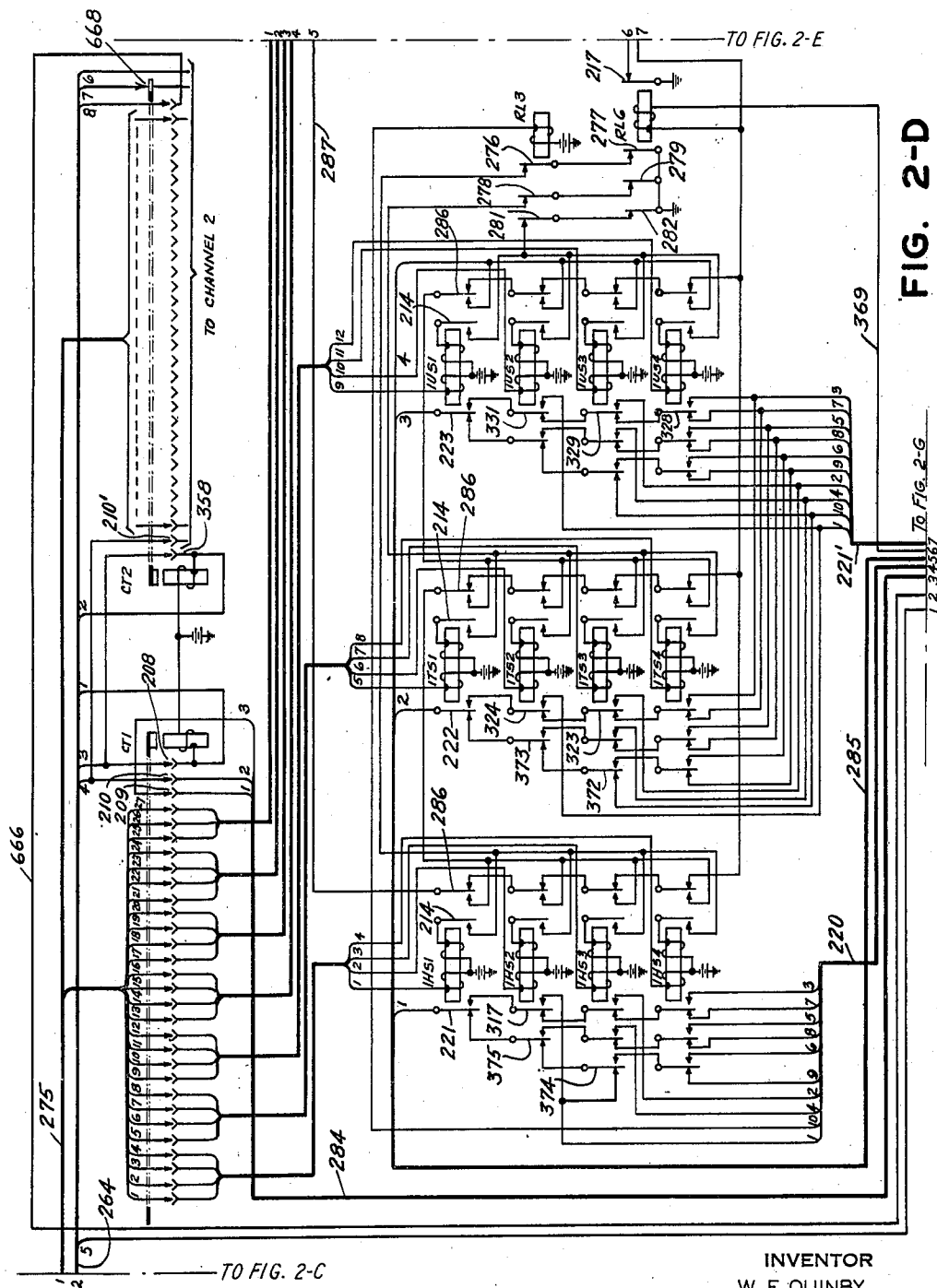


FIG. 2-D

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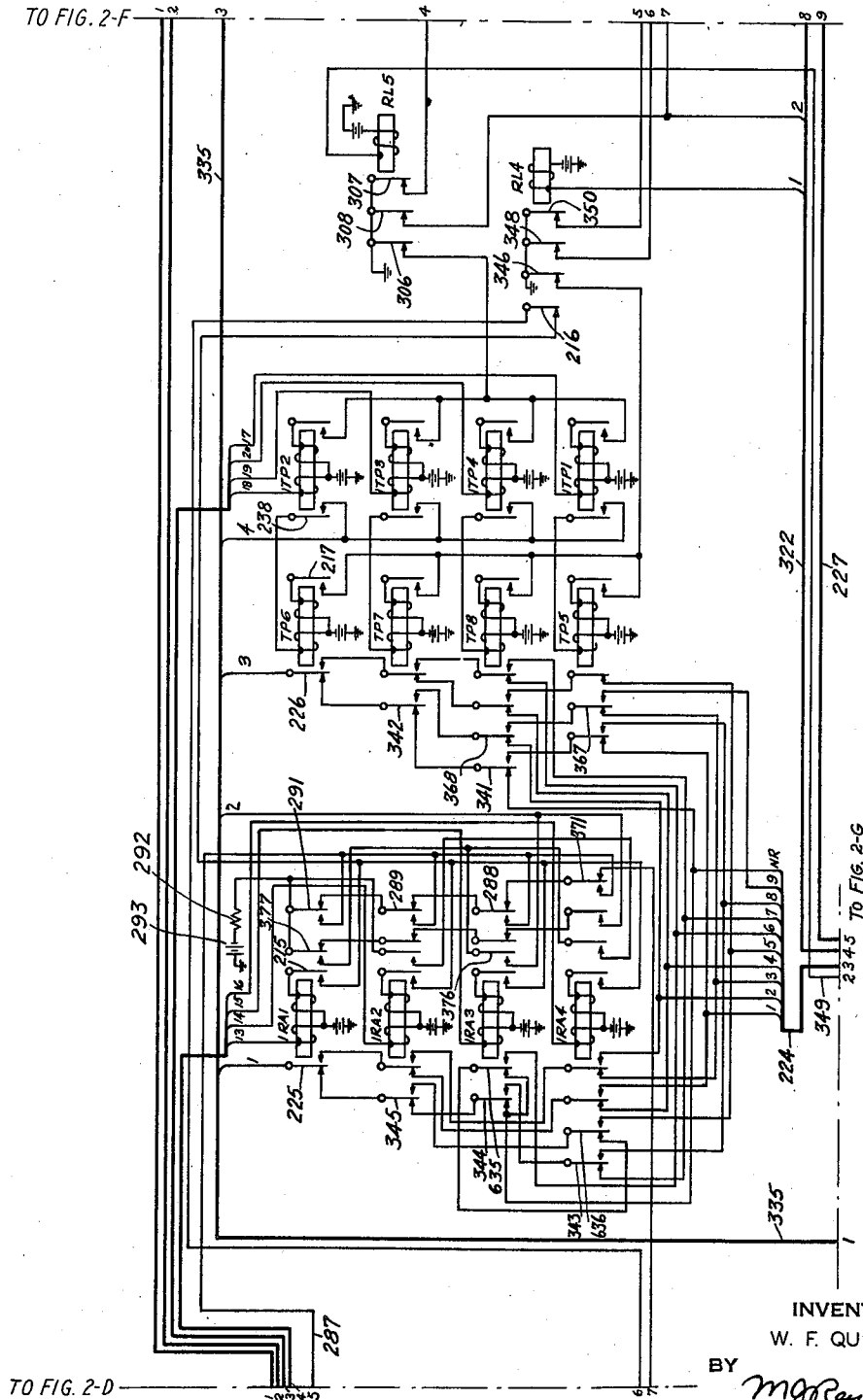


FIG. 2-E

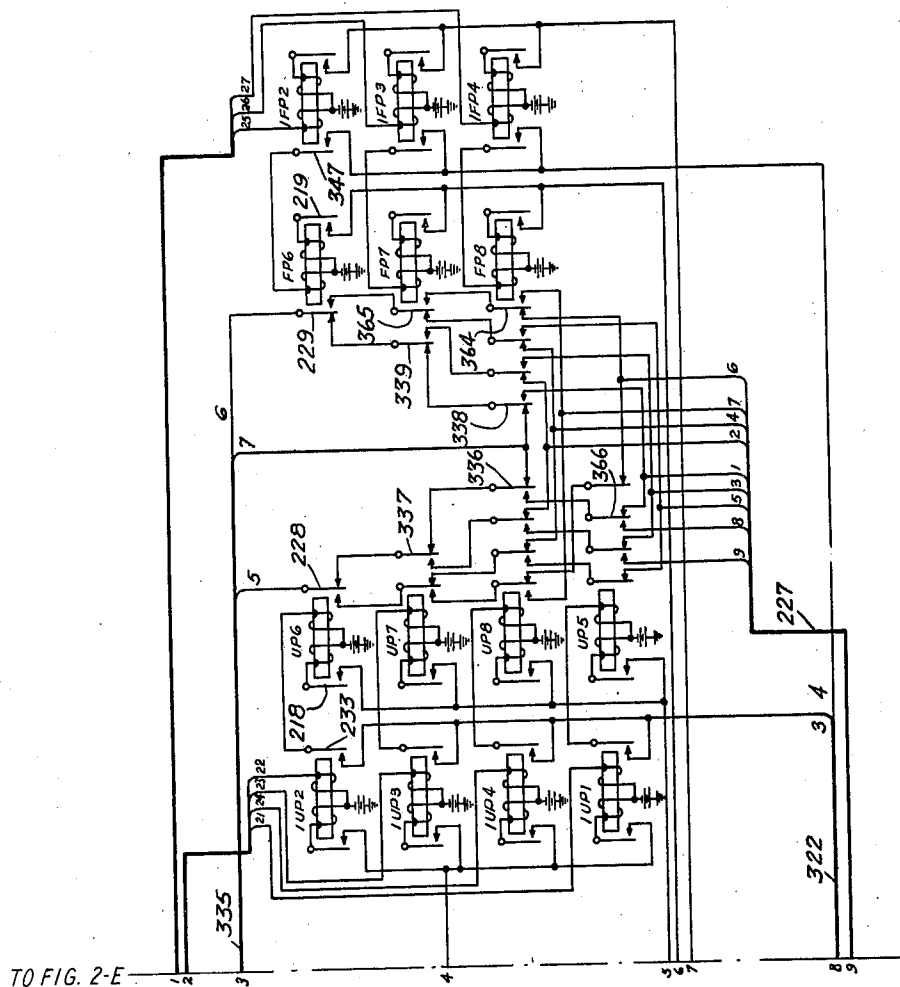
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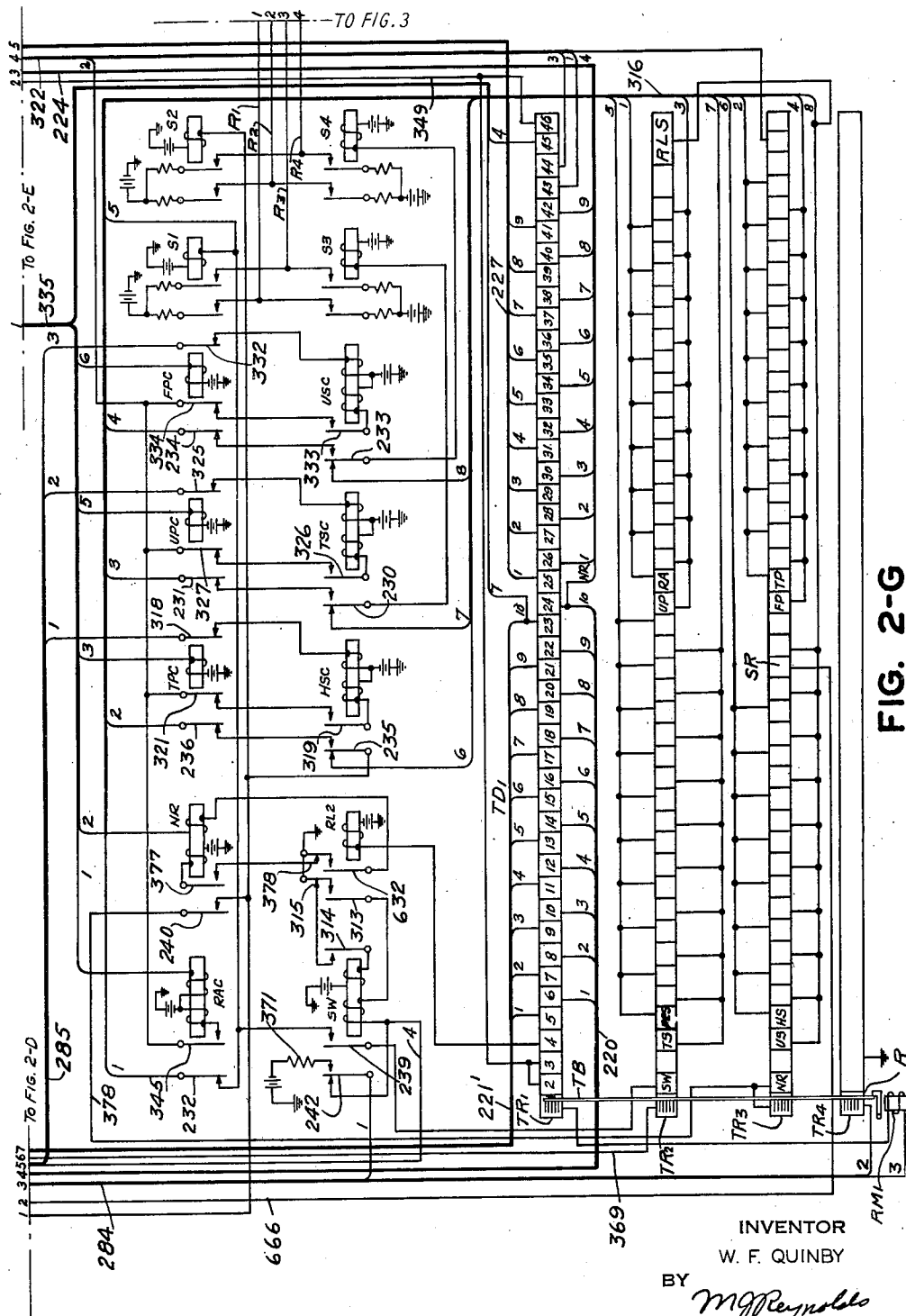


FIG. 2-G

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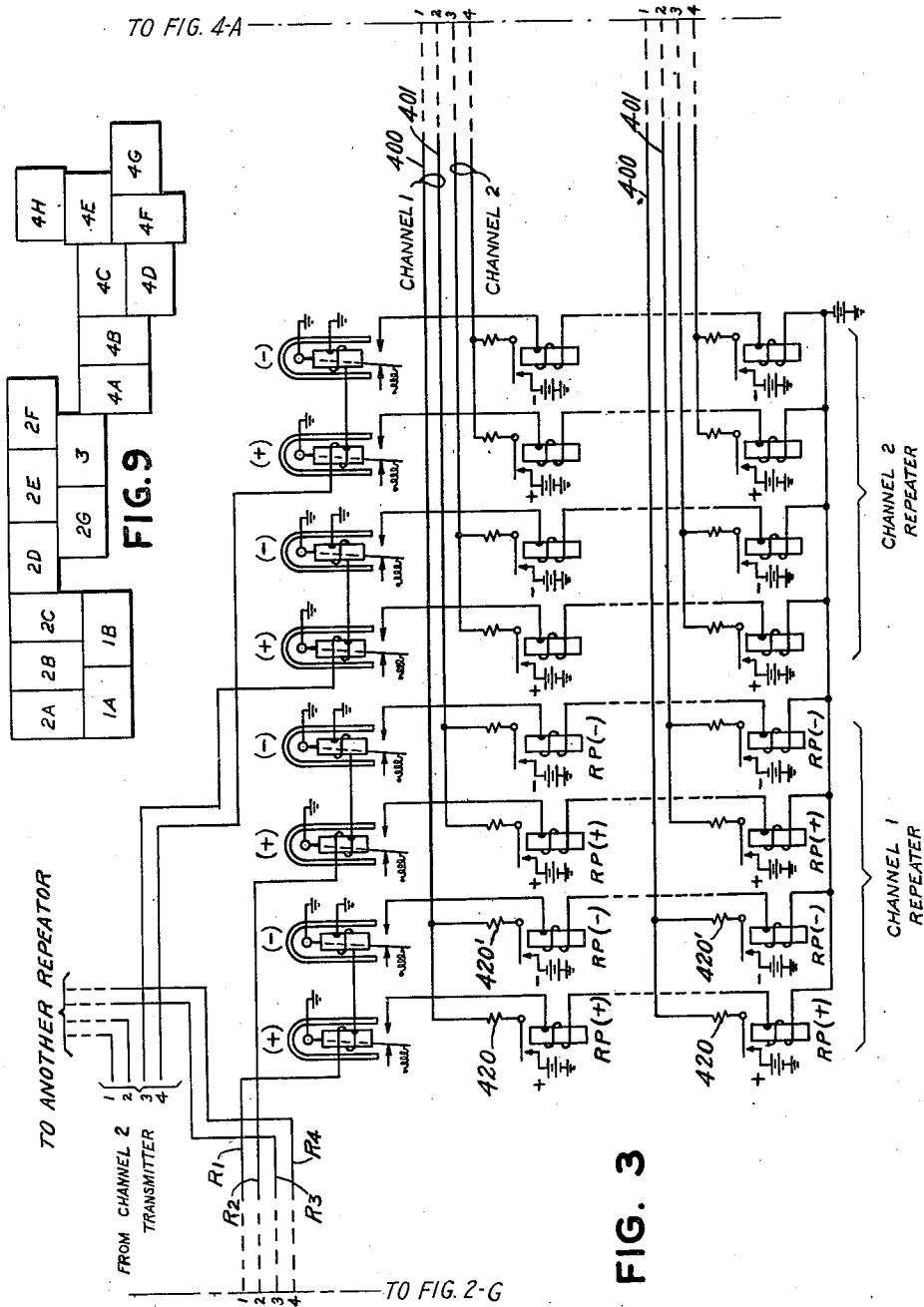
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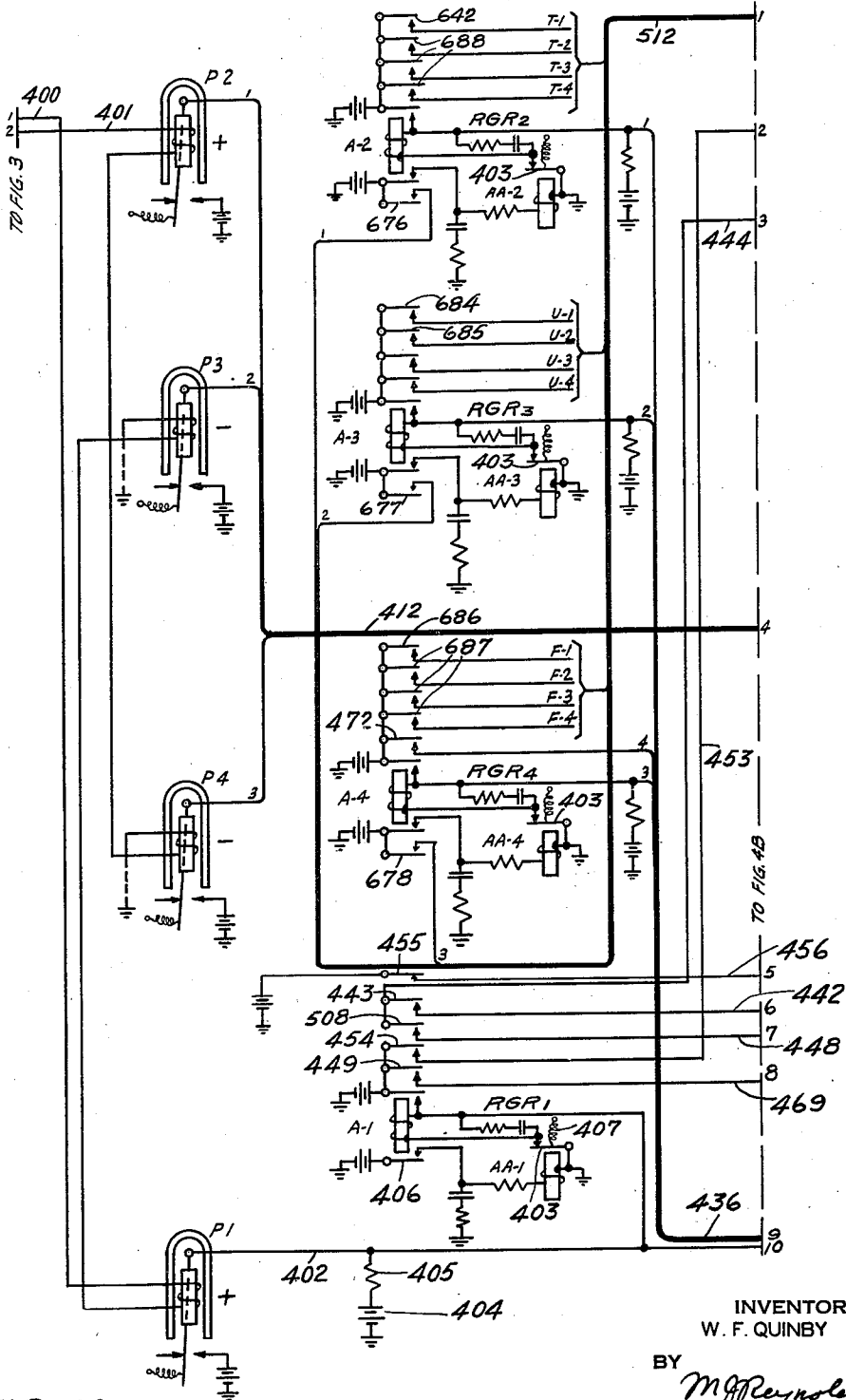


FIG. 4A

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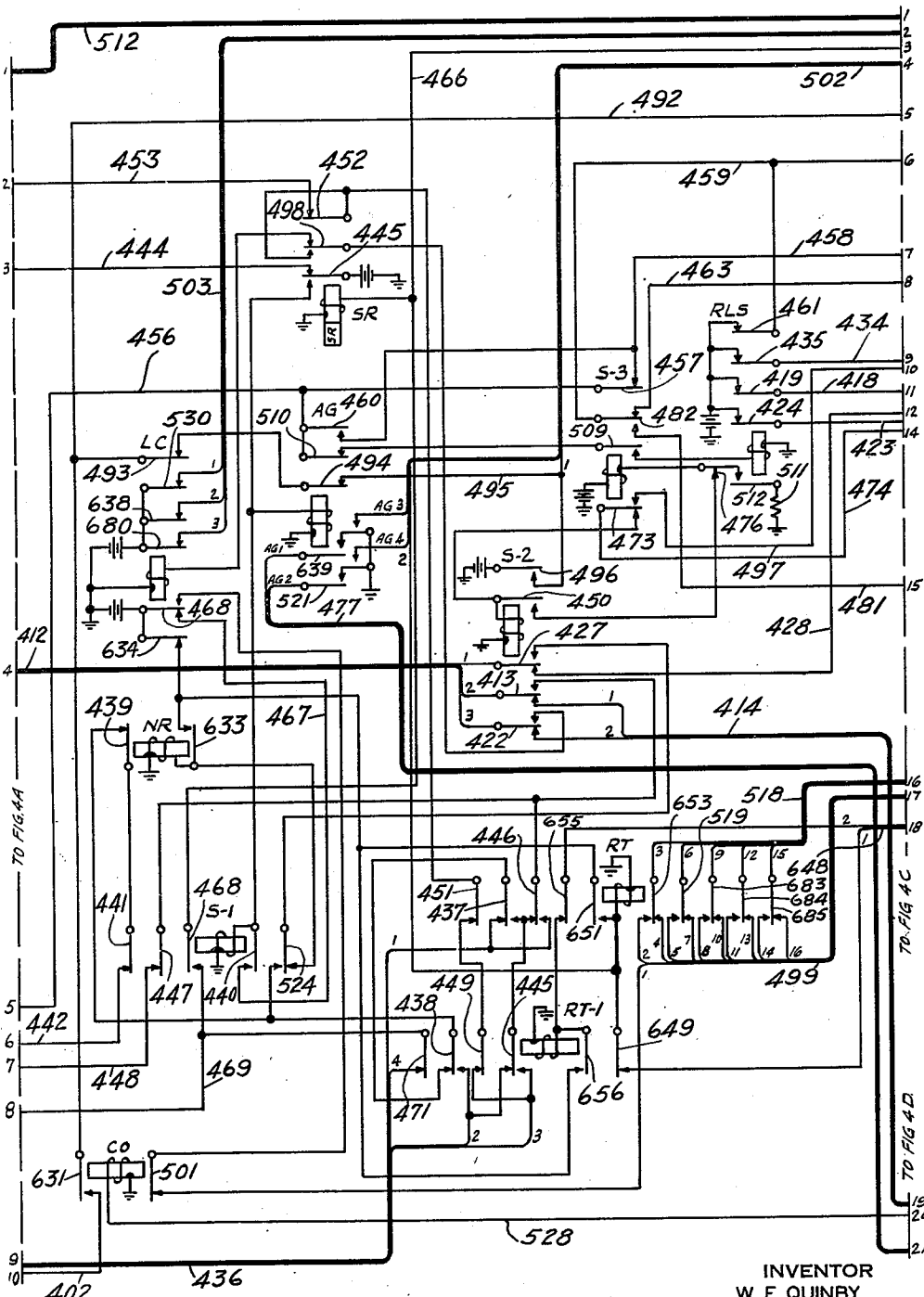


FIG. 4-B

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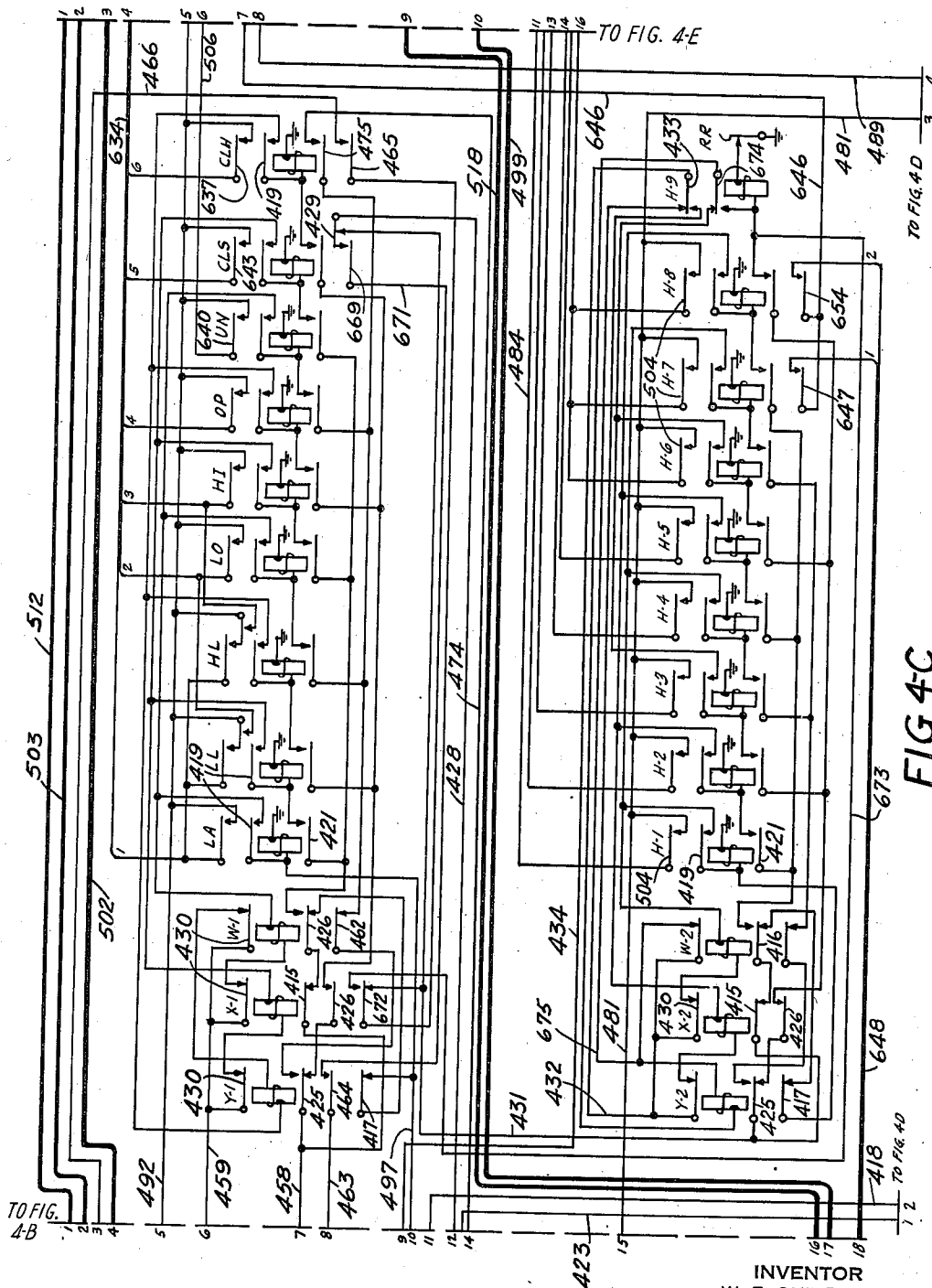


FIG. 4C

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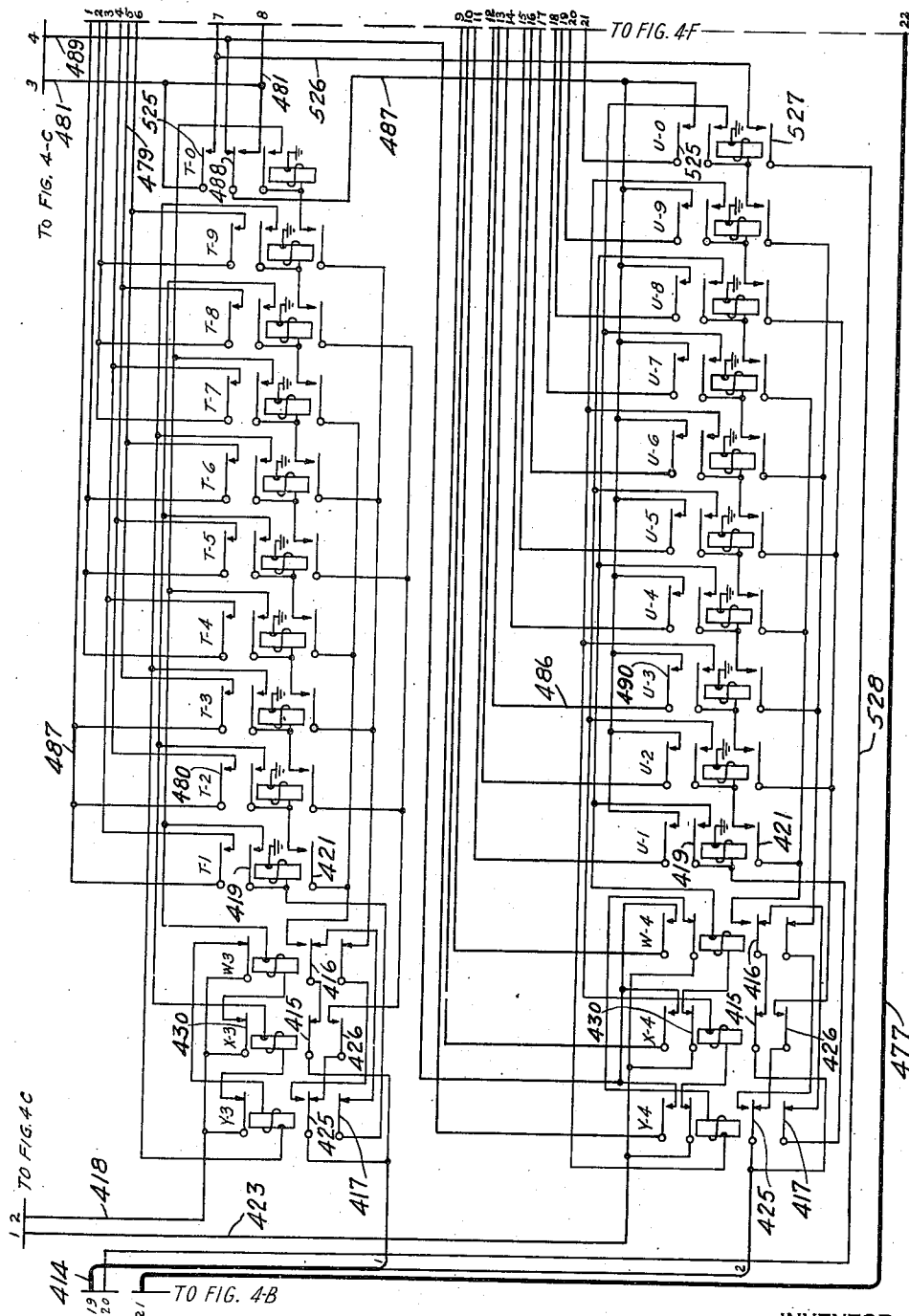
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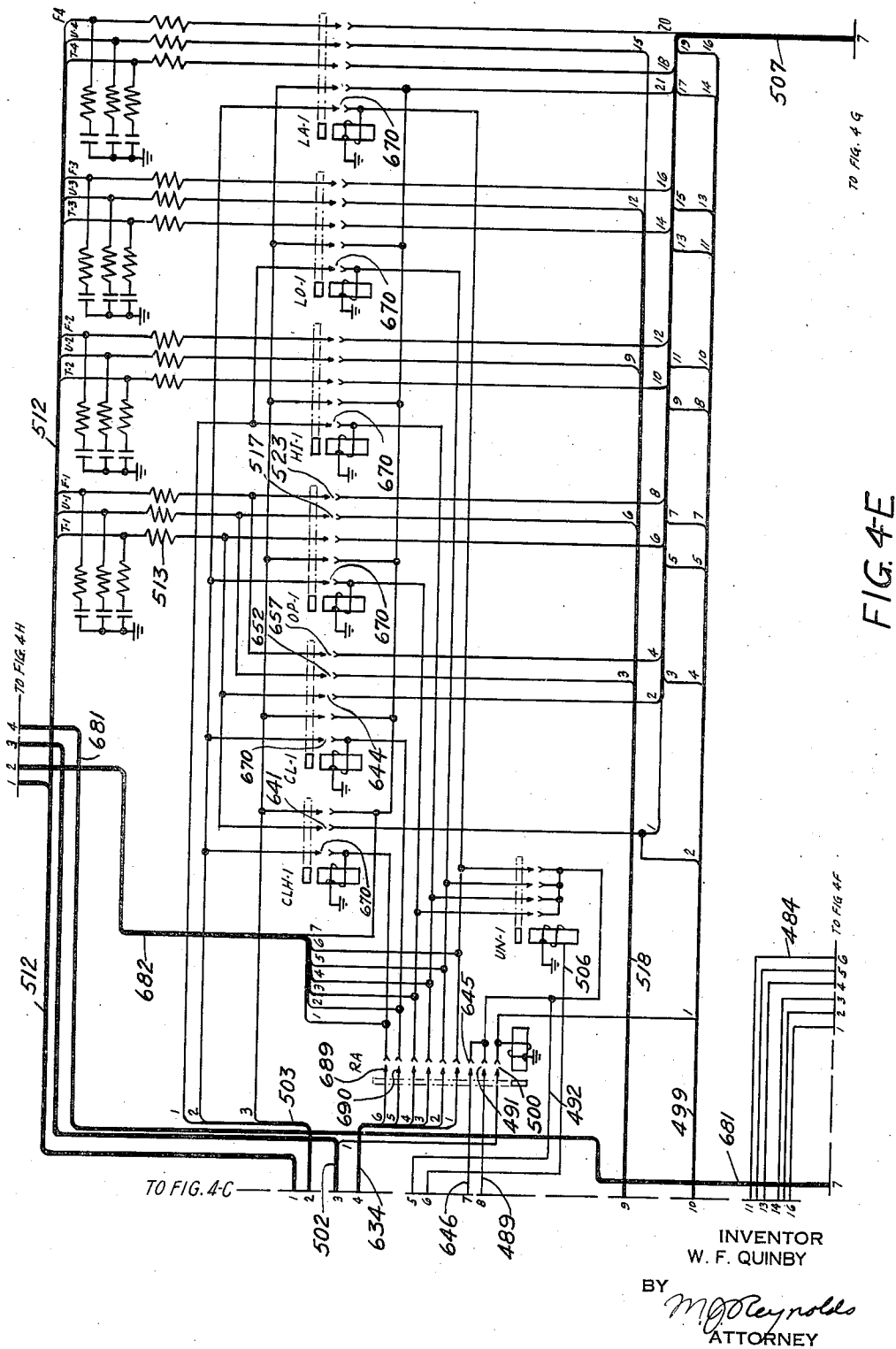
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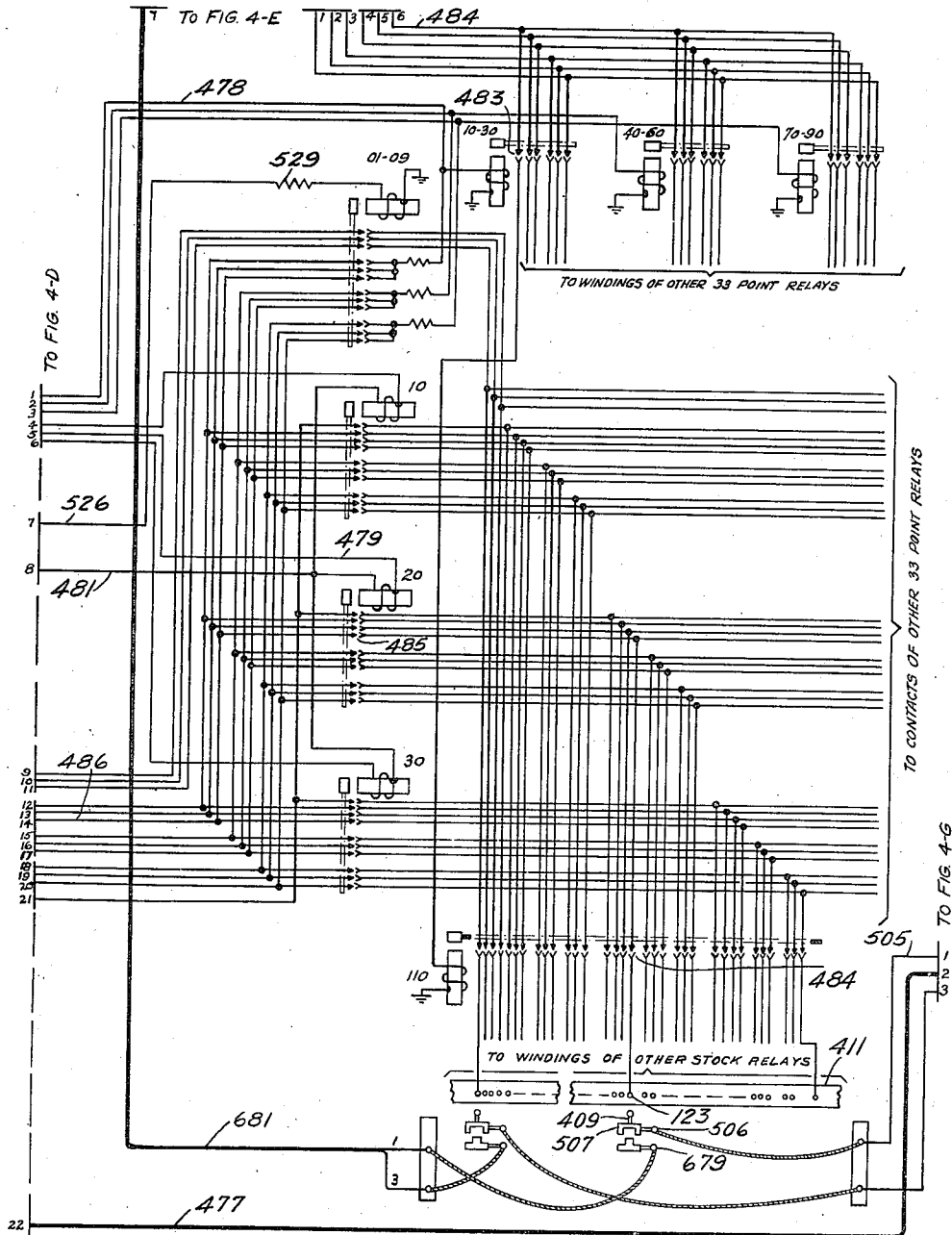


FIG. 4-F

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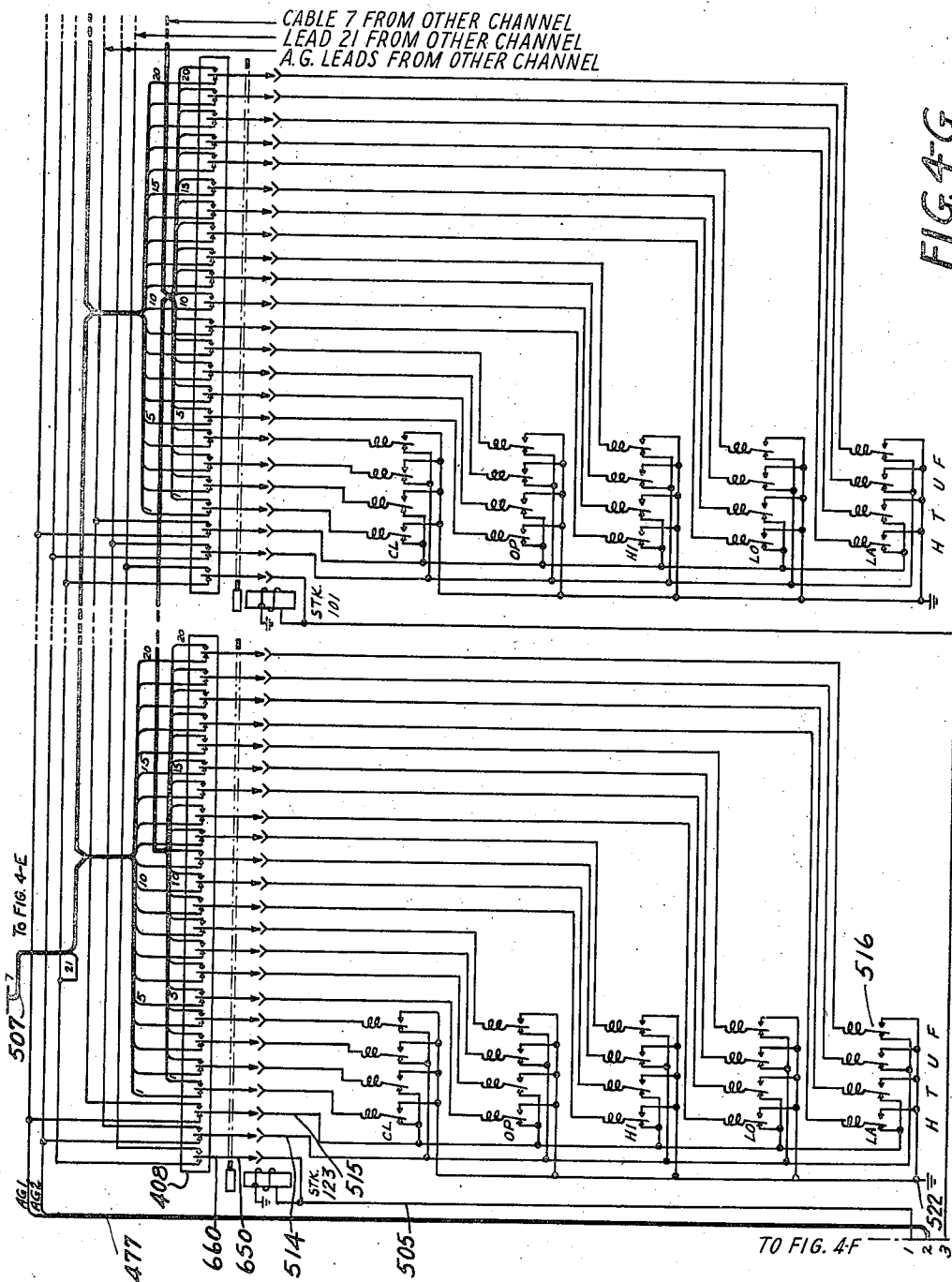
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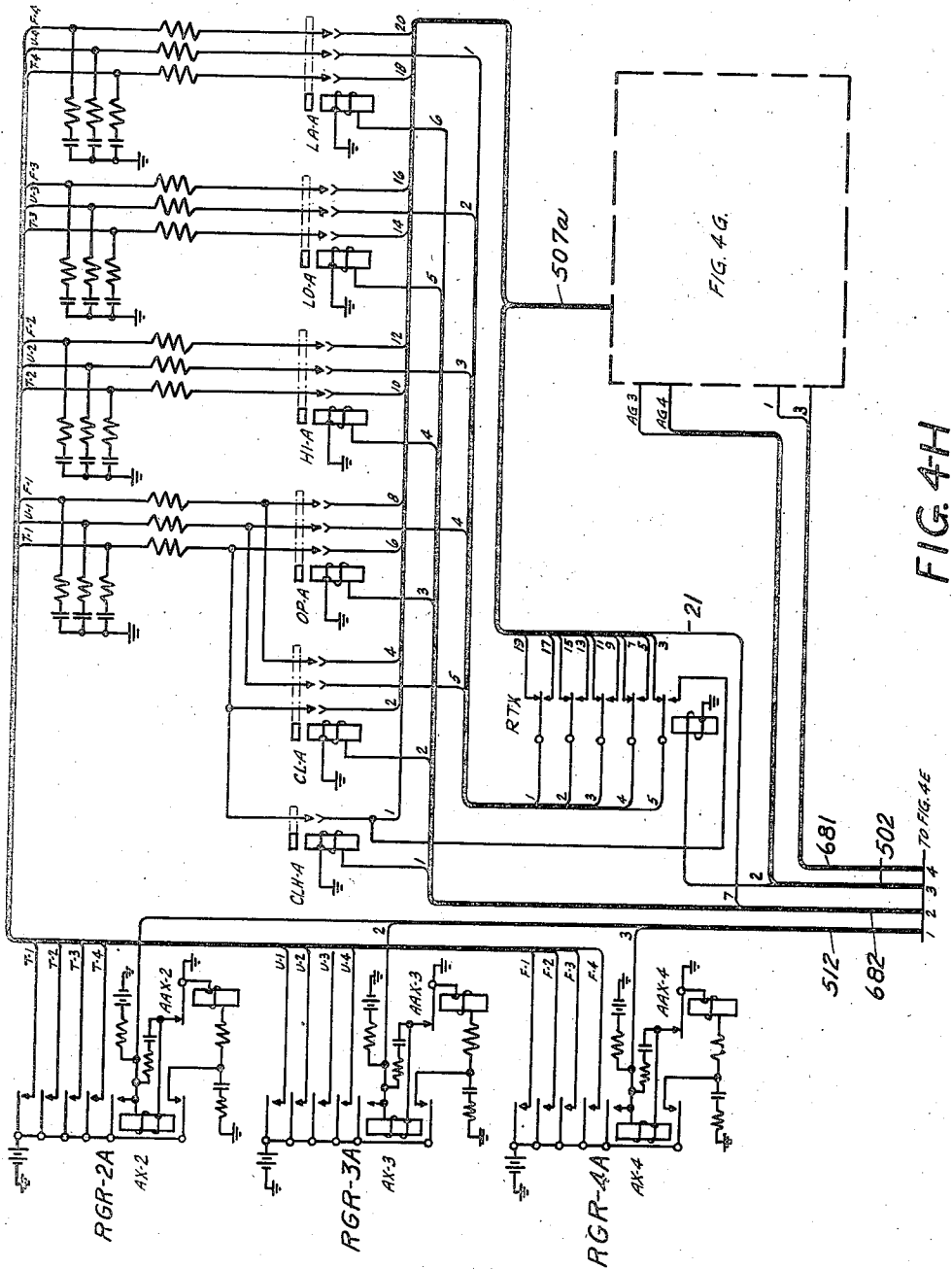


FIG. 4H

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FIG. 5

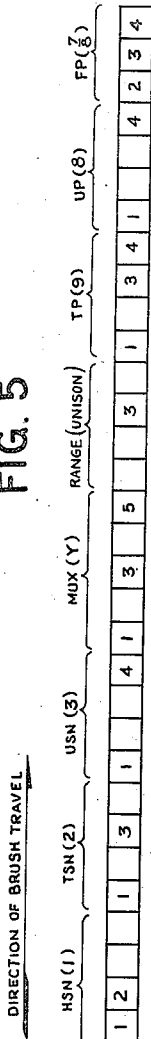
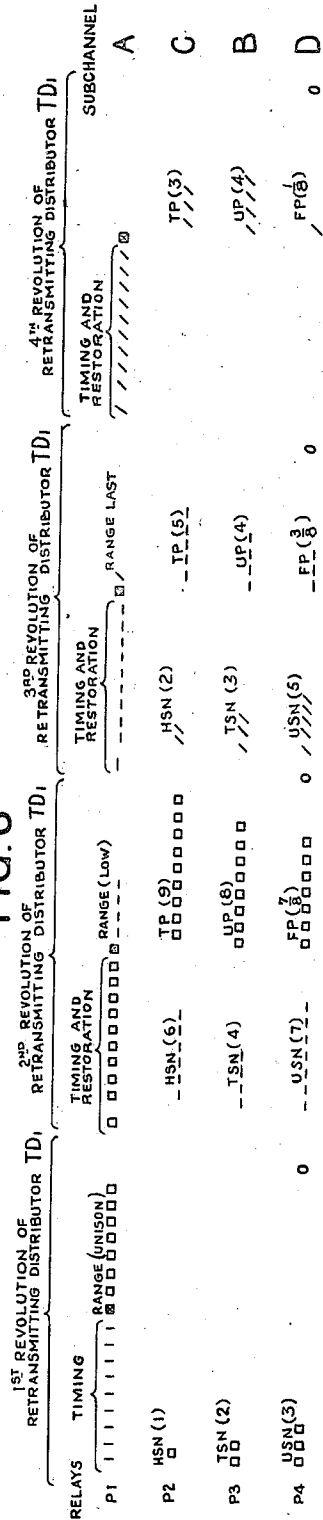


FIG. 6



LEGEND

- INDICATES 1ST QUOTATION OF CHANNEL 1
- INDICATES 2ND QUOTATION OF CHANNEL 1
- / INDICATES 3RD QUOTATION OF CHANNEL 1
- 0 INDICATES SWITCHING SIGNAL
- 0 INDICATES RELEASE SIGNAL

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FIG. 7

DIGIT	FRACTION	SELECTION CODE	PRICE CODE	RANGE	RANGE CODE
1	1/8	1	1	OPEN (TUF)	1
2	1/4	2	2	HI (TUF)	2
3	3/8	3	3	LO (TUF)	3
4	1/2	4	4	HI (UF)	4
5	5/8	5	5	LO (UF)	5
6	3/4	6	6	LAST (TUF)	6
7	7/8	7	7	LAST (UF)	7
8		8	8	UNISON (TUF)	8
9		9	9	HI-FA (TUF)	9
10		10	10	LO-FA (UF)	10
BLANK				LO-FA (TUF)	11
				LO-FA (UF)	12
				YCL (H)	13
				YCL (TUF)	14
				YCL (M)	15
				RR	16

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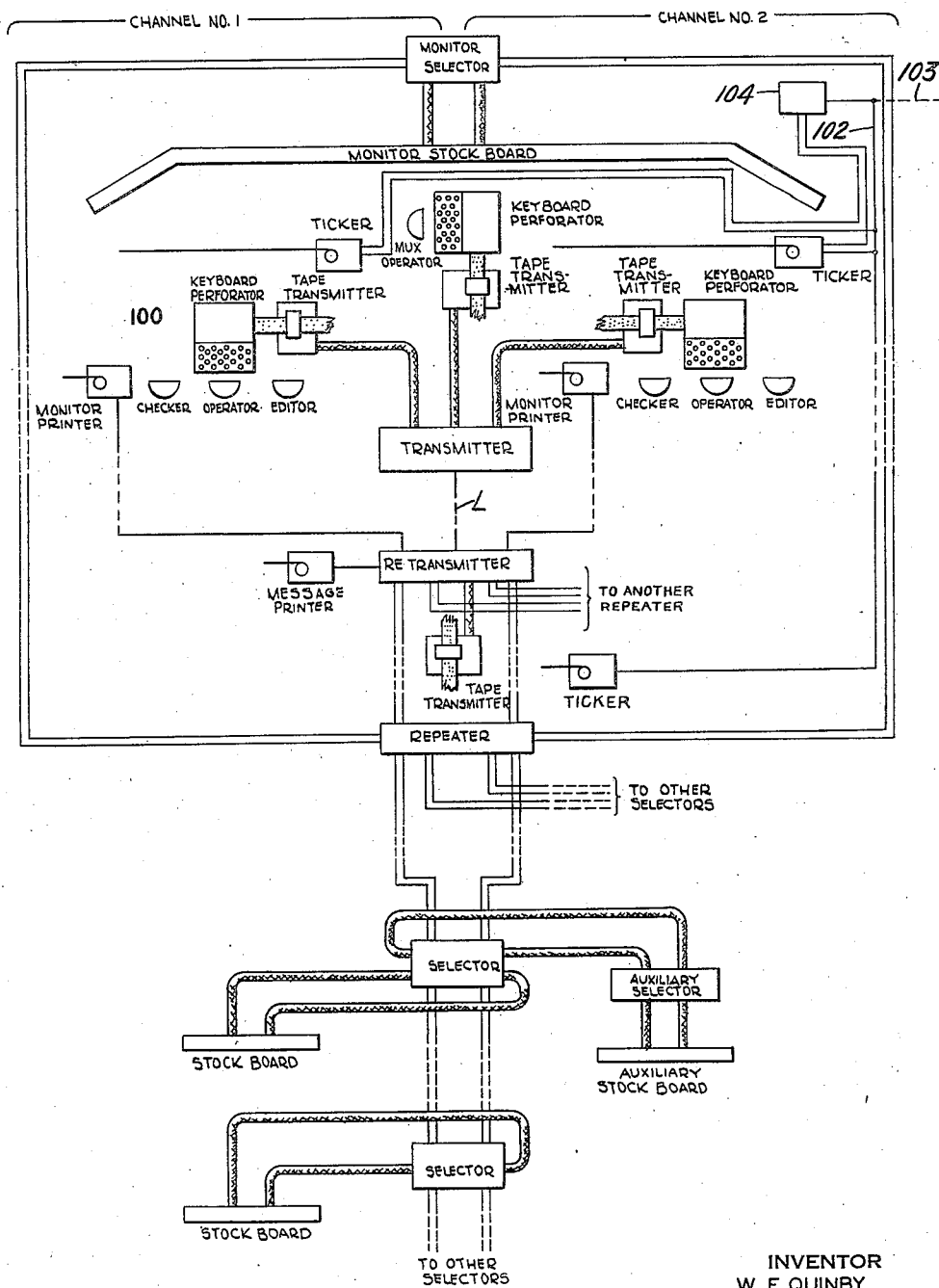


FIG. 8

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UNITED STATES PATENT OFFICE

2,248,822

SIGNALING SYSTEM

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Application December 21, 1935, Serial No. 55,510
Renewed June 7, 1939

35 Claims. (Cl. 177—35.3)

This invention pertains to signaling systems and is particularly adapted for the dissemination of information relative to quotations for stocks, commodities and the like, but is not so limited as it may be used with other communication systems for various purposes. It is particularly applicable for use in cities remote from the source of information to be displayed.

In the case of quotations originating within New York City, as for example, New York stock quotations, the procedure heretofore employed to display quotations in distant cities is to transmit signals representative of such quotations over a single wire by means of permutation telegraph code representative of the stock identification, range and price of the quotation wherein this price information is subsequently stored at the various receiving stations and utilized to remotely control the operation of step-by-step magnetically operated indicators.

The permutation signals comprise a start impulse followed by a group of 32 permutation code impulses and a rest impulse. The 32 code impulses convey the complete information required for posting a particular quotation. This information comprises a 1, 2 or 3 letter stock designation for selecting the stock to be posted. These signals are indicative of whether the quotation is for a common stock or is for the first, second or third preferred stock, the range of the quotation, i. e. one or more of the following ranges, "yesterday's close," "open," "high," "low" and "last," and the units and fractions portions of the price with or without the tens price digit.

The code for each letter of the stock designation requires five selecting impulses, and combinations of two impulses determines the selection of the first, second and third preferred issues of the various stocks. The range and the tens and units portions of the price utilize four impulses each and the fractions portion of the price utilizes three impulses making a total of 32 impulses.

Preferably, although not necessarily, I employ a three-digit number for selecting the stock, utilizing a separate number designation for each stock and any preferred issue thereof. The code for each digit of the three-digit number utilizes four impulses or a total of twelve impulses for the stock selection whereas seventeen impulses are required in the system heretofore mentioned. These twelve stock selection impulses, together with the fifteen impulses required for the range and price selection, comprise 27 impulses for each quotation. Five additional impulses are

employed for transmitting messages in multiplex code concurrently with the 27 quotation signals.

The order of transmission of the signals incident to the quotation of a single transaction is as follows: A start impulse, hundreds digit of the stock number, tens digit of the stock number, units digit of the stock number, multiplex character, range selection, tens portion of the price, units portion of the price, fractions portion of the price, and a rest impulse.

These signals are transmitted in continuous succession over a single line to a remote point at which place they are stored and retransmitted in a modified form to a plurality of receiving stations where they control the operation of automatic quotation boards. The quotation boards are of the general type described in a patent to Haselton et al. No. 1,890,878 granted December 13, 1932. Briefly, such a board comprises a multitude of indicators arranged in groups of twenty, each of such groups representing a single stock or other item is subdivided into five sets or levels of four indicators each for posting the "yesterday's close," "open," "high," "low," and "last" ranges of the stock. The four indicators of each set enable the hundreds, tens, units, and fractions portions of the price to be displayed. The indicators employed are of the step-by-step type requiring normalization to the blank position prior to actuation to the proper digit display position, to avoid the accumulation of errors when changing from one price setting to the next succeeding price setting. The signals applied to the board therefore comprise the stock selection, the range selection, restoration pulses and pulses corresponding in number to the digits to be displayed.

Heretofore signals have been applied to the receiving equipment in three groups over four channels, the first group comprised the range, and the hundreds, tens and units digits of the stock designation, the second group comprised a set of ten restoration impulses for each of the hundreds, tens, units and fractions indicators to be reset, and the last group comprised hundreds, tens, units and fractions price digit signals for such indicators as required resetting.

Among the objects of the present invention are to provide a quotation system for stocks or other items in which the quotations are transmitted by means of permutation code signals to retransmitting apparatus intermediate the transmitter and the various subscribers' stations, the permutation code signals being decoded in the re-

transmitting station and corresponding step-by-step impulses transmitted over a plural channel circuit to the subscribers' stations, which circuit, in the specific form illustrated, comprises four subchannels, the step-by-step impulses thus transmitted comprising a complete quotation, including the stock number, or item selection range and price portions of the quotation, the step-by-step impulses being adapted to select and actuate indicators in the proper range groups of indicators individual to the selected stock or other item at each of the subscribers' stations.

Sending the restoration impulses for normalizing the selected indicators over the line obviates the necessity of providing local impulse generating equipment in each subscriber's station and materially reduces the cost of the system, minimizes maintenance costs and eliminates the possibility of failure which is present when the complicated impulse generating equipment is located at the subscribers' stations. However, in systems heretofore proposed, in which restoration impulses were transmitted over the line, the transmission of these impulses materially increased the line time necessary to send the complete quotation, because while the restoration impulses were being transmitted, the remaining quotation signals could not be transmitted. Another object of the present invention, therefore, is to provide a system in which the restoration impulses relating to one quotation are sent concurrently with quotation impulses relating to another quotation and thus no loss of line time occurs by reason of the transmission over the line of the restoration impulses. In the specific embodiment disclosed herein, the restoration impulses are further utilized to time the operation of switching means which prepare circuits for actuation of the selected indicators by impulses corresponding to the price portion of the quotation.

Another object of the invention is the provision of retransmitting apparatus in which the incoming permutation code signals comprising a quotation are received, on a distributor associated with two quotation transmitting channels, during one revolution of the cycle of operation of the distributor, the corresponding step-by-step signals comprising each quotation being transmitted during four revolutions of the receiving distributor, i. e. during two cycles of its operation. To accomplish this, the signals received on the receiving distributor are first applied to a group of storage relays common to both quotation channels and then are selectively transferred to one of two groups of storage and decoding relays which are individual to the quotation channels, from which latter storage relays the signals are retransmitted over the proper channels as step-by-step impulses.

A further object of the invention is subscribers' receiving apparatus in which the incoming restoration impulses of one quotation may be received over one subchannel of a plural channel circuit while the item selection impulses of another quotation are received at the same time over the other subchannels, thus concurrently restoring all selected indicators of an item by impulses transmitted over a single channel. In the embodiment illustrated herein, the receiving apparatus includes a plurality of regenerator units adapted to be connected to line relays responsive to the incoming step-by-step impulses, one of the regenerator units invariably being connected to one of the line relays which receives the restoration

and range impulses, the other three regenerator units being connected alternately to the other regenerator unit and the other three line relays for receiving the restoration signals and signals comprising the price portion of a quotation, the other three line relays being connected to three receiving devices alternately with the other three regenerators to receive signals comprising the item selection signals of another quotation.

Another object of the invention is a quotation system in which the capacity of the system for disseminating information is enlarged by providing means for interspersing additional intelligence signals with the quotation signals, the system including means operable at will for transmitting the additional intelligence signals irrespective of whether quotation signals are being transmitted. The system of this invention also has means operable during the period when special intelligence signals only are being transmitted for preventing the transmitting distributor from sending quotation signals until the distributor has completed its current cycle of operation.

Another object is the provision of means for reducing the necessary receiving equipment employed at the subscribers' stations, by utilizing a set of line relays for receiving the incoming quotation signals, which relays are common to a main selector and an auxiliary selector for controlling at least two subscribers' boards.

A further object of the invention is a system of the character disclosed having means in a retransmitting apparatus for cancelling a quotation or other message when certain of the signals comprising the message are not properly transmitted or are not received by the retransmitting apparatus. Preferably, and as shown, a monitor printer or other suitable recording apparatus is provided at the original transmitting station and is connected to the retransmitting apparatus in such manner that the printer records these mutilated quotations in all cases except when the stock number or item selection signal is not transmitted or is not received at the retransmitting station, thereby advising the transmitting station of the fact that a quotation was improperly transmitted or was mutilated during transmission.

Another object of the invention is to enable a quotation system of the character disclosed to transmit statistical data or other information in regard to the items, such as the volume of sales at various times of the day, by the successive transmission of stock selection signals, the first of which signals actuates one or more indicators of a group respectively corresponding to digits of a number and the second of which signals actuates the other indicators corresponding to the remaining digits of the number, with switching mechanism for controlling the actuation of the respective indicators.

Still another object of the invention is to reduce the operating time of the pulsing relays and provide substantially uniform response thereof, to the step-by-step quotation signals, by causing a current, referred to hereinafter as a biasing or prebiasing current, to set up a magnetic field of predetermined flux density prior to the reception of signals so that the armature of the relay will respond substantially instantaneously to the received pulses. In the specific form shown, means including a timing relay are also provided for controlling, or maintaining constant, the lengths

of the pulses transmitted by the pulsing relays regardless of the lengths of the incoming pulses.

Another object is to provide a system of the character disclosed in which rewrite or other special signals may be transmitted to a subscriber's station for special purposes, such as for correcting an improper setting of a group of indicators at the station, without operating or affecting the indicators or other equipment at the remaining subscribers' stations.

Additional objects and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawings, and specifically pointed out in the appended claims.

Briefly, the embodiment of the invention shown in the accompanying drawings and described in detail hereinafter comprises a start-stop transmitting distributor at the source of origin of the signals, having means associated therewith for setting up on the distributor the stock selection, range, and price signals and a multiplex signal for transmission over a single line. At the receiving end of the line a start-stop distributor is provided upon which the thirty-two impulses are received, the stock selection, range, and price signals are distributed to a group of storage relays and the multiplex signals are distributed to a multiplex printer. The received quotation signals are divided into two groups hereinafter referred to as channels. The alternate or odd-numbered quotations constitute one group which for convenience is termed the channel 1 signals and the remaining or even-numbered quotations constitute the other group or channel 2 signals.

The channel 1 quotations are also transferred from the storage relays into intermediate storage relay groups which decode the permutation signals. The decoded signals are then transmitted with the addition of restoration signals to a quotation board mechanism in the form of stepping impulses. The transmission is effected over four channels by means of a start-stop transmitting distributor, which four channels are designated on Fig. 6 of the drawings and in certain of the claims as "subchannels" to distinguish them from channels 1 and 2 over which the quotations are transmitted to the receiving distributor RD shown in Figs. 2—A to 2—C. Similarly, channel 2 quotations are decoded and transmitted to the quotation board mechanism as stepping impulses over a second group of four such subchannels.

The order of transmission of signals over the four channels differs, however, from previous systems in that the selection and price signals for successive quotations are overlapped. Consider for example, four stocks, A, B, C and D, the quotations of which are to be posted in the order given. During the first half of one cycle of operation of the retransmitting distributor, the four channels are used to transmit the restoration impulses of stock A and the hundreds, tens and units digits of the stock designation of stock B. During the following half cycle of operation of the retransmitting distributor, the range of stock B is transmitted together with the tens, units, and fractions digits of the price of stock A. During the first half of the next revolution of the retransmitting distributor, the restoration impulses of stock B and the hundreds, tens, and units digits of the designating number of stock C are transmitted and during the last half of the second revolution, the range of stock C and the tens, units, and fractions portions of the price of stock B are transmitted.

The arrangement of the signals transmitted over one channel during two successive cycles of the transmitting distributor is shown on Fig 6 and will be described in greater detail hereinafter.

It should be noted, however, that two complete cycles of the distributor are required to transmit the complete quotation of stock B, but during this time a portion of the signals for quoting stocks A and C are also transmitted. Thus, positive pulses over one conductor of one of the two subscriber's line pairs are employed for transmitting only the restoration of range elements of the various stocks; negative pulses over the same conductor serve to transmit the tens digit of the stock number and units price digit only; positive pulses transmitted over the other conductor of this line pair select the hundreds stock number, and tens price, and negative pulses over this conductor select the units stock number, and fractions price. The price signals of one quotation and the stock number selection signals of a subsequent quotation are always interposed between the stock number and price signals of another quotation.

The restoration signal always comprises ten impulses and serves to restore to the blank positions all indicators of the previously selected stock and range. Since this signal is invariably of uniform length, it is used to control the length of the first half cycle of a transmission, and consequently the signals constituting the second half cycle may be transmitted in continuous succession with those of the first half cycle. The retransmitter distributor stops at the end of each cycle or revolution, thereby providing a definite rest period which serves to maintain this distributor in synchronism with the mechanism of the retransmitter.

In order that the invention will be more fully understood reference will be had to the accompanying drawings in which Figs. 1—A and 1—B illustrate a transmitting distributor and a plurality of tape transmitters at the central transmitting station for sending quotations and messages by permutation code over a single line.

Figs. 2—A to 2—G show the receiving and retransmitting apparatus at the distant station for converting the permutation code signals into step-by-step signals, and the transmission of said step-by-step signals in the above described order over two lines each of which provides two channels of communication.

Fig. 3 represents a repeater for the step-by-step signals.

Figs. 4—A to 4—H represent the apparatus at the receiving station responsive to the step-by-step signals to operate the board mechanism.

Fig. 5 shows the type of signals transmitted over a single line.

Fig. 6 shows the nature of the step-by-step signals transmitted to the various receiving stations.

Fig. 7 shows a code chart for selection, price and range signals.

Fig. 8 shows a diagram of the entire system, and

Fig. 9 shows the arrangement of the various sheets of drawings comprising the entire system.

GENERAL DESCRIPTION OF THE SYSTEM

One arrangement in accordance with the present invention for furnishing a quotation service to remotely situated subscribers' stations under

control of a central transmitting station is schematically shown on Fig. 8.

The central transmitting equipment shown at 100, Fig. 8, comprises a plurality of keyboard perforators and tape transmitters for initiating the signals required for the transmission of the various quotations of stocks or other items. These signals are stored on relays and subsequently propagated over a single conductor L through the medium of a rotary distributor. The transmitted quotations of channel 1 are interspersed with those of channel 2 so that channel 1 and channel 2 quotations are transmitted alternately, there being a channel 2 quotation or a blank signal, as the case may be, inserted between successive channel 1 quotations and vice-versa. If, for example, quotations are transmitted from channel 1 only, each quotation will be followed by a blank signal corresponding in length to the transmission of a quotation from channel 2.

The information to be transmitted is taken from a stock ticker located in front of each operator. These tickers are arranged to print quotations or such other information as appears on the ticker tapes. The ticker adjacent to the channel 1 operator or operators prints quotations of certain stocks only, characterized by the first letter of the stock abbreviation included within the alphabetical range of A to J, the other ticker adjacent to the channel 2 operator or operators printing quotations of other stocks, for example, quotations characterized by the first letter of the stock abbreviations included within the alphabetical range of K to Z. A line 102 extends from each ticker to a common line wire 103 over which stock quotations and other information are received without respect to classification of the same. The received telegraphic intelligence preferably is divided into groups recorded upon separate tickers in accordance with the telegraph system shown in Patent 1,814,902, issued July 14, 1931, to R. F. Dirkes. This system is shown on Fig. 8 at 104.

Adjacent to each operator is an editor who places a distinguishing mark upon the ticker tape when the quotation is a new high or a new low.

Adjacent to and on the other side of each operator is a checker who compares each transmitted quotation with the original quotation appearing on the ticker tape.

A multiplex operator prepares a message by perforating a tape. Each character of this message may be transmitted concurrently with a quotation or the transmission of a multiplex character may take place at a time when no quotation is being transmitted. The message so prepared may pertain to the quotations transmitted or may comprise additional quotations to increase the capacity of the system for quotation disseminating purposes or the message may comprise other information, e. g., special announcements or the issuance of instructions to operatives at a remote point. The transmitter also controls the operation of a monitor printer adjacent to each checker. This arrangement provides a means of checking a transmitted quotation with the same quotation appearing on the monitor stock board.

The monitor stock board displays within full view of the operators, editors, and checkers the quotations of all stocks transmitted and is used as a check of the transmitted quotation against the original quotation appearing on the ticker

tape. It will be understood that this same information may appear in a different form on the monitor printer which serves as an additional check upon the accuracy of the transmitting system. The monitor stock board is controlled from a monitor selector in a manner hereinafter to be described.

Remotely situated from the transmitter is a retransmitting equipment comprising a rotatable distributor, Figs. 2—A to 2—C, for selectively distributing the signals received over line L to various groups of storage relays, which respond in accordance with the signals received. The distributor is of the start-stop type and preferably is arranged to make one revolution for each quotation transmitted. The storage relays control the signals which are transmitted by means of two retransmitting distributors, one of which is shown in Fig. 2—G, to a plurality of repeater stations where the signals are regenerated as received and transmitted to quotation board selector equipments. The two retransmitting distributors above referred to begin their cycles of operations successively, one retransmitting distributor being provided for each of the two channels. Two complete revolutions of a distributor are required for the transmission of each quotation over its associated channel, although due to the over lap feature hereinafter explained, one quotation is completed at the completion of each revolution of each retransmitting distributor. The retransmitting equipment includes a group of storage relays for controlling the operation of a message printer in accordance with the signals initiated by the multiplex operator. Preferably, and as shown, a tape transmitter is included in the retransmitting means for controlling the operation of the various subscribers' stock boards at a point remote from the central transmitting station 100.

The selector is divided into two parts, there being one part for channel 1 and a corresponding part for channel 2 quotation. As these parts of the selector are functionally independent and similar in operation, a clear understanding of the operation of the selector will be obtained from a description of one part only, as, for example, that part comprising the equipment used for channel 1 quotations which will be hereinafter described in greater detail.

The selector equipment at the subscribers' stations is similar to the monitor selector at the central transmitting station and comprises regenerative relays for correcting the various line signals received over the two line pairs of conductors, to correspond to a predetermined constant signal length thereby to enable the system to operate at higher speeds and with greater reliability than heretofore obtainable. Certain of these regenerated signals actuate relay counting devices for storing range intelligence, some operate controlling devices, and others are diverted to the stock board for the normalization and subsequent actuation of impulsively operated step-by-step indicator units.

It will be understood that two line conductors are required for each of the two quotation channels making a total of four line conductors brought into each selector. Two polarized relays in each selector are connected in series with each of these conductors in such manner that one of each pair of relays is responsive to positive pulses and the other is responsive to negative pulses over the line. The selectors are preferably grouped in series, so that each conductor

is continued in series through several selectors and thence to ground. Each selector is also arranged to control the operation of an auxiliary selector so that a plurality of quotation boards may be simultaneously actuated by any one selector.

The auxiliary selector comprises relay regenerative means for actuating the indicators of a selected group or groups of an item upon the auxiliary quotation board.

The quotation board may be of the type disclosed in the patent to R. L. Daine, 1,658,516 dated February 7, 1928, arranged in horizontal tiers of unit sections each section comprising a plurality of items. Each item or stock space is covered by a mask having apertures therein through which are viewed the indicator units which display the various prices or other information. These indicators may be of the type shown in Patent 1,965,376 granted July 3, 1934, to R. M. Hicks although other indicators may be used with this invention as, for example, the indicator unit shown in Patent 1,979,028 dated October 30, 1934, granted to J. B. Ewart.

Transmitting and editing

Fig. 8 shows an arrangement at 100 comprising a keyboard perforator and associated transmitter before which is seated an operator, there being one such combination for each of the two channels. The keyboard perforator being well-known in the art will not be described in detail. Special key caps, however, are placed over the key levers having the designations shown on Fig. 7. These designations are grouped in accordance with the various codes shown on Fig. 7 so that the key associated with a particular code having a plurality of functions will bear designations clearly indicative of the various functions performed by that particular key. For example, referring to Fig. 7, the selection key 2 transmits a code signal consisting of marking, spacing, marking, and spacing impulses, and the key marked LO(UF) also transmits a code comprising marking, spacing, marking, and spacing impulses. The key lever used for transmitting this code therefore would preferably bear the identifying characters 2 and LO(UF). An alternative arrangement of keys is obtained by providing a separate key lever for each digit for selection, each digit for price, and each range. This latter arrangement provides a convenient grouping of the keys in accordance with the selection, price, and range characteristics of the keyboard.

In the arrangement illustrated, a four-unit code is employed for the selection, range, and digits of the price, a three-unit code being employed for the fractions part of the price. A fifth unit is added to the range signal whenever a quotation is repeated to a subscriber for the purpose of verifying the quotation. The verification of a quotation is hereinafter referred to as a "rewrite," and a rewrite key (RR) is used exclusively for such quotations. The "open" (TUF) key is used for actuating the indicator units of the open range of a selected stock corresponding to the tens, units, and fractions portions of the price characteristic. The "last" (UF) range is used when the units and fractions digits only of the last price are to be changed, such change not involving a change in the high or low quotations for the selected stock. This condition is illustrated by the appearance of a quotation on the ticker take of $8\frac{1}{4}$ for stock W at

a time when $67\frac{3}{4}$ was displayed on the quotation board. The use of this key prevents the restoration of the tens digit of the stock price and enables the operator to copy the price information exactly as it appeared on the ticker tape without adding the tens digit to this information. Examples of the use of this no reset feature will be apparent from consideration of the various ranges shown on Fig. 7.

The monitor printers at the transmitting central record an arbitrarily assigned three digit number used for selecting the stock and a range symbol characteristic of the range transmitted, followed by the price. As previously explained, the odd three digit numbers used for stock selection are invariably associated with channel 1 quotations and the even digit number for selecting stocks in channel 2. It will be understood, however, that any other suitable grouping of these stock selection numbers into two or more groups may be employed, as, for example, numbers 001 to 500 may be grouped and numbers 501 to 999 may be separately grouped.

Operation of transmitter

Referring first to Figs. 1—A and 1—B which show transmitting apparatus at the central transmitting station, which is the case of New York stocks is located within New York city, the transmitting apparatus includes a channel 1 transmitter TX1, a channel 2 transmitter TX2, and a multiplex tape transmitter MTX. The channel 1 transmitter TX1 is provided for all stocks having the first letter stock designation from A to J and the channel 2 transmitter TX2 is provided for stocks having the first letter designation of K to Z, although, of course, any special distribution of stocks between the two transmitters may be provided. In the system herein illustrated, however, the alphabetical designations of the stocks are replaced by three-digit numerical designations. This conversion from letter to numerical designation may be made mentally by the operator at the time of preparing the tape for transmitters TX1 and TX2 or the tape perforators may be operated through an automatic translating or coding apparatus which converts the alphabetical designation into corresponding three digit designations. The code signals perforated on each tape supplied to the transmitters TX1 and TX2 comprise four units each with the exception of the fractions portion of the price which employs but three units, the signals comprising the hundreds, tens and units digits of the stock number, the range, and the tens, units, and fractions portions of the price. The transmitters TX1 and TX2 operate alternatively, that is a complete quotation is sent from one transmitter after which a complete quotation is sent from the other transmitter. Each complete quotation comprising a change in the tens, units, and fractions portions of the price invariably comprises seven transverse rows of perforations in the tape.

The multiplex transmitter MTX is provided for transmitting messages over the same line with the stock quotation signals without interfering in any manner with, and independent of, the stock quotation signals and without affecting the time required to send the quotation signals, whereby the full line time of the system may be utilized. A tape independently controlled is supplied for this transmitter and is perforated in the regular 5-unit multiplex code, the message contained therein not necessarily being related

to the quotations in the process of transmission. It may be employed, for example, to transmit news items, to issue instructions or to convey desired information from the central station to the distant stations.

The transmitters TX1, TX2 and MTX operate into a rotary transmitting distributor TD having a solid transmitting ring R1, segmented transmitting ring R2, and three local rings R3, R4 and R5.

Rings R3 and R4 serve to time the operations of the transmitting apparatus. Ring R5 is continuous and supplies battery from a source 52 to the rings R3 and R4 through brush B2. Brush B1 connects rings R1 and R2.

Ring R2 is provided with a start segment S connected to positive (spacing) battery, 32 code signal segments numbered 1 to 32, and a rest segment R connected to negative (marking) battery. Code segments 1 to 4 transmit the hundreds digit of the stock number and are connected to the armatures 53 of a group of the hundreds digit transmitting relays HNR. Similarly segments 5 to 8 are connected to the corresponding armatures of the tens stock number transmitting relays TNR, and segments 9 to 12 are connected to the armatures of the units stock number transmitting relays UNR. The make contacts of the armatures 53 of the groups HNR, TRN and UNR are connected to negative battery, the break contacts of these armatures being connected to positive battery.

Segments 13 to 17 control the transmission of a special signal hereinafter described and also the multiplex characters, and are connected to the armatures of relay SRT, these circuits being extended to the five tongues of the multiplex tape transmitter MTX through the break contacts of relay SRT. Segments 18 to 21 serve to transmit the range signals and are connected to the tongues 53 of the range transmitting relays RTR. Similarly segments 22 to 25, 26 to 29, and 30 to 32, which serve to control the transmission of the tens, units and fractions portions of the price respectively are connected to the armatures of the groups of relays TPR, UPR and FPR respectively. The make contacts of the armatures 53 of the relay groups RTR, TPR, UPR and FPR are connected to negative battery, and the break contacts of these armatures are connected to positive battery.

One terminal of the winding of each of the transmitting relays HNR to FPR has battery applied thereto and the opposite terminals of the winding of the relays of the various groups are connected through the make contacts of individual control relays CR1 to CR7, and thence to conductors 1 to 4 of cable A, with the exception of the relays FPR which are connected only to the conductors 2, 3 and 4 of cable A. Conductors 1 to 4 of cable A are also connected to corresponding contacts of relays C1 and C2 and these circuits are extended to corresponding tongues of tape transmitters TX1 and TX2 whenever relays C1 and C2 respectively are operated. Control relays C1 to C4 are operated from various segments of the ring R3 as will presently appear. Relays HNR lock up through their lower armatures to ground on a break contact of relay LR1. When the distributor brush B2 comes into contact with segment 6 of ring R3 relay LR1 operates, thereby removing the ground from its break contact and releasing such operated relays HNR as may have been locked thereto. In like manner each of the remaining groups of relays

TNR to FPR lock up through individual break contacts of relays LR2 to LR7 until these latter relays are operated by the brush B2 coming into contact with their various associated segments 10, 19, 23, 27, 31, 32 and 2, respectively, of ring R3.

The channel 1 tape transmitter TX1 has five tongues connected to five armatures of relay C1 which when operated, respectively extend these circuits to conductors 1 to 4 of cable A and conductor 659. Channel 2 transmitter TX2 has its five tongues similarly connected to the armatures of relay C2 which when operated extends four of the tongues to conductors 1 to 4 of cable A and the fifth tongue to conductor 659. Tape transmitters TX1 and TX2 have their individual auto-control contacts AC1 and AC2, respectively adapted to be closed whenever a complete quotation is available in the associated tape for transmission, and to be opened when less than a complete quotation is available. The armature of auto control contact AC1 is connected by way of conductor 700, break contact and armature 701 of slow-to-release relay SR, to the segment R of ring R4. The armature of auto control contact AC2 is connected by conductor 702, break contact and armature 703 of relay SR, to segment R of ring R3. The armatures of these auto controls AC1 and AC2, are also connected to the break and make contacts respectively of armature 704 of relay A, from whence they are alternately connected by the movement of armature 704 of relay A, by way of conductor 705, one of the contacts 1 to 49 of rotary switch RS and its arm 72, and conductor 54 to segment 31 of ring R4. The contact associated with the armature of each of the auto controls AC1 and AC2 is connected to the winding of its respective control relay C1 and C2, and thence to ground.

Relay SR, Fig. 1—B, has one terminal of its winding connected to segment 32 of ring R3, and the other terminal thereof connected to ground, and operates when brush B2 crosses segment 32 of ring R3. Relay SR does not release during the continuous passage of brush B2 across the segments R of the transmitting distributor TD.

The distributor brushes B1 and B2 are arranged to always come to rest on an even-numbered revolution. For this purpose a relay counting chain comprising relays A and B, Fig. 1—A, is provided. Relay A is a single winding relay and relay B has two windings 56 and 57. Segment 30 of ring R3 is connected by conductor 58 through the armature 59 and break contact 61 of relay B to the winding 56 of relay B, and is also connected to the winding of relay A. From the winding of relay A the circuit continues through resistance 62 to ground and also to the armature 63 of relay B, and from the winding 56 of relay B the circuit continues to the armature 64 and make contact of relay A to grounded battery 65. The winding 57 of relay B has one terminal grounded and the other connected to both make contacts of relay B.

The operation of the counting relays is as follows:

With relays A and B both in their unoperated positions, as brush B2 passes over segment 30 of ring R3, battery is applied over conductor 58, armature 59 and break contact 61 of relay B to the winding of relay A and thence through resistance 62 to ground. On the resulting operation of relay A, grounded battery 65 is applied through the make contact and armature 64 of relay A, to

one terminal of the winding 56 of relay B, but since battery of the same polarity is applied to the opposite terminal of this winding from segment 30 of ring R3, relay B does not operate until the brush B2 passes off segment 30, at which time relay B operates in series with relay A. The circuit for the operation of relay B is traced as follows: Battery 65, operated armature 64 of relay A, winding 56 of relay B, and the winding of relay A through resistance 62 to ground. Armature 59 of relay B is thus actuated to its make contact, preparing a different operating circuit for the relay chain upon the next engagement of brush B2 with segment 30. Relays A and B both remain operated until this occurs, at which time battery 52 from ring R5 is applied through segment 30, conductor 58, armature 59 and make contact of relay B to winding 57, holding relay B operated. The same battery is also applied through operated armature 63 of relay B to one terminal of the winding of relay A. As battery 65 is now applied to the other terminal of relay A, the winding of this relay is short-circuited and deenergizes, and relay A releases and opens the circuit at armature 64 to the winding 56 of relay B. As brush B2 leaves segment 30 the operating circuit for winding 57 of relay B is interrupted, causing this relay to release. It will be noted, therefore, that both relays A and B are operated during one revolution and released during the succeeding revolution of the transmitting distributor TD. The operation of relays A and B in the manner described provides means to count, or to time, alternate revolutions of the distributor brushes, and serves as hereinafter described to prevent stopping of the distributor except at the end of even-numbered revolutions.

The relay A is also provided with an armature 69 which is connected by a conductor 96 to the winding of the operating magnet 71 of a step-by-step fifty point rotary switch RS having a contact 50 connected to close an operating circuit for relay PH1, once during each revolution of the switch arm 72. The purpose of the rotary switch is to count every 100 revolutions of the rotary distributor TD. Since armature 69 supplies ground over conductor 96 to the stepping magnet 71 once for every alternate revolution of the distributor, switch 72 makes one step for each two revolutions of the distributor. At the end of the first revolution of distributor TD and every succeeding odd-numbered revolution of the distributor, armature 69 is grounded to energize the magnet 71, and at the end of the second revolution and every succeeding even-numbered revolution ground is removed from the armature 69, thereby releasing magnet 71 and permitting the switch 72 to make one step on the back stroke of the armature. The stepping occurs as brush B2 engages segment 30 of ring R3 near the end of each even-numbered revolution. At the end of the 99th revolution of the distributor TD the switch 72 will have stepped on to terminal 50. Immediately thereafter a circuit is closed from battery on brush B2, segment 31 of ring R4, conductor 54, contact 50 and arm 72 of switch RS to the winding of phasing relay PH1 which operates and locks to battery supplied by its make contact and armature 706 through arm 72 and contact 50 of switch RS to the winding of relay PH1. Relay PH1 in operating extends ground by way of armature 760 and its make contact, conductor 707, and armature 708 and its make contact of relay SC if operated, to the winding of the latter relay to maintain it in

the operated condition. Ground from armature 709 of relay PH1 extends by way of its make contact, and conductor 710 to the winding of start magnet ST, thereby holding the latch LA from engagement with the brush arm, thus permitting the brushes B1 and B2 to continue rotating.

As brush B2 crosses segment R of ring R4 at the end of the ninety-eighth revolution, this being the revolution in which relay PH1 was operated from segment 31 of ring R4, battery is extended by way of armature 701 and its make contact of relay SR, conductor 711, armature 712 and its make contact of relay PH1 to one end of the winding of relay PH2, the circuit being completed from the other end of the winding of relay PH2, through resistance 714 to ground. Relay PH2 upon operation locks by way of its armature 713 and make contact to battery.

Relay PH2 in operating removes ground from conductor 715 and the winding of the multiplex stepper magnet MSM by the opening of the armature 716 and its break contact thereby preventing the operation of the tape transmitter MTX during the ninety-ninth and one hundredth revolutions of the distributor TD.

Armature 717 of relay PH2, in operating first extends negative battery to the contact 718 and line L and then forces contact 718 away from engagement with contact 719 thereby disconnecting conductor 720 which extends to ring R1 of distributor TD. The line L is thus disconnected from ring R1 of the transmitting distributor, and connected to negative battery during the ninety-ninth and hundredth revolutions of the distributor TD.

During the one hundredth revolution of the distributor, and at a time when brush B2 is passing across segment 30 of ring R3, battery is extended by way of conductor 58, armature 59 and its make contact of relay B, and make contact and armature 63 of the latter relay to one end of the winding of relay A, thereby causing relay A to release as battery of like polarity is now applied to both ends of its winding, in a manner heretofore described. As relay A releases, ground is removed from its armature 69, and conductor 96 and the winding 71 of the switch RS. As the winding 71 becomes deenergized arm 72 is stepped from terminal 50 to terminal 1, thereby interrupting the locking circuit of relay PH1 which releases, and at its armature 709 removes ground from conductor 710 and the start magnet ST, thereby permitting the latch LA to release to engage the brushes B1 and B2 and prevent further rotation thereof, provided the relay SC is not operated, in which event the release of relay PH1 will remove ground from conductor 707, armature 708 and its make contact and winding of relay SC thereby causing this latter relay to release. Relay SC is a slow-to-release relay and when operated, it operates the start magnet ST by applying ground from its armature 721 to one end of the winding to the start magnet ST. Therefore, relay SC, when released, does not open its contacts and release the latch LA until after the brush arm has passed the latch and the brushes B1 and B2 are rotating during the next revolution. At the end of the hundredth revolution, as brush B2 engages segment R of ring R4, battery is extended by way of armature 701 and its make contact of relay SR, conductor 711, armature 712 and its break contact of relay PH1, and armature 722 and its make contact of relay PH2 to one end of the winding of the latter relay. Battery is

now connected to both ends of the winding of relay PH2, therefore it releases and removes negative battery from the line L by the armature 717 disengaging from contact 718, and line L is reconnected to conductor 720 and ring R1 by contacts 718 and 719 engaging with one another.

The function of relay PH2 is to disconnect the distributor from the line L and to maintain a steady marking or rest condition on the line at the end of each 100 revolutions of the distributor for a sufficient period to insure the receiving apparatus to come to rest in a condition to start out in phase with the channel 1 transmitter. This circuit arrangement serves to restore the proper phase relation to the transmitting and receiving apparatus should they, for any reason, get out of unison with one another.

The operation of the transmitting apparatus shown on Figs. 1—A and 1—B will best be understood by reference to a particular example. Assume that the transmitters TX1, TX2 and MTX are provided with a copious supply of perforated tape so that auto-control contacts AC1 and AC2 are closed. Brushes B1 and B2 are on their rest segments R, relays A and B of the counting chain are deenergized, and negative (marking) battery is supplied to the line L from segment R of ring R2, brush B1, ring R1, break contacts 719 and 718 of relay PH2 to the line L. Battery 52 on ring R5 is connected by brushes B2 to segments R of rings R3 and R4 and thence by way of the armatures 703 and 701 respectively, and their break contacts of relay SR, conductors 702 and 700, and auto-control contacts AC1 and AC2 to one end of the windings of relays C1 and C2 respectively. The circuits are completed by ground at the other ends of these windings, therefore, the relays C1 and C2 operate and connect ground by way of their make contacts and armatures 723 and conductor 724 to one end of the winding of relay SC, thereby causing it to operate and in turn connect ground by way of its armature 721 and make contact to the winding of the start magnet ST. The start magnet ST upon energization withdraws the latch LA from engagement with the brush arm thus permitting brushes B1 and B2 to rotate. Relay SC is a slow-to-operate as well as a slow-to-release relay, therefore, relay C1 upon operation completes a circuit from battery on armature 725 and its break contact of relay SC, conductor 726, and make contact and armature 727 of relay C1, to one end of the winding of the stepper magnet SM1 of the tape transmitter TX1, the other end of this winding is connected to ground. The energization of the winding SM1 causes the first code combination corresponding to the hundreds digit of the stock number to be stepped into the tape transmitter TX1. As relay SC operates it interrupts the aforesaid circuit of the stepper magnet SM1 at the break contact and armature 725 of relay SC, thus causing the deenergization of the magnet SM1 thereby permitting the tongues 1 to 5 of the tape transmitter TX1 to take settings corresponding to the first transverse row of perforations in the tape T1. As brushes B2 pass off the segments R of rings R3 and R4, after having been released by the operation of latch LA under control of its magnet ST, the operate circuits of relays C1 and C2 (heretofore described) are interrupted, and relay C2 is released. Relay C1, however, locks by way of its armature 728 and make contact, and conductor 729 to the break contact and armature 67 of relay A, which is connected to battery. As the

brushes B1 and B2 pass on to the first segments S of the respective rings R2 and R3, positive (spacing) battery is applied to the line L from segment S of ring R2, brush B1 and ring R1. At the same time relay CR1 is operated from battery 52, ring R5, brush B2 and segment S of ring R3. The operation of relay CR1 causes the hundreds stock number relays HNR to be actuated in accordance with the combination of perforations in the tape, corresponding to the hundreds digit of the stock number, set up in the transmitter TX1. Relays HNR lock up over the break contact of relay LR1 to ground.

As brush B1 passes on to segment 1 of ring R2 the first impulse of the hundreds digit of the stock number is transmitted over ring R1 to the line. Coincidentally therewith a circuit is completed from ring R5, brush B2, and segment 1 of ring R3 through the armature 730 and make contact of relay C1 to the stepping magnet SM1, causing the next combination representing the tens digit of the stock number to be stepped into the transmitter TX1. As the brush B2 passed off segment S of ring R3, relay CR1 released and disconnected the windings of the relays HNR from the conductors 1 to 4 of cable A. As the brush passes on to segment 2 of ring R2, the second impulse of the hundreds digit of the stock number is transmitted over ring R1, and at the same time relay LR1 operates from segment 2 of ring R3 to unlock the fractions price relays FPR from their previous settings. Engagement of the brush B1 with segment 3 of ring R2 causes the third impulse of the hundreds digit of the stock number to be transmitted from ring R1 to the line L. Coincidentally therewith relay CR2 is operated from segment 3 of ring R3 thereby connecting the windings of the tens digit stock number relays TNR to tongues 1 to 4 of the transmitter TX1. The relays TNR now take settings in accordance with the perforations in the tape representative of the tens digit of the stock number. As the brush B2 left segment 2 of ring R3, relay LR1 released thereby conditioning for operation the locking circuit for the fractions price relays FPR. Passage of brush B1 across segment 4 of ring R2 transmits the fourth or final impulse of the hundreds digit of the stock number.

Similarly, as segments 5 to 8 of ring R2 are traversed by the brush B1, the tens digit of the stock number is transmitted and during this same time the brush B2 in crossing segments 5 to 8 of ring R3 sets up circuits from battery 52, through segment 5 of ring R3 and armature 730 of relay C1, to the stepping magnet SM1 to advance the perforations in the tape representative of the units digits of the stock number into operative relationship with the transmitter TX1. From segment 6 of ring R3 a circuit is established to relay LR1 which operates and unlocks the relays HNR causing them to release in readiness for the next quotation, and a circuit is established from segment 7 of ring R3 to the control relay CR3 to connect the units stock number relays UNR to the transmitter TX1 to store the units digit signal thereon. As the brush B2 passed off segment 6 of ring R3, relay LR1 released thereby preparing the locking circuit for relays HNR generally in the manner above described in regard to the relays FPR. During the time that brush B2 crosses segments 9 to 12 the units digit of the stock number is transmitted. As brush B2 traverses the segments 9, 10 and 11 of ring R3, the range combination is stepped into the tape

transmitter TX1, the locking relay LR2 is operated to unlock the tens stock number relays TNR after which relay LR2 releases, and relay CR4 is operated to connect the range relays RTR to the transmitter TX1, respectively.

The passage of brush B1 over segments 13 to 17 of ring R2 causes a multiplex character to be transmitted from the multiplex tape transmitter MTX.

As the brush B1 passes over segments 18 to 21 of ring R2 the range signal is transmitted. When the brush B2 closes the circuit through segment 18 of ring R3, the tens digit combination of the price is stepped by the magnet SM1 into the transmitter TX1. As the brush passes on to the segment 19, battery 52 is supplied over brush B2 to operate relay LR3 to unlock the units stock number relays UNR. As the brush passes on to segment 20, relay CR5 operates to connect the tens digit price relays TPR to the transmitter TX1, and as the brush passes on to segment 21 the multiplex step magnet MSM is operated to set up the succeeding character in the multiplex transmitter MTX.

As brush B1 passes over groups of segments 22 to 25, 26 to 29, and 30 to 32, respectively, the tens digit, units digit, and fractions portion of the price are transmitted. The local ring R3 at this same time causes step magnets SM1, relays CR6, CR7, LR4, LR5 and LR6 to be operated and released in the proper sequence. As previously explained, the passage of brush B2 over segment 30 of ring R3, completes a circuit to operate the A and B relays of the counting chain, which relays remain operated until segment 30 is again engaged during the succeeding revolution. The operation of the relay A at its armature 67 removes battery from conductor 729 and armature 728 of relay C1, thereby causing the latter relay to release, and connects battery to conductor 731 in preparation for locking relay C2 upon its subsequent operation.

Armature 68 of relay A when operated to its make contact, supplies ground by way of conductor 710 to the winding of start magnet ST thereby insuring that the distributor brushes will not come to rest at the end of an odd-numbered revolution, but will come to rest only at the end of an even-numbered revolution after the contact and armature 721 of relay SC have opened.

Armature 733 of relay A connects ground by way of its make contact, and conductor 707 to the armature 708 of relay SC thereby holding relay SC operated.

Armature 69 and its make contact of relay A connect ground by way of conductor 96 to energize the winding 71 of rotary switch RS, preparatory to stepping the arm 72 to the next terminal when relay A releases.

As brush B2 passes over segment 31 of ring R4, battery is extended by way of conductor 54, arm 72 and one of the terminals 1 to 49 of the switch RS conductor 705, armature 704 and its make contact of relay A, conductor 702, and through the closed contacts of the auto-control AC2, to the winding of relay C2 which operates and locks by way of its armature 732 and make contact, to battery on conductor 731 which is supplied by the make contact and armature 67 of relay A.

Brush B2 in passing over segment 32 of ring R4 connects battery by way of conductor 734, armature 730 and break contact of relay C1, and make contact and armature 735 of relay C2 to the winding of the stepping magnet SM2 of

the tape transmitter TX2, thereby energizing the magnet SM2 to step the perforations corresponding to the hundreds digit of the stock number of a channel 2 quotation into the transmitter TX2. Coincidentally therewith battery from segment 32 of ring R3 energizes the slow-to-release relay SR which as heretofore stated remains operated for a time greater than that required for brushes B2 to pass continuously over segments R of rings R3 and R4, therefore as brushes B2 pass over these latter segments, no circuits are completed by way of conductors 700 and 702 as the corresponding break contacts and armatures 701 and 703 of relay SR are open.

As the brushes B1 and B2 pass on to the start segments S at the beginning of the second revolution, relay CR1 operates as before to connect the hundreds number relays HNR to the transmitter TX2, the control relay C2 having been previously operated as described. In similar manner, as described in connection with the operation of transmitter TX1, a complete quotation is transmitted from the transmitter TX2 and one character is transmitted from the multiplex transmitter MTX during this second revolution of the distributor. Also during this second revolution, as segment 30 of ring R3 is traversed by brush B2, relays A and B are released, thereby causing the release of relay C2 and the preparation of a locking path for relay C1 by the armature 67 of relay A moving from the make contact to the break contact, and the release of armature 704 of relay A disconnects auto-control contact AC2 from segment 31 of ring R4, and connects this segment to the auto-control contact AC1, in preparation for operating relay C1 as brush B2 passes over the segment 31.

Brush B2 in crossing segment 31 of ring R4 operates relay C1 through the closed contacts of the auto-control AC1, relay C1 locks by means of its armature 728 and make contact to battery at the break contact of armature 67 of relay A. As the brush B2 crosses segment 32 of ring R4, battery is applied to conductor 734, armature 730 and make contact of relay C1, to the winding of stepping magnet SM1 of the tape transmitter TX1, causing the first transverse row of perforations corresponding to the hundreds digit of the stock number of the succeeding channel 1 quotation to be stepped into the tape transmitter TX1.

If at the end of the second revolution of the distributor there is not a complete quotation in either tape T1 or T2 available for transmission, both auto-control contacts AC1 and AC2 will be open and relay C1 will not operate as brush B2 passes over segment 31 of ring R4. Consequently as relay A is released during the latter part of an even-numbered revolution, the locking circuit of the SC relay which extends by way of its make contact and armature 708, and conductor 707 to the make contact and grounded armature 733 of relay A is interrupted at the latter contacts. Relay SC as heretofore mentioned has slow-to-release characteristics, therefore it remains operated and in turn by supplying ground from its armature 721 maintains the start magnet ST energized until the brushes B1 and B2 are beginning another revolution, after which time relay SC and start magnet ST release. As segment 30 of ring R3 is crossed by brush B2 during this odd-numbered revolution, relay A is again operated, thereby causing the start magnet ST to be energized by ground on conductor 710 from armature 68 and its make contact of

relay A, thus causing the brushes B1 and B2 to make another revolution. During this latter revolution as brush B2 passes over segment 30 of ring R3, relay A is again released, thereby causing the start magnet ST to be deenergized by the interruption of ground at the contact and armature 68 of relay A, thus causing the brushes B1 and B2 to be brought to rest after having made two additional revolutions and transmitted signals indicative of no quotations during these last two revolutions.

However, should the supply of one tape only be exhausted, the distributor brushes will be released for at least two more revolutions, transmitting blank signals over the line L during the revolution corresponding to transmission from the idle transmitter.

Assuming, by way of example that tape T2 should have sufficient, but tape T1 should have insufficient perforations for a complete quotation, the auto-control contacts AC2 will be closed. Auto-control contacts AC1, however, will be open and thus prevent a circuit from being completed to operate relay C1. Relay C1 not being operated, prevents the stepping of the tape transmitter TX1 and also prevents the connection of the tongues of this tape transmitter to the various relays HNR to FPR as the distributor causes the successive operation of relays CR1 to CR7. The distributor, therefore, during this revolution transmits blank signals to the line L. During the next revolution a channel 2 quotation will be transmitted in a manner heretofore described.

Likewise, insufficient perforations in the tape T2, when the auto-control contact AC1 is closed to indicate that a channel 1 quotation is ready for transmission, the transmitter is caused to function generally in a manner similar to that assumed in the previous example, transmitting the channel 1 quotation followed by blank signals transmitted during the channel 2 revolution of the distributor.

While either transmitter has sufficient tape supplied to it to enable a complete quotation to be transmitted the distributor will continue to operate.

As previously explained, at the completion of the 98th revolution of the distributor, the line L is disconnected from the ring R and connected to steady negative (marking) battery at the operated armature 717 and contact 719 of relay PH2. This line condition is maintained for two revolutions of the distributor, which is sufficient time to enable the receivers to come into unison as will appear later in the description of the receiving apparatus.

It will be noted that I have provided a transmitter which operates automatically from previously prepared tapes to send out channel 1 and channel 2 quotations alternately, blank signals being transmitted in place of signals from either channel when no quotation is available for that channel. Furthermore, a transmitter of the start-stop type has been provided which comes to rest only at the end of the transmission of an even-numbered revolution after having made at least two blank revolutions after a last quotation. The transmitter sends signals corresponding to a numerical stock designation, range, and price, together with a multiplex character for each revolution of the distributor. The 32 impulses comprising these signals are preceded by a start impulse and followed by a rest impulse. Except during the time that the distributor comes to rest due to an insufficient supply of perforated

tape, the brushes rotate continuously and the interval of each of the rest and start impulses is substantially equal to each of the 32 code impulses.

With the switch MC moved into engagement with its contact 736, auto-control contact AC3, Fig. 1—B, operating under control of tape T3 serves to keep the brushes B1 and B2 rotating to transmit multiplex signals perforated on the tape T3, when no quotations are being transmitted from transmitters TX1 and TX2 or when quotations are so infrequent as to cause the distributor not to revolve continuously. Any multiplex character awaiting transmission causes the contacts AC3 to close. The switch arm MC when closed to its contact 736, connects ground through the contacts AC3, thence by way of conductor 724 to one end of the winding of relay SC, which operates. The operation of relay SC at its armature 721 and make contact energizes start magnet ST which withdraws the latch LA from engagement with the brushes B1 and B2 and causes them to revolve to transmit the waiting multiplex signals.

The receiving and retransmitting apparatus at the distant station which responds to these permutation signals will now be described.

Retransmitter

The apparatus shown in Figures 2—A to 2—G comprises a start-stop receiving distributor RD having receiving rings RR1 and RR2, monitor printer controlling rings RR3 and RR4, a solid grounded ring RR5 and a control ring RR6. Rings RR1 and RR2 are bridged by brushes RB1, and rings RR3 to RR6 are joined by brushes RB2. Ring RR1 is solid except for the last or rest segment 2. Solid segment 1 of ring RR1 is connected by a conductor 200 through a resistance 201, contact 399 of switch KS and conductor 260 to the marking contact M of a receiving polarized line relay LR. The rest segment 2 of ring RR1, Fig. 2—A is joined by conductor 203 through the contact 204 of a key switch KS and thence through a conductor 270 to the spacing contact S of relay LR. The armature of relay LR is connected to ground.

Ring RR2 has 32 live segments 1 to 32 corresponding to the segments of ring R2 of the transmitting distributor TD. Ring RR2 also has a rest segment R connected through the start magnet STM to grounded battery. Each of the live segments 1 to 32 of the ring RR2 is separated by a dead segment from each adjacent live segment so that only the central suitable portion of each received impulse is transmitted through the segments of ring RR2 to storage relays HS1 to FP4 to be described presently. The first 12 segments of ring RR2 are employed for receiving the hundreds, tens and units digits of the stock number, segments 1 to 4 being connected through slip connections 205 to the windings of the hundreds stock storage relays HS1 to HS4, Fig. 2—A. Segments 5 to 8 are similarly connected to the windings of the tens stock storage relays TS1 to TS4, and segments 9 to 12 are connected in a similar manner to the windings of the units stock storage relays US1 to US4. The opposite terminals of the windings of each of these relays is connected to grounded battery. Segments 13 to 17, Fig. 2—B, upon which the multiplex character is received are grouped individually to the five multiplex selecting magnets MX1 to MX5. These latter relays control the operation of the multiplex printer MXP, Fig. 2—A, and also are used

to store a special signal the purpose of which will be described hereinafter.

Segments 18 to 21 upon which range signals are received are connected through slip connections 205 to the windings of the range storage relays RA1 to RA4 respectively, Fig. 2—B. Segments 22 to 25 upon which the tens digit signal of the price is received are connected to the windings of the tens price digit relays TP1 to TP4. Segments 26 to 29, Fig. 2—C, upon which the units digit signal of the price is received are connected to the windings of the units price storage relays UP1 to UP4, and segments 30 to 32 upon which the fractions signal of the price is received are connected through the windings of the fractions price storage relays FP2 to FP4 respectively. The opposite terminals of the windings of each of the relays MX1 to FP4 is connected to grounded battery. The armatures 206 immediately above and connected to the windings of each of these storage relays, including the MUX storage relays MX1 to MX5, is used for locking the relays. The armatures 206' immediately below and adjacent to the windings of the relays HS1 to US4 and RA1 to FP4 control the operation of a group of intermediate storage and decoding relays, from which retransmission is effected, and the lower armatures 207 adjacent to armatures 206' control the operation of monitor printers in accordance with the received signals. The armatures 663 and 664 for the relays MX1 to MX5 are used exclusively for a special signal as will hereinafter appear. The upper contacts 665 of the MUX relays MX1 to MX5 control the character selection within the multiplex printer MXP. The circuits completed through the various contacts of the storage relays HS1 to FP4 will be referred to hereinafter.

Ring RR3 is divided into 33 segments, segments 1 to 8 serving to repeat the hundreds digit of the stock number to the monitor printers MP1 and MP2 to be described, segments 9 to 16 perform the same function for the tens digit of the stock number, segments 17 to 24 repeat the units digit of the stock number, and segments 25 to 32 repeat the range signal. Each of these groups, it will be noted, comprises eight segments. As stated, the function of each group is to control the printing of a character on the monitor printers MP1 and MP2 according to the stock number and range of the stock to be selected. Channel 1 quotations are printed on monitor printer 1 and monitor printer 2 is used for printing channel 2 quotations.

These monitor printers may comprise the usual six unit start-stop stock tickers known in the art, except that the type wheels are modified to cause numbers indicative of the stock designations to be displayed in the upper position on the tape instead of letters, and the range designation, price and other information are printed in the lower position on the tape.

The tickers operate on a total of eight impulses for each character, six of which are permutation code impulses, the remaining two of which are start and stop impulses. Since each digit of the stock number and range comprises four received impulses only without a start and stop impulse, it is necessary to fill in the remaining code and synchronizing impulse. The four impulses received for each of the three digits of the stock number and for the range selection are set up on certain segments of ring RR3, and the remaining four impulses of each

group necessary for the operation of the monitor tickers are filled in by other segments of ring RR3, segments 2 to 5 of ring RR3 are connected individually to the armatures 207 of relays HS1 to HS4. Segments 10 to 13 are likewise connected to the armatures 207 of relays TS1 to TS4 respectively. Segments 18 to 21 of ring RR3 are connected to the armatures 207 of relays US1 to US4 respectively, and segments 26 to 29 are connected to armatures 207 of relays RA1 to RA4 respectively.

In the same manner ring RR4 serves to distribute the tens, units and fractions digits of the price of the quotation to the monitor printers MP1 and MP2 and to distribute the special signal received over segments 13 to 17 of ring RR2, the purpose of which will hereinafter appear. The ring RR4 also serves to fill in the necessary code start-stop impulses required for the operation of the monitor printers. Segments 3 to 6 of ring RR4 are connected to the armatures 207 of the tens price relays TP1 to TP4 respectively. Segments 11 to 14 are connected to armatures 207 of the units price relays UP1 to UP4 respectively, and segments 20 to 22 are connected to armatures 207 of the fractions price relays FP2 to FP4 respectively.

Control ring RR6 is divided into seventeen segments, each of the first sixteen segments corresponding in length to two segments of the rings RR3 and RR4. These sixteen segments are connected to the windings of various control relays C1 to C6, range unlocking relay RA, tens units price release relay TUP, stock number and fractions price release relay SNFP, and relays CT1 and CT2, Figs. 2—A to 2—D. The function of each of these relays will appear in the detailed description of the operation of the receiving apparatus to be given subsequently.

It will be recalled that the channel 1 transmitter TX1 and the channel 2 transmitter TX2 at the central station transmitted quotations alternately. At the receiving station it is desired to maintain the channel 1 and channel 2 quotations separate from each other and to record the channel 1 quotations on one monitor printer and the channel 2 quotations on another monitor printer. Consequently, two monitor printers MP1 and MP2 are provided, monitor printer MP1 serving channel 1 quotations and monitor printer MP2 serving the quotations transmitted on channel 2, each printer as stated being of the six-unit start-stop type and having a single selecting magnet SR1 and SR2 respectively. Magnet SR1 is controlled from the armature of monitor ticker relay MT1 having battery of opposite polarity connected to its two fixed contacts. Magnet SR2 is similarly controlled from the monitor ticker relay MT2. Relays MT1 and MT2 are arranged to be operated alternately from rings RR3 and RR4 in such a manner that when a channel 1 quotation is being received relay MT1 is associated with ring RR3 to relay the stock number and range signals to the printer MP1, and relay MT2 is associated at the same time with ring RR4 to relay the price of the previous channel 2 quotation to the printer MP2. Also, when a channel 2 quotation is being received the connections are reversed so that relay MT2 is responsive to signals from ring RR3, and relay MT1 receives its signals in accordance with the code markings on ring RR4.

It will be seen therefore that two revolutions of the distributor RD are required to record a single quotation on each of the printers MP1 or

MP2. The stock number and range signals are recorded during the same revolution of the distributor RD in which they are received, the price being stored and distributed to the proper printer during the succeeding revolution of the distributor.

Relay CH1 controls the order of connection of the monitor ticker relays MT1 and MT2 with the rings RR3 and RR4. Relay CH1 is controlled in turn through relays CP and CH2 in such a manner as to remain energized during the reception of a channel 1 quotation and to be held energized during the reception of the following or channel 2 quotation. A phasing relay PH serves to maintain the proper phase relation of CH1 relative to the received channel 1 and channel 2 quotations.

The primary purpose of the received signals in the illustrative embodiment shown, is to operate brokers' boards in subscribers' stations. Monitor printers MP1 and MP2 and the control relays for operating the same are provided for the purpose of checking the received signals. In order to control a broker's board of the type herein disclosed, the received permutation signals are translated into step by step signals, the channel 1 quotations being sent to the selectors at the various receiving stations over one pair of conductors and the channel 2 quotations being sent over another pair of conductors. The translating and transmitting apparatus for channel 1 quotations only is shown in Figures 2—D to 2—G, the apparatus for the channel 2 quotations being identical therewith. Referring to Figure 2—D, a gang relay CT1 is provided for the channel 1 quotations, said relay having thirty make contacts, twenty-seven of which are connected to the make contacts of the armatures 206' of the twenty-seven storage relays HS1 to FP4, the relays MX1 to MX5 being excluded from these circuits. Relay CT1 is also provided with a locking contact 208 and two control contacts 209 and 210. Relay CT1 is operated through the break contact of armature 211 of relay CH1, Figure 2—C, from which the circuit is extended, over conductor 2 in cable 259, through break contacts 212 of relays HS4 to HS1 in series to ground on the armature 213 of relay C3 when this latter relay operates.

Contacts 1 to 4 of relay CT1 are connected to windings of the intermediate hundreds stock relays IHS1 to IHS4 respectively. Contacts 5 to 8 of the relay CT1 are connected to the windings of the intermediate tens stock relays ITS1 to ITS4 respectively. Contacts 9 to 12 are connected to the windings of the intermediate units stock relays IUS1 to IUS4 respectively. Contacts 13 to 16 are connected to the windings of the intermediate range relays IRA1 to IRA4 respectively. Contacts 17 to 20 are connected to the windings of the intermediate tens price relays ITP1 to ITP4 respectively. Contacts 21 to 24 are connected to the windings of the intermediate units price relays IUP1 to IUP4, and contacts 25 to 27 are connected to the windings of the intermediate fractions price relays IFP2 to IFP4 respectively. Relays IHS1 to IHS4, ITS1 to ITS4, and IUS1 to IUS4 lock through their armatures 214 and break contacts of release relays RL3 and RL6 to ground. Relays IRA1 to IRA4 lock up through their armatures 215, through the break contact 216 of relay RL4, and break contact 217 of relay RL6 to ground. Relays ITP1 to ITP4, IUP1 to IUP4, and IFP2 to IFP4 lock up through the break contacts of release relay RL5 to ground.

Associated with each relay ITP1 to ITP4 is a

transmitting control relay TP5 to TP8 respectively, the windings of these latter relays being connected at one end to the armatures 238 of the aforesaid associated relays. Similarly, each of the relays IUP1 to IUP4 is provided with a transmitting control relay UP5 to UP8 respectively having their windings connected to the armatures 233 of the associated relays, and each of the fractions relays IFP2 to IFP4 has an associated transmitting control relay FP6 to FP8 respectively. The operating winding of each of these latter relays FP6 to FP8 is connected to an armature 347 of its associated relay IFP2 to IFP4 respectively. Relays TP5 to TP8 each has a locking winding connected to its armature 217, through a break contact and grounded armature 346 of release relay RL4. Similarly, relays UP5 to UP8 lock over their armatures 218, through break contact and grounded armature 350 of relay RL4, and relays FP6 to FP8 lock over their armatures 219, through break contact and grounded armature 348 of relay RL4.

The relays of group IHS1 to IHS4 have their left-hand armatures and associated contacts connected in code so that for each combination in which they are operated one of a group of conductors 1 to 10 inclusive in cable 220 will be connected to the armature 221 of relay IHS1. Similarly the relays of groups ITS1 to ITS4, and IUS1 to IUS4, have their left-hand armatures connected in code so as to enable any one of ten conductors in cable 221' to be connected to the armature 222 of relay ITS1 and/or to the armature 223 of relay IUS1.

In the same manner, the left-hand armatures of relays IRA1 to IRA4, and relays TP5 to TP8, are coded to enable any one of the conductors 1 to 9 and NR of cable 224 to be connected to the armature 225 of relay IRA1 and/or to the armature 226 of relay TP6. Relays UP5 to UP8 have their right-hand armatures coded, and relays FP6 to FP8 have their left-hand armatures coded, so as to enable any one of the nine conductors, 1 to 9 inclusive, of cable 227 to be connected to the armatures 228 of relay UP6 and/or to the armature 229 of FP6.

Associated with the intermediate storage relays of the channel 1 transmitter is a transmitting distributor TD1, Fig. 2—G, having four transmitting rings TR1, TR2, TR3, and TR4. Rings TR1 and TR3 are divided into forty-six segments. Ring TR2 is divided into forty-five segments of which forty-three are of equal length. Ring TR4 is solid except for the rest segment R, the solid portion thereof being grounded. A brush TB bridges the four rings and is normally held at rest on segments 1 by a latch on release magnet RM1. The even-numbered segments 4 to 22 of ring TR2 are connected through break contact and armature 230 of the tens stock number cut-off relay TSC and thence through the winding of transmitting relay S3 to grounded battery. Even-numbered segments 24 to 42 of ring TR2 are connected to the armature 231 and break contact of relay UPC, and through the make contact and armature 230 of relay TSC when operated, to the winding of transmitting relay S3.

The odd-numbered segments 5 to 23 of ring TR2 are connected directly to the winding of transmitting relay S1, and the odd-numbered segments 25 to 41 of ring TR2 are connected through the armature 232 and break contact of the range cut-off relay RAC to the winding of relay S1.

The even-numbered segments 4 to 22 of ring TR3 are connected to segment RLS of ring TR2 and also to a circuit extending through the break contact and armature 233 of relay USC to the winding of transmitting relay S4. The even-numbered segments 24 to 42 of ring TR3 are connected to the armature 234 and break contact of the fractions price cut-off relay FPC and thence through the make contact and armature 233 of relay USC when operated, to the winding of transmitting relay S4.

The odd-numbered segments 5 to 19 of ring TR3 are connected through break contact and armature 235 of relay HSC, to the winding of transmitting relay S2. The odd-numbered segments 25 to 43 are connected through the armature 236 and break contact of relay TPC, through the make contact and armature 235 of relay HSC when operated, and thence through the winding of relay S2.

The relays S1 and S3 respectively control the transmission of step-by-step positive and negative impulses over the line conductors R1 and R3, and relays S2 and S4 respectively control the transmission of positive and negative impulses over line conductors R2 and R4.

Segment 1 of ring TR1 is connected to the winding of the release magnet RM1. Segments 2, 3 and 46 of ring TR1 are connected, by conductor 349, to the winding of release relay RL5. Terminal 4 of ring TR1 is connected to the winding of release relay RL2. The even-numbered segments 6 to 24 are connected through the ten conductors 1 to 10 of cable 220 to the coding contacts of relays IHS2 to IHS4. The odd-numbered segments 5 to 23 of ring TR1 are connected to the ten conductors of cable 221, thence to the coding contacts of relays ITS2 to ITS4, and IUS2 to IUS4. Segment 23 is also connected by conductor 7 of cable 335 to break contact of armature 336 of relay UP8 and break contact of armature 333 of relay FP8, Fig. 2—F. The even-numbered segments 24 to 42 of ring TR1 are connected to the conductors designated NR and 1 to 9 of cable 224 and thence to the coding contacts of relays TP5 and TP8 and relays IRA3 and IRA4, with the exception of conductor 9 which is connected to the make contact of armature 367 of relay TP5, and is not connected to the relay IRA3 or IRA4. The odd-numbered segments 25 to 41 are connected to the nine conductors of cable 227, and thence to coding contacts of relays UP5 and UP8, the conductors 1 to 7 also extending to coding contacts of relay FP8. Segment 43 of ring TR1 is connected, by conductor 1 of cable 322, to the winding of release relay RL4. Segment 44 is connected by conductor 3 of cable 322, to the make contacts of armatures 233 of relays IUP1 to IUP4, and segment 45 of ring TR1 is connected, by conductor 4 of cable 335 to the make contacts of armatures 238 of relay ITP1 to ITP4. Segment 1 of ring TR2 is connected by conductor 369 to the winding of release relay RL6, Fig. 2—D. Segment SW of ring TR2 is connected to armature 239 of relay SW, so that when the relay SW operates the circuit is extended to the winding of transmitting relay S1. Segments 1 and 2 (NR) of ring TR3 are connected by conductor 378 to armature 240 of relay NR, this circuit being extended to the winding of relay S2 when the relay NR operates. Rest segment R of ring TR4 is connected, by conductor 2 of cable 284, to contact 210 of relay CT1 which when operated extends the circuit through conductor 4

of cable 264 to make contact of the grounded armature 241 of relay SNFP. The opposite terminal of the winding of the start magnet RM1 is connected, by conductor 3 of cable 283, to a contact 209 of relay CT1 which when operated extends the circuit by conductor 1 of cable 284 to the armature 242 of relay SW. The purpose of these and the remaining circuits and apparatus shown in Figures 2—A to 2—G will become apparent from the description of the operation of the system given below.

Assume that the brushes RB1 and RB2 of the receiving distributor RD are at rest on their rest segments R with the line key KS, Fig. 2—B, in the position shown, and steady marking or rest battery is on the line L. The monitor printers MP1 and MP2 will be at rest at this time since marking or rest battery is applied to them by their associated relays MT1 and MT2 which are operated. Relay MT1 is operated from grounded brush RB2, segment 33 of ring RR3, conductor 283, break contact and armature 243 of relay BS1, through the winding of MT1 and thence to grounded battery. Relay MT2 is operated from grounded segment 33 of ring RR4, through the break contact and armature 245 of relay BS2 to the winding of relay MT2 and thence to grounded battery.

Operation of retransmitter

Assume, for example, that a channel 1 quotation from the transmitter TX1, Figs. 1—A and 1—B, is to be received over the line L, and that the quotation relates to a stock designated by the code number 123, the quotation comprising a union range and price of 98%. Also assume that permutation code multiplex signals indicative of the letter "Y" are interspersed with the quotation signals. The signals successively received over the line L and applied by the line relay LR to the various segments of ring R2 of the receiving distributor RD are as follows:

	Start impulse + Spacing
Hundreds stock number (1)	Code impulse No. 1—Marking
	Code impulse No. 2—Marking
	Code impulse No. 3+Spacing
	Code impulse No. 4+Spacing
Tens stock number (2)	Code impulse No. 5—Marking
	Code impulse No. 6+Spacing
	Code impulse No. 7—Marking
	Code impulse No. 8+Spacing
Units stock number (3)	Code impulse No. 9—Marking
	Code impulse No. 10+Spacing
	Code impulse No. 11+Spacing
	Code impulse No. 12—Marking
Multiplex character (Y)	Code impulse No. 13—Marking
	Code impulse No. 14+Spacing
	Code impulse No. 15—Marking
	Code impulse No. 16+Spacing
	Code impulse No. 17—Marking
	Code impulse No. 18+Spacing
	Code impulse No. 19+Spacing
	Code impulse No. 20—Marking
	Code impulse No. 21+Spacing
	Code impulse No. 22—Marking
	Code impulse No. 23+Spacing
	Code impulse No. 24—Marking
	Code impulse No. 25—Marking
	Code impulse No. 26—Marking
	Code impulse No. 27+Spacing
	Code impulse No. 28+Spacing
	Code impulse No. 29—Marking
	Code impulse No. 30—Marking
	Code impulse No. 31—Marking
	Code impulse No. 32—Marking
	Stop impulse—Marking

Upon the reception of the first of the spacing impulses the armature of line relay LR moves to its spacing contact S, connecting ground through contact 204 of the switch KS, conductor 203, segment 2 of ring RR1, brush RB1, and segment R of ring RR2, and through the winding of the start magnet STM to grounded battery thereby operating the start magnet and releasing the brushes RB1 and RB2 for one revolution. As the brush

RB2 leaves its rest segments and passes on to segments 1, ground is removed from the windings of the monitor printer control relays MT1 and MT2 at segments 33 of rings RR3 and RR4 respectively. These relays release their armatures which engage their break contacts and apply a start signal to the monitor printers MP1 and MP2 which release their selector cam shafts for one revolution. As brush RB1 moves on to segment 1 of ring RR2, the first code impulse of the hundreds stock number is received. This being marking in character operates relay LR to its marking contact M, thereby applying ground over conductor 260, through operated contact 399 of the key switch KS, conductor 202, series resistance 201, and conductor 200 through the No. 1 segment of ring RR1 and thence to brushes RB1 and segment 1 of ring RR2, through slip connection 205 to the winding of the hundreds stock number relay HS1, and thence to grounded battery. The relay HS1 is thereupon operated and locks up over its armature 206 and conductor 1 of cable 246 to the break contact and armature 247 of relay SNFP to ground. At the same time brush RB2 is in contact with segment 1 of ring RR6 and effects operation of the control relay C1.

Operation of relay C1 applies ground at its armature 247 by way of conductor 248 to the winding of the phasing relay PH, Fig. 2—C, to operate the same. Relay PH is slow releasing and is so adjusted that it remains operated after its external circuit has been opened for slightly more than the normal stop time of the brush of the receiving distributor RD during continuous operation, or it remains operated for slightly more than the time required for the brush to pass over any one segment of ring RR6. The function of the phasing relay PH is to maintain the proper phase relation between channels at the beginning of each series of quotations, that is, if the transmitter is operated continuously and the receiving distributor RD gets out of phase with the transmitting distributor TD, Figs. 1—A and 1—B, to such an extent that the receiving apparatus is prepared to receive a channel 2 quotation at a time when a channel 1 quotation is about to be transmitted or vice versa, this out of phase condition will exist until the transmitting and receiving distributors have come to rest for a sufficient period to permit the phasing relay to release. This phasing always occurs, in the specific embodiment disclosed, at the end of each one hundred revolutions of the transmitting distributor brush arm through the action of the stepping switch 72 and the relay 74 of the transmitting apparatus, Fig. 1—B. During this phasing period the brushes of the receiving distributor RD come to rest for a period greater than that between quotations during continuous operation, permitting the phasing relay to release as will subsequently appear and causing the receiving apparatus to assume a normal condition ready to receive a channel 1 quotation.

It will be remembered in connection with the description of the transmitting apparatus that the transmitting distributor came to rest only at the end of a channel 2 quotation. Consequently the phasing relay PH will release only at the end of a channel 2 quotation and therefore the first of the next series of quotations will always be a channel 1 quotation. The manner in which the relay PH prepares the receiving apparatus to receive a channel 1 quotation will appear subsequently. It should be borne in mind, however,

that this relay must be permitted to release only at the proper time, that is, when the brushes are at rest on their rest segment for a time greater than the normal stopping time between successive quotations during continuous operation of the receiving distributor.

As the brushes RB1 engage segment 2 of the ring RR2, the second code signal of the hundreds stock number is received on the distributor; since this signal is also marking in character, ground is maintained on the ring RR1 and the hundreds stock number relay HS2 is operated. This relay locks up at the break contact and armature 247 of the SNFP relay in the same manner as relay HS1. At the same time brush RB2 engages segment 2 of ring RR3 thereby completing a circuit from grounded ring RR5 through the brushes RB2, segment 2 of ring RR3, conductor 1 of cable 249, operated armature 207 of relay HS1 and the make contact thereof, conductor 250, through break contact and armature 251 of relay CH1, break contact and armature 243 of relay BS1 through the winding of the MT1 relay, and thence to battery. The armature of this latter relay moves to its marking contact and applies a marking signal to the selecting magnet SR1 of the monitor printer MP1 to set up a selection corresponding to the first code unit of the hundreds digit of the stock number.

During the first revolution of the brushes of the receiving distributor, the stock number and range are printed on the monitor printer MP1, and the monitor printer MP2 prints blank. During the second revolution of the receiving distributor brushes, at which time a channel 2 quotation is received, the signals for the monitor printer MP1 will have been transferred from ring RR3 to ring RR4, and the signals to printer MP2 will have been transferred from ring RR4 to ring RR3 through the contacts of relay CH1. Consequently, during the second revolution, the price on the channel 1 quotation will be printed on the monitor printer MP1 and the stock number and range of the channel 2 quotation will be received upon the printer MP2. The manner in which the transfer from one printer to another is effected will appear as the description proceeds.

As the third impulse of the hundreds stock number is received, brush RB1 moves on to segment 3 of ring RR2. Since this impulse is spacing, ring RR1 is not grounded and relay HS3 remains unoperated. Brush RB2 on engaging segment 3 of ring RR3 at this time causes a marking impulse to be transmitted to the monitor ticker relay MT1 from grounded ring RR5, brush RB2, segment 3 of ring RR3, conductor 2 of cable 249, armature 207 and make contact of relay HS2, conductor 250, break contact and armature 251 of relay CH1, and break contact and armature 243 of relay BS1 to the winding of the relay MT1, thereby causing relay MT1 to remain operated to maintain the marking signal in the monitor printer MP1. At this time, brush RB2 also engages segment 2 of ring RR6, causing relay C2 to operate and apply ground through its armature 252 to conductor 248 to maintain the phasing relay PH operated after relay C1 was released as grounded brush RB2 passed off segment 1 of ring RR6.

As the fourth impulse of the hundreds stock number is received, brush RB1 engages segment 4 of ring RR2 and since this impulse is also spacing, relay HS4 does not operate. At the same time, as brush RB2 engages segment 4 of ring RR3, a spacing condition is applied to

the winding of the relay MT1 due to the fact that the circuit from segment 4 of ring RR3 is open at the unoperated armature 207 of relay HS3. The third selecting condition, which is spacing in character, is therefore set up in the monitor printer MP1.

Since it is assumed that the quotation now in progress is the first one of a series, that is, that no previous quotations have been transmitted, the ring RR4, which at this time controls the operation of monitor printer MP2, performs no function during this revolution except to cause the printer to make four blank revolutions, and therefore the circuits established through the segments of this ring, will not be referred to at this time.

As the fifth selecting impulse is received, corresponding to the first impulse of the tens digit of the stock number, brush RB1 engages segment 5 of the ring RR2, and since this impulse is marking in character, relay TS1 operates and locks up through its armature 206 to the No. 2 conductor of cable 246, and the break contact and armature 253 of relay SNFP to ground. At the same time, brush RB2 engages segment 5 of ring RR3 to transmit the previously received fourth selecting impulse to the monitor ticker relay MT1. Since relay HS4 is unoperated at this time, this signal is of spacing character. Brush RB2 also engages segment 3 of ring RR6 at this time, applying ground directly from ring RR5 through segment 3 of ring RR6 to conductor 248 to maintain the phasing relay PH operated as relay C2 releases.

As each succeeding impulse which is marking in character up to and including the twelfth selecting impulse is received, it causes operation of the corresponding one of the relays TS2 to TS4 and US1 to US4 in the manner above described with respect to the relay TS1.

As the sixth pulse of the stock number is received, brush RB2 engages the blank segment 6 of ring RR3, consequently during this time the conductor 250 is ungrounded and a spacing condition is applied to the relay MT1 thus providing the fifth selecting impulse of the hundreds stock number to the printer MP1. It will be recalled that only four impulses were transmitted over the line L for the hundreds stock number, whereas six impulses are employed to effect the operation of the selecting mechanism within the printers. The segment 6 of ring RR3 fills in the fifth selecting impulse.

As the seventh impulse of the stock number is received to control the operation of relay TS3, the brush RB2 crosses segment 7 of ring RR3 to fill in the sixth selecting condition for the monitor printer MP1. It also grounds segment 4 of ring RR6 causing operation of the range controlling relay RA. This relay maintains the phasing relay PH operated over a circuit extending from ground at the make contact and armature 254 of relay PH, Fig. 2-C, conductor 255, armature 256 of relay RA and make contact thereof, conductor 248 and thence through the winding of relay PH to grounded battery. Relay RA also unlocks any of the range storage relays RA1 to RA4 which would have been operated in the event of a previous quotation. However, since it is assumed that there have been no previous quotations, all of the RA1 to RA4 relays will be unoperated, and the function of the relay RA at this time is to maintain the phasing relay PH operated as the brush RB2 passes off segment 3 of ring RR6.

As the eight impulse of the stock number is received, which impulse determines the operation of relay TS4, brush RB2 engages segment 8 of ring RR3 thereby applying ground from ring RR5 directly to conductor 250, and thence through the break contact and armature 251 of relay CH1, break contact and armature 243 of relay BS1, and through the winding of relay MT1 to grounded battery to operate the relay and apply a rest impulse to the selecting magnet SR1 of the printer MP1 to cause the camshaft thereof to come to rest.

It will be noted that the passage of brush RB1 over the segments 1 to 8 of ring RR3 causes the selecting condition set up in relays HS1 to HS4 to be supplied to the monitor printer MP1. Segment 1 of the ring RR3 supplies the start signal through the medium of relay MT1; segments 2 to 5 inclusive supply signals in accordance with the four unit code signals stored on the hundreds digit stock number relays HS1 to HS4; segments 6 and 7 supply two spacing signals to the four previous hundreds digit stock number signals to make a six-unit selection code for which the particular printer MP1 herein disclosed is adapted; and segment 8 of the ring supplies a marking impulse to the printer for bringing the receiving distributor of the printer to rest.

At the time the ninth impulse is received, brush RB2 engages segment 9 of ring RR3, and since this is a blank segment, a spacing or start condition is applied to the relay MT1 which in turn applies a start impulse to the printer MP1, preparing the same to receive a tens stock number selection. At the same time a ground is applied to segment 5 of ring RR6 to cause operation of relay C3 which in turn, through its armature at 257, grounds conductor 248 to maintain the phasing relay PH operated as relay RA releases.

Relay C3 also performs another function, namely, to prevent continued operation of the printer MP1 when no hundreds stock number signals have been stored on the relays HS1 to HS4. It will be recalled, in connection with the operation of the transmitters TX1 and TX2, Fig. 1-A, that if perforated tape was supplied only to transmitter TX2 for instance, during the time when transmission would normally take place from transmitter TX1, blank signals only were transmitted over the line. Obviously, if at the time the receiving distributor brush RB1 rotates, blank signals only are received, it is then unnecessary for the monitor printer associated at that time with the ring RR3 to operate. Accordingly, when relay C3 operates, if the hundreds stock number signal is spacing in character so that none of the relays HS1 to HS4 are operated, a circuit is established from ground at the armature 213 of relay C3 and operated contact thereof, conductor 258, armatures and break contacts 212 of relays HS1 to HS4 in series, conductor 1 of cable 259, armature 261 of relay CH1 and break contact thereof, to the winding of relay BS1, causing this relay to operate and supply ground through its make contact and armature 243 to the winding of relay MT1, thereby causing this latter relay to apply a marking or rest condition to the printer MP1. Relay BS1 locks up over its lower armature 262 and make contact to ground at the make-before-break armature 263 of relay CP. Consequently, if the hundreds stock number is blank or is not received, thus indicating that the entire following quotation is blank or is improperly received, the MP1 printer

is maintained at rest. However, since in the assumed example relays HS1 and HS2 are operated, the circuit through the armature 212 of these relays is open and consequently, relay BS1 remains unoperated.

As the tenth selecting impulse is received over line L, brush RB2 engages segment 10 of ring RR3 to apply ground through the segment and conductor 5 of cable 249, armature 207 of relay TS1 which is operated at this time, and conductor 250 to the monitor printer relay MT1 which operates and thereupon applies a marking condition to the selecting magnet of the monitor printer MP1. This is the first selecting condition of the tens stock number, the subsequent selecting conditions being applied as brush RB2 crosses segments 11, 12, 13, 14 and 15, the latter two segments serving to fill in the fifth and sixth impulses of the tens stock number.

At the time the eleventh selecting impulse is received, brush RB2 grounds segment 6 of ring RR6, causing a circuit to be completed over conductor 2 of cable 259, armature 211 of relay CH1 and the break contact thereof, conductor 1 of cable 264 to the winding of the gang relay CT1, Fig. 2—D, and thence to grounded battery. Relay CT1 operates and closes its contacts, the contacts 1 to 27 preparing circuits for the operation of relays in the groups IHS, ITS, IUS, IRA, ITP, IUP and IFP from the contacts 206' of those relays HS1 to US4 and RA1 to FP4 which may be operated due to incoming marking quotation signals. Relay CT1 locks up through its contact 208 and conductor 3 of cable 264, break contact and armature 256 of relay RA, conductor 255 and armature 254 and make contact of relay PH to ground.

As brush RB2 crossed segment 12 of ring RR3, ground was applied to conductor 7 of cable 249, contact 207 of relay TS3 which is operated at this time, and conductor 250 to the monitor ticker relay MT1 which thereupon operates and applies the second marking condition to the selecting magnet of the monitor printer MP1 for printing the digit 2 corresponding to the tens stock number digit 2 signal received on the distributor RD.

The thirteenth impulse received over line L is the first impulse of the multiplex character Y, and is received as brush RB1 engages segment 13 of ring RR2. Since, in the example given, it is marking in character, it causes ground to be applied to relay MX1 which operates to store the first multiplex character. Relay MX1 locks up over its operated armature 206, conductor 4 of cable 265, and the break contact and armature 266 of relay RA to ground.

As the fourteenth impulse is received, relay MX2 is not operated since this signal is spacing in character. The fifteenth impulse is marking and operates relay MX3. As the sixteenth impulse is spacing, relay MX4 does not operate, but relay MX5 operates as the seventeenth impulse, being marking in character, is received. Relays MX3 and MX5 lock over the circuit previously traced for locking MX1.

During the reception of the thirteenth impulse, the brush RB2 grounded segment 7 of ring RR6 to cause the operation of relay C2, thereby holding the phasing relay PH operated. It will be noted that at the time segment 6 of ring RR3 was traversed by brush RB2 no circuit was completed to the relay PH, but due to the slow-to-release character of the relay PH it did not release at this time. As the fifteenth impulse was

received, segment 8 of ring RR6 was grounded by brush RB2 to operate relay C4 which, through its operated armature 266 applied ground to conductor 248 to maintain the phasing relay PH operated. During the reception of seventeenth and eighteenth impulses, ground is applied from segment 9 of ring RR6 to conductor 248 to hold the phasing relay PH energized after the relay C4 released as the brush RB2 left segment 8 of this ring.

As impulses 18 to 32 are received, the relays RA1 to RA4, TP1 to TP4, UP1 to UP4 and FP2 to FP4 are operated in response to the marking impulses and remain unoperated in response to the spacing impulses received during this time. Without tracing the circuits in detail it will be apparent that since impulses 20, 22, 24, 25, 26, 29, 30, 31 and 32 are marking, relays RA3, TP1, TP3, TP4, UP1, UP4, FP2, FP3 and FP4 will be operated. Relay RA1 locks up through conductor 1 of cable 265 to the break contact and armature 267 of relay RA to ground. The relays TP1, TP3 and TP4 lock up through conductor 2 of cable 265 to the break contact and armature 268 of relay TUP, and by way of conductor 269 through the contacts of armatures 271 of relays RA1 to RA4.

The purpose of locking the tens price relays TP1 to TP4 through the break contacts and armatures 271 of the range relays RA1 to RA4 in the manner shown, as will appear more fully hereinafter, is to prevent the storage of a signal in the tens price relays whenever a "no-reset" signal is received. The no-reset signal comprises any range signal having the third impulse marking, except combinations of impulses 2, 3; 3, 4; or 3 alone marking. The no-reset signal indicates that the tens digit price of the quotation is not to be changed.

The units price relays UP1 to UP4 lock up over conductor 3 of cable 265 and break contact and armature 272 of relay TUP to ground, and the fractions relays FP2 to FP4 lock up through conductor 4 of cable 246 to the break contact and armature 280 of relay SNFP to ground.

During the time the range and price storage relays were being operated from ring RR2, brushes RB2 were passing over rings RR3 to RR6 to perform a number of additional functions. As the brush RB2 engaged segment 10 of ring RR6, relay TUP, Fig. 2—B, was thereby operated, and interrupted the locking circuits of any operated relays in groups TP1 to TP4 and UP1 to UP4, Figs. 2—B and 2—C respectively, to prepare them to receive the tens and units price signals. The operation of relay TUP also supplied ground through its armature 272 and make contact to the relay C2, Fig. 2—A, which on operating maintains the phasing relay PH in operation.

As the seventeenth, or last multiplex impulse was received, brush RB2 engaged segment 17 of ring RR3 and since this segment is dead, relay MT1 released, so that a spacing or start impulse was transmitted to the printer MP1. As the segments 18, 19, 20 and 21 of ring RR3 were crossed by brush B2, the units digit of the stock number was received by the monitor printer MP1. With the units stock number relays US1 and US4 operated, a marking impulse was supplied to the printer as segment 18 of ring RR3 was crossed by brush RB2, the circuit extending from the grounded ring RR5, brush RB2, segment 18 of ring RR3, conductor 9 of cable 249, armature 207 of relay US1, conductor 250, and thence

through the break contact and armature 251 of relay CH1, break contact and armature 243 of relay BS1 through the winding of the relay MT1 to battery. A similar circuit was completed as segment 21 of relay RR3 was crossed by brush RB2, through conductor 12 of cable 249 and armature 207 of relay US4, conductor 250 and thence to relay MT1. Relays US2 and US3 not having been operated, spacing signals were transmitted as segments 19 and 20 of ring RR3 were crossed. Since segments 22 and 23 are dead, spacing impulses were transmitted to the printer when these segments were crossed. Segment 24 is connected directly to the conductor 250 and hence as this segment was crossed, ground was supplied to the relay MT1 to transmit a rest impulse to the printer MP1, thus completing the operation of the printer in response to the signals for the units digit of the stock number.

As the brush RB2 engaged segment 11 of ring RR6, relay C5 was operated. This relay performs a number of functions, one of which is to maintain the phasing relay PH operated through grounded armature 274 and operated contact of relay C5, the circuit being completed over conductor 248. Also, the engagement of armatures 276 to 278 with their respective make contacts applied ground to conductors 1, 2, 3 and 4 of cable 279 to complete circuits through the operated armatures 206' and make contacts of relays HS1, HS2, TS1, TS3, US1, US4 and RA3, through conductors 1, 2, 5, 7, 9, 12 and 15 of cable 275 to the correspondingly numbered contacts of the multi-contact relay CT1, and thence to battery through the respective windings of the intermediate hundreds stock relays IHS1 and IHS2, the intermediate tens stock relays ITS1 and ITS2, the intermediate units stock relays IUS1 and IUS4, and the intermediate range relay IRA3, thereby causing the operation of these relays corresponding to the selecting impulses stored in the hundreds, tens and units stock number relays HS1 to US4 and the range relays RA1 to RA4.

Referring again to the receiving distributor RD, as the brush RB2 left segment 12 and engaged segment 13 of ring RR6, relay SNFP was operated applying ground through its armature 253 to conductor 243 thereby holding the phasing relay PH operated. The operation of relay SNFP also removed ground from conductors 1, 2, 3 and 4 of cable 246 thereby releasing all operated relays in groups HS1 to HS4, TS1 to TS4, US1 to US4 and FP2 to FP4, causing these relays to be conditioned to respond to succeeding signals. A circuit is also completed from grounded armature 241 of relay SNFP, conductor 4 of cable 264, contact 210 of the gang relay CT1, Fig. 2—D, and thence by conductor 2 of cable 284 to the rest segment R of ring TR4 of the channel 1 transmitting distributor TD1, through brush TB, segment 1 of ring TR1 to the winding of the start magnet RM1, conductor 3 of cable 284, contact 209 of the gang relay CT1, and by conductor 1 of cable 284 to the armature 242 and break contact of relay SW, and thence by conductor 4 of cable 285 through the make contact and armature 286 of relay IUS1, the corresponding make contact and armature 286 of relay ITS1, make contact and armature 286 of relay IHS1, conductor 287, make contact and armature 288 of relay IRA3, Fig. 2—E, break contact and armatures 289 and 291 of relays IRA2 and IRA1 respectively, and resistance 292 to grounded battery 293. The completion of this circuit energizes start magnet RM1 releasing brush TB of the channel 1 transmitting distributor which thereupon makes one revolution. The operation of the transmitting distributor TD1 will be subsequently described.

As the brush RB2 continued its movement, it next engaged segment 14 of ring RR6 thereby applying ground through this segment to conductor 248, and thence to the winding of the phasing relay PH to maintain the relay operated as relay SNFP released.

Brush RB2 next engaged segment 15 of ring RR6, causing the operation of relay C6. This relay at its armature 294 and make contact thereof operated relay C2 to maintain the phasing relay PH operated, its remaining armatures performing no function at this time.

As the brush RB2 came into contact with segment 16 of ring RR6, ground was again applied to conductor 243 and thence to the phasing relay PH to maintain this relay operated as relays C6 and C2 release. Brushes RB1 and RB2 then came to rest on the last or rest segments at which time segment 17 of ring RR6 is grounded through brush RB2 completing a circuit over conductor 295, make contact and armature 296 of relay PH, thence by armature 297 and break contact of relay CP, and armature 298 and break contact of relay CH2 through the winding of relay CH1 to battery, causing this latter relay to operate. In so operating it causes the connections of the relays MT1 and MT2 to be reversed relative to rings RR3 and RR4. It will be recalled that

Continuing the movement of brush RB2 as it advanced to segment 25 of ring RR3, a start impulse was transmitted to the monitor printer MP1 to start the receiving distributor preparatory to receiving the range selection, and as segments 26 to 29 of ring RR3 were engaged the range selection stored in the relays RA1 to RA4 was repeated to the monitor relay MT1 and thence to printer MP1 in the same manner as the stock selection stored in relays HS1 to HS4 were repeated to the monitor printer. As segment 30 of ring RR3 is crossed a fifth selecting impulse, which is spacing in character, is sent to the monitor printer, and as segment 31 of ring RR3 is crossed, a sixth selecting impulse, which is marking in character, is transmitted from the grounded ring RR5, brush RB2, segment 31 of ring RR3, conductor 283, break contact and

during the revolution of the receiving distributor just described, relay MT1 was connected to ring RR3 through armature 251 and break contact of relay CH1. Upon operation of relay CH1, however, armature 251 engages its make contact thereby connecting relay MT1 to conductor 299 which communicates, through the make contacts and lower armatures 207 of the tens, units and fractions price relays TP1 to FP4, with conductors 1 to 11 of cable 351 associated with ring RR4, so that during the next revolution of the receiving distributor the price stored in relays TP1 to FP4 will be distributed through ring RR4 to the monitor printer MP1. It should be noted that the conductor 299 also extends directly to segments 7, 8, 15, 16, 23, 24, and 27 to 30 of ring RR4 for the additional control required for the operation of the monitor printer at the time controlled by the ring RR4.

Monitor relay MT2, which controls channel 2 printer MP2, is controlled at this time by ring RR3, through armature 244 and make contact of relay CH1, conductor 250 which extends to the make contacts and lower armatures 207 of the stock number relays HS1 to US4 and range relays RA1 to RA4, and the segments 8, 16 and 24 of ring RR3, so that during the next revolution the stock number and range of the channel 2 quotation will be distributed by the relay MT2 for recording upon monitor printer MP2.

Operation of relay CH1 also completes a circuit for relay C7, Fig. 2—C, this circuit extending from grounded battery through the winding of relay C7, make contact and armature 302 of relay CH1, armature 303 and break contact of relay CP, and break contact and armature 304 of relay CH2 to ground.

Relay C7, upon operating, transfers the tens, units and fractions prices from relays TP1 to FP4 to the corresponding intermediate tens, units and fractions price relays ITP1 to ITP4, IUP1 to IUP4, and IFP2 to IFP4 over the following circuits:

In the example assumed, the tens price relays TP1, TP3 and TP4 were operated. The transfer circuit for these relays is completed from ground at the phasing relay PH, through armature and make contact of relay 254, armature of relay C7, conductor 1 of cable 305, armatures 206' and make contacts of relays TP1, TP3 and TP4, conductors 17, 19 and 20 of cable 275, and through the correspondingly numbered contacts of gang relays CT1, and the windings of the intermediate tens price relays ITP1, ITP3 and ITP4 to battery.

Unit price relays UP1 and UP4 were operated in the example assumed, and the transfer circuit for these relays was also completed from ground at the phasing relay PH, through an operated armature of relay C7, conductor 2 of cable 305, armatures 206' and make contacts of relays UP1 and UP4, conductors 21 and 24 of cable 275, and through the correspondingly numbered contacts of gang relay CT1 and the windings of the intermediate units price relays IUP1 and IUP4 to battery. A similar circuit is completed through the third armature of relay C7 and conductor 3 of cable 305, armatures 206' of the fractions price relays FP2, FP3 and FP4, conductors 25, 26 and 27, through correspondingly numbered contacts of relay CT1, and the windings of the intermediate fractions price relays IFP2, IFP3 and IFP4 to battery.

The intermediate tens price relays ITP1, ITP3 and ITP4 lock up through a break contact and armature 306 of relay RL5, and in a similar

manner the intermediate units price relays IUP1 and IUP4 lock up to a break contact and armature 307 of relay RL5, and the intermediate fractions relays IFP2, IFP3 and IFP4 lock through a break contact and armature 308 of relay RL5.

It will be noted that at the end of the first revolution of the receiving distributor the stock number, range and price signals of the channel 1 quotation stored on the relays HS1 to US4 and RA1 to FP4 have been transferred to the intermediate storage relays IHS1 to IFP4, and also that the stock number and range of the channel 1 quotation have been recorded upon monitor printer MP1, and the connections of the monitor printers MP1 and MP2 reversed relative to the rings RR3 and RR4.

It will be recalled that the transmitting distributor at the central station stops only at the end of a channel 2 quotation. Consequently, the brushes RB1 and RB2 of the receiving distributor RD remain at rest at the completion of their first revolution only momentarily, the stopping time of these brushes, including the time required for them to pass over their rest segments, being substantially equal to the time that the brush arm B1 of the transmitter TD, Figs. 1—A and 1—B, takes in passing over any one of the transmitting segments of ring R2. Consequently, the phasing relay PH does not release at this time due to its slow-to-release action. However, in order to insure that the receiving brushes will arrive at their rest segments before the transmitting distributor has completed its revolution, the receiving brushes are geared to rotate slightly faster, for example, 2% faster, than the transmitting brushes. This permits the receiving distributor brush arm to return to its starting position and have a stop time equivalent to 2% of the time of one revolution before the next start signal is received. In this arrangement, a slight difference in speed of either the transmitting or receiving distributors will cause the receiving distributor arm to come to rest for a shorter period of time if the receiving distributor is slightly slower than the transmitting distributor, or a longer period if the receiving distributor is faster. This stop period of the receiving distributor brushes permits the receiving distributor arm to always maintain its proper phase relation with the transmitting distributor arm. Therefore any error in the phase relation of the brushes of the transmitting and receiving distributors while passing over corresponding segments is corrected at the end of each revolution of the distributors.

As the start impulse of the second channel quotation is received, brushes RB1 and RB2 are released for a second revolution. As brush RB2 leaves segment 17 of ring RR6, relay CP, Fig. 2—C, is operated due to the fact that ground at segment 17 is removed from the winding of relay CH1, causing locking ground to be applied to this relay through its armature 309 and make contact, winding of relay CP, armature 311 and break contact of relay CH2, and the armature 312 and make contact of relay PH to ground. Relay CH1 thus remains operated for the next revolution. The operation of relay CP, however, interrupts at its armature 303 the circuit to relay C7, causing relay C7 to release thereby interrupting the transfer circuits for the tens, units and fractions price relays TP1 to FP4.

The receiving distributor RD now makes its second revolution during which time the channel 2 quotation is being received. It will be recalled,

however, that during the reception of a channel 1 quotation as segment 13 of ring RR6 was crossed relay SNFP was operated to release brush TB of the channel 1 transmitting distributor TDI shown in Fig. 2—G. Therefore, before describing the operation of the receiving distributor RD to respond to the channel 2 quotation the circuits completed by rotation of the brushes TB of the channel 1 transmitting distributor TDI will be described.

The intermediate storage relays shown in Figs. 2—D, 2—E and 2—F are employed in conjunction with the transmitting distributor TDI of Fig. 2—G to convert the permutation code signals received over line L into step-by-step impulses. As hereinbefore stated, these impulses are transmitted alternately over two pairs of conductors (the two conductors R1 and R3 comprising one pair and the conductors R2 and R4 comprising the other pair) either directly to a subscriber's office or to a repeater station as shown in Fig. 3, from which they are repeated to the various subscribers' offices. Since the signals applied to conductors R1 and R3 of the first pair are the same, reference will be made only to the conductor R1 of the pair in the following description. Similarly, the signals applied to the conductors R2 and R4 of the second pair are the same, and therefore reference will be made only to the conductor R2 of this pair. The step-by-step signals are arranged in four channels, as is customary in the operation of subscribers' boards of the type herein described. For convenience, these channels are termed the A, B, C and D channels. The channel A signals comprise positive impulses transmitted over conductor R1, and the B channel signals comprise negative impulses transmitted over this conductor; the C channel signals comprise positive impulses transmitted over conductor R2, and the D channel signals comprise negative impulses transmitted over this latter conductor.

A typical set of signals, and the time relation therebetween, transmitted during a cycle of operations comprising consecutive revolutions of the distributor TDI is shown in Fig. 6. By reference to this figure it will be noted that upon the first half revolution of the distributor TDI, nine timing impulses followed by a switching impulse, are sent out over channel A and concurrently therewith the hundreds digit of the stock number is sent over the C channel, the tens digit of the stock number is sent over the B channel, and the units digit of the stock number is sent over the D channel. During the second half revolution of distributor TDI, the range signal for this stock number is transmitted over channel A. Since this is the first revolution in the cycle of operations of the distributor TDI, no price signals are transmitted over channels B, C and D during this revolution, although a release signal is sent over channel D at this time for a purpose hereinafter explained. During the first half of the second revolution of distributor TDI, ten restoration and timing impulses for the selected stock number, followed by a switching impulse, are transmitted over channel A, and the stock number of a subsequent quotation is transmitted over channels C, B and D. During the last half of the second revolution the range of the subsequent quotation is transmitted over channel A, while the tens, units and fractions of the price of the previously selected stock are sent over channels C, B and D, respectively, followed by a release signal over channel D.

More specifically, Fig. 6 shows three successive quotations transmitted on channel 1 characterized, in the examples given, as follows:

The first quotation is a unison price of 98 $\frac{3}{4}$ for the stock 123. The second quotation is a low price of 54 $\frac{3}{4}$ for the stock 647, and the third quotation is a last price of 34 $\frac{3}{4}$ for the stock 235. The relay designations P1, P2, P3, and P4 to the left of Fig. 6 represent the correspondingly designated polar relays of the selector equipment shown in Fig. 4—A of which relays P1 and P3 are connected in series and respond to positive and negative impulses respectively corresponding to signals on channels A and B respectively, and relays P2 and P4 are connected in series and respond to positive and negative impulses respectively corresponding to channel C and channel D signals.

It will be seen from Fig. 6 that two complete revolutions of the transmitting distributor are required for each quotation, but due to the overlap arrangement shown thereon, one quotation is completed with each revolution of the distributor, with the exception of the first revolution. The transmitted signals over the line L corresponding to the first quotation shown in Fig. 6 are shown in Fig. 5, together with the multiplex signal (Y). In accordance with the code employed, Fig. 7, the hundreds digit 1 of the stock number has segments 1 and 2 marking, the tens digit 2 of the stock number has 1 and 3 marking, the units digit 3 of the stock number has 1 and 4 marking, the multiplex character (Y) has 1, 3 and 5 marking, the range (unison) has segment 3 marking, the tens digit 9 of the price has 1, 3 and 4 marking, the units digit 8 of the price has 1 and 4 marking, and the fraction ($\frac{3}{4}$) of the price has the 2, 3 and 4 marking. All other portions of the code on Fig. 5 are spacing in character. The received channel 1 quotation shown on Fig. 5 is retransmitted as shown in Fig. 6, it being understood that the next succeeding quotation over the line L will be a channel 2 quotation which will be transmitted over the channel 2 transmitting distributor in a manner similar to the transmission of a channel 1 quotation over the channel 1 distributor TDI. The receiving distributor RD in Figs. 2—A to 2—C therefore makes the same number of revolutions as the combined revolutions of transmitting distributor TDI of channel 1 and the transmitting distributor of channel 2 during the time that quotations are sent over both channels.

Referring to Fig. 7 the code employed for selection of the stock is shown as a different code from that employed for the various units of the stock price, although it will be understood that the same code for both may be used without departing from the spirit of the invention. The code for the range signals Fig. 7 employs all possible combinations of a four-unit code, with the exceptions of the all-spacing signal. It should be noted that one characteristic of this code used for range selection is the omission of a resetting operation to the indicator corresponding to the tens digit of the price as determined by a marking condition applied to the third unit of this code, for example, a last quotation involving resetting of the indicators corresponding to the tens, units and fractions characteristics of the stock price requires a range code having units 1 and 4 marking, the other two units being spacing, whereas a last quotation involving a change in the indicators of the units and fractions price only requires a range code of not only units 1

and 4 of the code to have a marking characteristic, but also the unit 3 of the code to be marking, the remaining unit being spacing in character. Other characteristics of the code employed for range selection will appear as the description proceeds.

For simplicity of description, however, it will be assumed that only the signals for stock number 123 are being transmitted over channels C, B and D respectively.

It will be recalled that at the time the brush TB of the channel I transmitting distributor TD1 was released, the channel I quotation stock number and range signals had been transferred to the intermediate storage relays, the following of these relays being operated, namely IHS1, IHS2; ITS1, ITS3; IUS1, IUS4 and IRA3. As brush TB is released it passes over segments 2 and 3 of TR1 causing the operation of relay RL5, Fig. 2-E, for releasing any of the intermediate price relays which may have been locked up. As brush TB engages segments 4, three circuits are completed; the first extends from grounded ring TR4, brush TB, segment 4 of ring TR1 to relay RL2, operating the same. This relay upon operating completes a circuit from ground at the make contact of armature 313 of relay RL2, winding of relay SW, conductor 4 of cable 285, make contact and armature 286 of relay IUS1, corresponding make contact and armature 286 of relay ITS1, and make contact and armature 286 of relay IHS1, thence by conductor 287 to the make contact and armature 288 of relay IRA3, the break contacts and armatures 289 and 291 of relays IRA2 and IRA1 in series, and through resistance 292 to battery 293. Relay SW operates over this circuit, locking up through its armature 314 to the make before break contact 215 of relay RL2 as this latter relay releases by passage of brush TB off of segment 4 of ring TR1.

The second circuit completed by engagement of brush TB with segment 4 extends from the grounded segment 4 (TS) of ring TR2, conductor 7 of cable 316, break contact and armature 230 of the tens stock cut-off relay TSC to transmitting relay S3, operating the relay S3 to apply negative battery to the line R1. This is the first impulse of the tens digit of the stock number and is transmitted over channel B.

Concurrently with this operation, a circuit is established from grounded brush TB, segment 4 (US) of ring TR3, conductor 3 of cable 316, break contact and armature 233 of the units stock cut-off relay USC to relay S4, operating the latter to transmit a negative impulse over line R2. This is the first impulse of the units digit of the stock number and is transmitted over channel D.

Brush TB now passes on to segments 5 completing the following circuits: (1) From ground through segment 5 (RES) of ring TR2, over conductor 5 of cable 316 and directly to the winding of the transmitting relay S1 to operate this relay and send a positive pulse over conductor R1. This is the first restoration or timing impulse, and is transmitted over channel A. (2) From ground through segment 5 (HS) of ring TR3, over conductor 6 of cable 316, break contact and armature 235 of the hundreds stock cut-off relay HSC to the winding of transmitting relay S2, sending a positive impulse over conductor R2. This is the first impulse of the hundreds digit of the stock number and is transmitted over channel C. No circuits are completed from segment 5 of ring TR1 at this time.

As brush TB passes over each of the odd-numbered segments from 5 to 23, inclusive, of ring

TR2, relay S1 will be operated to send a positive impulse over channel A, making a total of ten impulses invariably transmitted over this channel during the first half revolution of the transmitter TD1. These timing or restoration impulses operate certain counting mechanism at the receiving apparatus in a subscriber's office, as will subsequently appear.

Assuming brush TB to move now into engagement with segment 6 of the various transmitting rings, the following circuits are completed: (1) From grounded segment 6 of ring TR2, over conductor 7 of cable 316, and break contact and armature 230 of relay TSC to operate relay S3 to send out the second negative impulse over conductor R1 (channel B), this being the second impulse of the tens digit of the stock number. (2) From segment 6 of ring TR3, conductor 8 of cable 316, break contact and armature 233 of relay USC to transmitting relay S4 to transmit the second negative impulse over conductor R2, this being the second impulse of the units digit of the stock number. (3) From segment 6 of ring TR1, conductor 1 of cable 220, make contact and armature 317 of relay IHS2, make contact and armature 221 of relay IHS1, and conductor 1 of cable 285 to the armature 318 and break contact of the tens price cut-off relay TPC to the winding of the hundreds stock cut-off relay HSC to operate the latter relay. This relay upon operating opens the connection between the winding of transmitting relay S2 and conductor 6 of cable 316, thereby interrupting the circuit from the odd-numbered segments 5 to 19 of ring TR3, so that as the brushes cross over the remaining ones of these segments, transmitting relay S2 remains unoperated and no further impulses of the hundreds digit of the stock number will be transmitted. As the brush continues its movement over odd-numbered segment 21 (SR) of ring TR3, the relay S2 remains unoperated because the operating circuit thereof is open at the unoperated armature 667 of relay SR, Fig. 2-B.

Relay HSC locks up through its armature 319 and make contact, break contact and armature 321 of relay TPC, and thence by conductor 2 of cable 322 and break contact and armature 308 of relay RL5 to ground.

Brush TB now passes on to segments 7, at which time relays S3 and S4 release and S1 is operated from segment 7 of ring TR2, sending the second timing or restoration impulse over channel A. Relay S2 is not operated by segment 7 of ring TR3 due to the opening of the control circuit at the armature 235 of operated relay HSC. A circuit is established from grounded segment 7 of ring TR1, through conductor 2 of cable 221', make contact and armature 323 of relay ITS3, break contact and armature 324 of relay ITS2, make contact and armature 222 of relay ITS1, and thence by conductor 2 of cable 285 and armature 325 and break contact of relay UPC to the winding of the tens stock number cut-off relay TSC which operates. This relay locks up through its armature 326 and make contact, break contact and armature 327 of relay UPC, and thence by conductor 2 of cable 322 to the break contact and armature 308 of relay RL5 to ground. Relay TSC upon operating interrupts the control circuit for transmitting relay S3 so that no further impulses will be transmitted therefrom as the brush RB continues to cross the even-numbered segments 4 to 22 of ring TR2.

Brush TB now passes on to segments 8, at

which time relay S1 releases and relay S4 operates from grounded segment 8 of ring TR3, conductor 8 of cable 316, break contact and armature 233 of the units stock cut-off relay USC to the winding of transmitting relay S4 which operates to send a negative impulse over channel D. This is the third impulse of the units digit of the stock number.

As the brush TB now passes on to segments 9, relay S4 releases and relay S1 operates from segment 9 of ring TR2 to send out the third impulse of the timing and restoration group of pulses. A circuit is completed at this time from grounded segment 9 of ring TR1, through conductor 3 of cable 221', and the make contact and armature 328 of relay IUS4, break contact and armature 329 of relay IUS3, break contact and armature 331 of relay IUS2, make contact and armature 223 of relay IUS1, conductor 3 of cable 225, and thence through armature 332 and break contact of relay FPC to the winding of the units stock number cut-off relay USC which upon operating locks through its armature 333, and the break contact and armature 334 of relay FPC and thence by conductor 2 of cable 322 to the break contact and armature 308 of release relay RL5.

Relay USC upon operating interrupts the control circuit for transmitting relay S4 so that no further impulses are transmitted from the even-numbered segments 4 to 22 of ring TR3 as they are crossed by the brush TB.

It will be noted that up to this point of the circuit description one impulse was sent out by relay S2 before this transmitting relay was cut off, corresponding to the hundreds digit 1 of the stock number, two impulses were transmitted by relay S3 corresponding to the tens digit 2 of the stock number, and three impulses were sent out by relay S4 corresponding to the units digit 3 of the stock number. No further impulses are transmitted by any of these three relays until the brushes TB of the transmitting distributor have completed the first half of their revolution or until after segment 23 of the various transmitting rings has been crossed. As stated, however, the relay S1 continues to operate as each odd-numbered segment of ring TR2 is crossed until ten impulses have been transmitted thereby.

As brush TB crosses segment 23, a circuit is completed from segment 23 of ring TR1 over conductor 7 of cable 335 to the break contact and armature 336 of relay UP8, break contact and armature 337 of relay UP7, break contact and armature 226 of relay UP6, and thence by conductor 5 of cable 335 to the winding of the units price cut-off relay UPC to cause operation of the latter relay. A similar circuit is also completed from segment 23 of ring TR1, conductor 7 of cable 335, break contact and armature 338 of relay FP8, break contact and armature 339 of relay FP7, break contact and armature 229 of relay FP6, and thence by conductor 6 of cable 335 to the winding of the fractions price cut-off relay FPC to operate the latter relay. The relays UPC and FPC upon operating interrupt the locking circuits for the tens stock number cut-off relay TSC and the units stock number cut-off relay USC which release.

In the foregoing example, the operation of relays UPC and FPC was contingent upon there being no combination set up in the intermediate units price relays IUP1 to IUP4 nor in the intermediate fractions price relays IFP2 to IFP4. Had the units and fractions of the price of a quotation been stored in the relays IUP1 to IUP4 and

IFP2 to IFP4, the circuit to the cut-off relays UPC and FPC would not have been completed at that time. The operation of transmitter TDI when a price is stored in relays ITP1 to ITP4, IUP1 to IUP4, and IFP2 to IFP4 will be described with reference to the second revolution of the distributor TDI at which time the price of stock number 987 will be stored in these relays. For the second half of the first revolution of the distributor TDI, however, it is assumed that none of these intermediate price storage relays are operated.

As brush TB begins the second half of its revolution by passing on to segment 24 (UP) of ring TR2, the circuit normally established from this segment, over conductor 3 of cable 316, armature 231 and break contact of the UPC relay, and make contact and armature 230 of the TSC relay, to transmitting relay S3 is open at the armature 230 of relay TSC which was just released through the operation of relay UPC. Also, the circuit normally established, from segment 24 (FP) of ring TR3 to the transmitting relay S4, is open at the armature 233 of relay USC just released by the operation of the relay FPC.

A circuit is established, however, from segment 24 of ring TR1 over conductor NR of cable 224, break contact and armature 341 of relay TP8, break contact and armature 342 of relay TP7, break contact and armature 226 of relay TP6, and thence by conductor 3 of cable 335 to the winding of the tens price cut-off relay TPC. This relay is operated, and at its armature 321 interrupts the locking circuit for the hundreds stock number cut-off relay HSC causing this latter relay to release. As the brushes TB now pass on to segment 25 the circuit normally established from the segment (TP) of ring TR3 to transmitting relay S2 is opened at armature 235 of the hundreds stock number cut-off relay HSC which was just released by the operation of relay TPC. A circuit is established from segment 25 (RA) of ring TR2, over conductor 1 of cable 316 to the armature 232 and break contact of relay RAC, and thence to the winding of the transmitting relay S1 which operates and sends out a positive pulse over conductor R1. This pulse is the first range impulse of the stock number 123 transmitted on channel A.

As brushes TB continue to cross the even-numbered segments of rings TR2 and TR3 and the odd-numbered segments of ring TR3 none of the transmitting relays S2, S3 or S4 operate since their circuits are open, as previously stated, at the armatures of HSC, TSC and USC respectively.

As odd-numbered segments 27, 29, 31, 33, 35 and 37 of ring TR2 are crossed, however, transmitting relay S1 will operate sending a series of six additional range impulses over conductor R1.

As brush TB engages segment 38 of ring TR1, a circuit is completed from ground at ring TR4, brush TB, segment 38, conductor 7 of cable 224, break contact and armature 343 of relay IRA4, make contact and armature 344 of relay IRA3, and the break contacts and armatures 345 and 225 of relays IRA2 and IRA1 respectively, to conductor 1 of cable 335 and thence to the winding of the range cut-off relay RAC. This relay upon operating locks up over its armature 345, conductor 2 of cable 322, and break contact and armature 308 of relay RL5 to ground.

The operation of relay RAC at its armature 332 interrupts the control circuit for the transmitting relay S1 and consequently no additional

range impulses are transmitted as odd-numbered segments 39 and 41 of ring TR2 are crossed.

It will be noted that during this second half revolution, seven range impulses were transmitted for stock number 123 by relay S1 over conductor R1, these impulses representing channel A signals, and that no impulses were transmitted over channels B, C and D.

As brushes TB engage segment 43 of ring TR1, ground at this segment is connected over conductor 1 of cable 322 to the winding of release relay RL4, causing this relay to operate and at its armature 216 interrupting a locking circuit for the intermediate range relay IRA3 which was the only one of this group operated at the time. At its remaining armatures, relay RL4 opens the locking circuits to the tens price relays TP5 to TP8 and units price relays UP5 to UP8 and fractions price relays FP6 to FP8. However, it is assumed that since none of these latter relays are operated at this time, none of them were locked up.

As brushes TB now pass on to segments 45, three circuits are completed; the first circuit is completed from segment 45 of ring TR1, by way of conductor 4 of cable 335, make contact and armatures 238 of tens price relays ITP1, ITP3, and ITP4 (which were operated as the receiving distributor RD completed its first revolution) and thence through windings of relays TP5, TP7 and TP8 to operate the latter group of relays, thereby transferring the signals stored in the former group of relays to the latter group. Relays TP5, TP7 and TP8 lock up through their armatures 217 and break contact and armature 346 of relay RL4 to ground. The second circuit is completed from segment 45 of ring TR3, over conductor 4 of cable 322, to the make contacts and armatures 347 of the operated fractions relays IFP2, IFP3 and IFP4 to the windings of relays FP6, FP7, and FP8 respectively. These latter relays lock up over their armatures 219 to ground at the break contact and armature 348 of relay RL4. The third circuit is completed from ground on the last segment RLS of ring TR2, conductor 8 of cable 316, through the break contact and armature 233 of relay USC to the winding of transmitting relay S4 which operates and sends out a pulse of a negative polarity over line R2, the purpose of which will be explained hereinafter.

It will be noted at this point that the signals for the tens, units and fractions price of the stock number 123 which were stored in intermediate relays ITP1 to ITP4, IUP1 to IUP4 and IFP2 to IFP4 are transferred to their corresponding transmitting relays.

Brush TB now passes on to segment 46 of ring TR1 and in so doing completes a circuit from this segment over conductor 349 to the winding of release relay RL5, thereby operating this relay and interrupting the locking circuits of the operated relays of groups ITP1 to ITP4, IUP1 to IUP4 and IFP2 to IFP4, thereby reconditioning these relays to receive the price of the succeeding quotation. The operation of relay RL5 also interrupts the locking circuit for the range cut-off relay RAC permitting this relay to release.

Brushes TB now come to rest on segments 1 of the transmitting distributor TD1. As previously explained, this brush operates at approximately half the speed of the brushes RB1 and RB2 of the receiving distributor RD, and consequently at the time the brushes TB come to rest at the end of the first revolution brushes RB1 and RB2 of the receiving distributor will have completed their second revolution to receive the channel 2

quotation and a part of the third revolution corresponding to another channel 1 quotation. Therefore, before continuing the description of the operation of the channel 1 transmitting distributor TD1 during its second revolution, the operation of the receiving distributor RD as it makes its second revolution will be described.

During the second revolution of the receiving distributor RD the associated equipment operates in generally the same manner as during the first revolution excepting that the connections for the monitor printer relays MT1 and MT2 are reversed. The channel 2 quotation received during this second revolution of distributor RD is transferred through the contacts of the gang relay CT2 to an individual set of intermediate storage relays, cut-off relays, transmitting relays and transmitting distributor, preferably identical to the apparatus shown in Figures 2D to 2G.

As the brush RB1 makes its second revolution or channel 2 rotation, the stock number, range and price of the channel 2 quotation are set up on relays HS1 to US4 and RA1 to FP4 in the same manner as was the channel 1 quotation, and a multiplex character is set upon the relays MX1 to MX5 for transmission to multiplex printer MXP in the same manner as before. Therefore, the description of this phase of the operation will not be repeated.

The hundreds, tens and units digits of the stock number of the channel 2 quotation and the range signal are also set up on the segments of ring RR3 and repeated therefrom to the monitor ticker relay MT2 in the same manner as were the corresponding signals of the channel 1 quotation repeated to the channel 1 printer by relay MT1 from this same ring during the first revolution.

At the start of the second revolution of the distributor RD the price of the channel 1 quotation is still stored in the price storage relays TP1 to FP4, and is set up thereby on to the segments of ring RR4 for transmission to the monitor printer MP1. The operation of this printer to record the price of the channel 1 quotation will be explained in detail as well as the special functions accomplished by the local ring RR6 during the second revolution of the brushes RB2.

Since there is no interrelation between the functions performed by the segments of rings RR4 and RR6, the complete passage of brush RB2 over ring RR4 will be described before reference is made to its passage across ring RR6.

As the brush RB2 leaves the thirty-third or rest segment of ring RR3 at the end of its first revolution and moves on to segment 1 of the same ring at the beginning of the second revolution, the ground supplied from solid ring RR5, through brush RB2 and segment 33 of ring RR3, break contact and armature 243 of relay BS1, to the winding of the monitor printer relay MT1, is interrupted causing this relay to release and apply a spacing or start condition to the selecting magnet SR1 of the channel 1 printer MP1. This start impulse corresponds in duration to the time of passage of brush RB2 over segment 1 of ring RR4. As segment 2 of ring RR4 is crossed, the first selecting condition is applied to the printer MP1. Since segment 2 is dead, this selecting condition will be a spacing impulse since relay MT1 is not operated. As segment 3 of ring RR4 is crossed, the first of the received selecting impulses of the tens digit of the price is transmitted to the printer MP1 over a circuit starting at grounded segment 3 of ring RR4, conductor 1 of cable 351, armature 207 and make contact of

the tens price relay TP1, conductor 299 to the make contact and armature 251 of relay CH1, and thence by the break contact and armature 243 of relay BS1 to the winding of relay MT1, causing the latter relay to operate and thereby send a marking impulse to the monitor printer MP1. As segment 4 of ring RR4 is crossed, a spacing impulse is supplied to the printer since the circuit to relay MT1 is open at the armature 207 of the tens price relay TP2 which is not operated. Relays TP3 and TP4 which were both operated during the first revolution have remained operated, and consequently as segments 5 and 6 of ring RR4 are crossed, marking impulses are supplied to the relay MT1 and thence to the monitor printer MP1. As segment 7 is crossed, the sixth selecting impulse for the monitor printer is filled in, this impulse being marking since grounded segment 7 is connected by means of conductors 352 and 299, through make contact and armature 251 of relay CH1, and break contact and armature 243 of relay BS1 to the winding of relay MT1. This sixth impulse (marking) is a shift impulse and causes the price to be printed in the lower position on the tape. Segment 8 is also connected to conductor 352 thereby supplying a final or rest impulse for the monitor ticker MP1.

As brush RB2 next passes over the group of segments 9 to 16 (which are connected in the same manner as segments 1 to 8), the units price digit is transmitted to the printer MP1, the first and sixth impulses of the units price digit being filled in to make a six unit code, and the second, third, fourth and fifth impulses being controlled through conductors 5, 6, 7 and 8 of cable 351, and the armatures 207 of the units price relays UP1, UP2, UP3 and UP4 respectively. Since, in the example given, relays UP1 and UP4 are the only ones of this group operated, marking impulses will be supplied as segments 11 and 14 of ring RR4 are crossed.

The fractions digit of the price is repeated to the monitor printer MP1 as segments 17 to 24 are crossed; segment 17 supplies the start impulse; segments 18 and 19 supply the first two selecting impulses which are spacing in character; segments 20, 21 and 22 repeat the combination set up in the fractions price relays FP2, FP3 and FP4, all of which in the example given are operated and therefore produce marking impulses; segment 23 supplies a marking (shift) impulse; and segment 24 supplies a marking (rest) impulse to conductor 352 and thence over a previously traced circuit to the monitor relay MT1. The remaining segments 25 to 32 serve to control the printing of a character indicating a rewrite signal, the purpose of which will be hereinafter explained. When this signal is received, segment 26 of ring RR4 is connected to conductor 352 thereby transmitting a marking impulse from this segment to the monitor printer. The circuit is traced from ground at segment 26, conductor 3 of cable 353 to the armature 354 and break contact of relay SR, conductor 2 of cable 353, conductors 352 and 299, operated contact and armature 251 of relay CH1, and break contact and armature 243 of relay BS1 to the winding of the monitor relay MT1.

The circuit for the operation of the selective rewrite relay SR, Fig. 2—B, is traced from battery through the winding of the SR relay, conductor 4 of cable 353, break contact and armature 664 of relay MX5, operated contact and

armature of relay MX4, break contacts and armatures of relays MX1 to MX3 in series, conductor 1 of cable 353 to ground at operated armature 355 of relay C1. Thus, when a signal is received over segments 13 to 17 of ring RR2 having the fourth unit of the MUX code marking in character and the other units of the code spacing, relays MX1 to MX3 and relay MX5 will not be operated and relay MX4 will be operated, thereby conditioning the previously traced circuit for operation of relay SR when relay C1 operates as brush RB2 comes into contact with segment 1 of ring RR6. Relay SR locks over its operated armature 356, conductor 357, to ground at the break contact and armature 294 of relay C6. Assuming that the SR relay is not operated at this time, marking impulses are transmitted to the printer control relay MT1 from segments 26, 27, 28, 29 and 30 of ring RR4, and also from segments 31, 32 and 33 of ring RR3, the impulse from segment 32 causing the printer to come to rest, and the impulse from segment 33 causing the printer to remain at rest. It will be apparent, therefore, that as brush RB2 crosses ring RR4, the price of the channel 1 quotation is repeated to the channel 1 printer MP1.

The functions performed as brush RB2 engages ring RR5 and the various segments of ring RR6 during its second revolution will now be described. As the brush RB2 crosses the segments of ring RR6, the phasing relay is held energized by the successive operations of relays C1, C2, RA, C3, C4, TUP, C5, SNFP and C6. The operation of relay RA also interrupts at its armature 267 the locking circuit of the operated range relays RA1 to RA4, thereby releasing any of these relays which were operated for the channel 1 range selection and preparing them to respond to signals corresponding to the range selection of the channel 2 quotation. It also interrupts the locking circuit of the channel 1 gang relay CT1, Fig. 2—D, at the break contact of armature 256.

As segment 6 of ring RR6 is engaged, the channel 2 relay CT2 is energized over a circuit from grounded segment 6, conductor 2 of cable 259, armature 211 and make contact of relay CH1, and conductor 2 of cable 264 to the winding of relay CH2. This relay operates and locks up over its contact 358, conductor 3 of cable 264, break contact and armature 256 of relay R8, conductor 255, armature 254 of relay PH, and thence through its make contact to ground.

As segment 10 of ring RR6 is engaged, relay TUP operates to interrupt the locking circuits of the tens and units price relays TP1 to TP4 to release the tens and units digit signals of the price of the channel 1 quotations stored therein. It will be noted that this occurs after the tens and units digit signals of the channel 1 quotation have been repeated to the monitor printer MP1 by passage of brushes RB2 over segments 1 to 16 of ring RR4. As the brush RB2 comes into contact with segment 11 of ring RR6, relay C5 operates and closes its armature 361, thereby grounding conductor 362 and causing the printing of the second multiplex character which was received with the channel 2 quotation of printer MXP. Relay C5 also controls through its armatures 275 to 278 inclusive the transfer of the stock number and range selection of the channel 2 quotation set up in storage relays HS1 to US4 and RA1 to RA4 through the contacts of the channel 2 gang relay CT2 to the channel 2 intermediate storage relays not shown but corre-

sponding to relays IHS1 to IRA4 of Figures 2—D and 2—E.

As the relay SNFP operates, the locking circuit for the hundreds, tens and units stock number relays HS1 to US4 are interrupted, thereby releasing therefrom the stock number of the channel 2 quotation. Also, the locking circuit of the fractions price relays FP2 to FP4 is interrupted to release therefrom the fractions portion of the price of the channel 1 quotation. This occurs, as will be noted, just after the fractions price has been repeated from segments 17 to 24 of ring RR4 to monitor printer MP1, and before the fractions digit of the channel 2 quotation is received on segments 30, 31 and 32 of ring RR2. Relay SNFP also completes the circuit to the start magnet of the channel 2 transmitting distributor, not shown but corresponding to distributor TD1. This release circuit extends from grounded armature 241 of relay SNFP, conductor 4 of cable 264, and through contact 210' of gang relay CT2, and thence by a circuit similar to that associated with the start magnet of distributor TD1. The channel 2 transmitting distributor thereupon is started upon its first revolution during which time it transmits the same information relative to the channel 2 quotation that the distributor TD1 transmitted during its first revolution relative to the channel 1 quotation.

As segment 17 of ring RR6 is reached, relay CH2 operates over a circuit extended from grounded segment 17, conductor 295, make contact and armature 296 of relay PH, armature 297 and make contact of relay of CP to the winding of relay CH2. On operating, this relay locks from grounded segment 17, conductor 295, operated contact and armature 296 of relay PH to the contact and operated armature 363 of relay CH2, thence to the winding thereof. Upon operation of relay CH2, its armature 311 breaks from its back contact interrupting the locking circuit of relays CP and CH1 which thereupon release. The release of relay CH1 again reverses the circuits to the monitor printer relays MT1 and MT2 relative to rings RR3 and RR4 so that during the succeeding or third revolution of the receiving distributor RD, the price of the channel 2 quotation is distributed from ring RR4 to monitor printer MP2, and the stock number and range of the second quotation on channel 1 is transmitted to the monitor printer MP1.

Relay C1 is also operated at this time over a circuit extending from the grounded armature 304 and make contact of relay CH2 directly to the winding of relay C1. This relay upon operating transfers the price signals from relays TP1 to FP4 to the channel 2 intermediate storage relays, not shown but corresponding to relays ITP1 to IFP4 of Figures 2—E and 2—F.

As the brush passes off of its rest segment 17 of ring RR6, relay CH2 is released, in turn causing relay C1 to release. During this third revolution of the receiving distributor the second channel 1 quotation is received. As brush RB2 reaches segment 13 of ring RR6 during this third revolution, relay SNFP again operates to complete the circuit for the start magnet RM1 of the channel 1 transmitting distributor TD1, this circuit being the same as previously traced during the first revolution of the receiving distributor brushes. The brush TB of the channel 1 transmitting distributor TD1 thereupon makes its second revolution during the first half of which the restoration pulses of the first channel

1 quotation and the stock number of the second channel 1 quotation are transmitted over conductors R1 and R2. During the second half revolution of distributor TD1, the range of the second channel 1 quotation and the price of the first channel 1 quotation are transmitted over these conductors. This second revolution of TD1 will now be traced.

At the time the brushes TB are released for the second revolution it should be remembered that the stock number and range signals of the second channel 1 quotation (third quotation received on distributor RD) are stored in the intermediate storage relays IHS1 to IRA4, and the price signals for the first channel 1 quotation (stock number 123) are stored in relays TP5 to FP8, the price signals for the first channel 1 quotation having been transferred to these latter relays from intermediate price storage relays ITP1 to IFP4 as brushes TB crossed segments 45 during the first revolution. In the example assumed, the operated relays of the price group are TP5, TP7, TP8, UP5, UP8, FP6, FP7 and FP8. Relays ITP1 to ITP4 were released as brush TB crossed segment 46 of ring TR1, thus preparing these relays to receive and store the price of the second channel 1 quotation as brushes RB1 and RB2 of the receiving distributor RD complete their third revolution.

As brush TB moves from its rest position on to segment 2 a circuit is established from grounded segment SW of ring TR2, armature 239 and make contact of relay SW (operated and locked up during the first revolution) to the winding of the transmitting relay S1. Relay S1 operates to transmit, over conductor R1, a positive switching impulse which operates as the first restoration impulse for the indicators of the previously selected stock. The other purposes of this switching impulse will appear in the subsequent description of the receiving apparatus of the board mechanism which is located at the subscriber's station.

From this point on the operation of distributor TD during its second revolution is similar to its operation during its first revolution. As odd-numbered segments 5 (RES) to 23 of ring TR2 are crossed the relay S1 operates to send, over conductor R1, ten timing impulses, nine of which function also as restoration impulses for the first channel 1 quotation, and as the even numbered segments 4 (TS) to 22 of ring TR2 are crossed relay S3 operates to send the impulses representative of the tens digit of the stock number of the second channel 1 quotation over conductor R1.

As segments 4 (US) to 22 of ring TR3 are crossed the units and hundreds digits of the second channel 1 quotation stock number are alternately transmitted from relays S2 and S4 over conductor R2. The impulses representing the second channel quotation stock number are cut off at the proper time by the operation of relays HSC, TSC and USC as previously described in reference to the transmission of the stock number of the first channel 1 quotation. Since only the first channel 1 quotation is being followed in detail, the circuits for the relays for controlling the stock number signals of the second channel quotation will not be traced.

As segments 24 of rings TR2 and TR3 are reached relays S3 and S4 are operated to transmit the first impulses of the units and fractions of the price of the first channel 1 quotation respectively. The circuit to relay S3 extends from

grounded segment 24 (UP) of ring TR2, through conductor 3 of cable 316, armature 231 and break contact of relay UPC, and the make contact and armature 230 of relay TSC to the winding of relay S3. The circuit for operating relay S4 extends from segment 24 (FP) of ring TR3, conductor 4 of cable 316, armature 234 and break contact of relay FPC, and the make contact and armature 233 of relay USC to the winding of relay S4. As segment 25 is reached relays S1 and S2 operate to send the first impulses of the range of the second channel 1 quotation and the tens price of the first channel 1 quotation respectively. The circuit for operating relay S2 extends from grounded segment 25 (TP) of ring TR3, conductor 2 of cable 316, armature 236 and break contact of relay TPC, and the make contact and armature 235 of relay HSC to the winding of relay S2. Since the range signals are associated with the second channel 1 quotation, their transmission will not be further described except to state that they are cut off at the proper time by the operation of the range cut off relay RAC under control of the intermediate range relays IRA1 to IRA4 as previously described.

As even numbered segments 24 (FP) to 36 of ring TR3 are crossed relay S4 continues to operate sending out a total of seven negative impulses representing the fractions digit 7 of the first channel 1 quotation. These signals go out over conductor R2. When segment 37 of ring TR1 is engaged by the brush TB, a circuit is completed for the fractions price cut-off relay FPC, this circuit extending from the grounded segment 37 of TR1, conductor 7 of cable 227, make contact and armature 364 of relay FP3, make contact and armature 365 of relay FP1, make contact and armature 299 of relay FP6, to conductor 6 of cable 335 and thence to the winding of relay FPC. This relay upon operating interrupts the locking circuit for relay USC, thereby interrupting the control circuit to relay S4 so that no further impulses are transmitted by this latter relay during the remainder of the revolution of the transmitting distributor brushes TB.

As even numbered segments 24 (UP) to 38 of ring TR2 are crossed, relay S3 continues to operate sending out a total of eight negative impulses representing the units digit 8 of the price. These impulses are transmitted over conductor R1. When segment 39 is engaged a circuit is established for the units price cut-off relay UPC from segment 39 of ring TR1, conductor 8 of cable 227, make contact and armature 366 of relay UP5, make contact and armature 336 of relay UP8, break contact and armature 337 of relay UP7, and break contact and armature 223 of relay UP6, conductor 5 of cable 335 and thence to the winding of relay UPC. This relay on operating interrupts the locking circuit for relay TSC thereby interrupting the control circuit for relay S3 so that no further impulses are transmitted to this relay during the remainder of the revolution of the distributor brushes TB.

As odd-numbered segments 25 (TP) to 41 of ring TR3 are crossed relay S2 operates to send out nine positive impulses representing the tens digit 9 of the price. These impulses are sent out over conductor R2. When segment 42 is reached relay TPC is operated over a circuit extending from grounded segment 42 of ring TR1, conductor 9 of cable 224, make contact and armature 367 of relay TP5, make contact and armature 368 of relay TP8, make contact and

armature 342 of relay TP7, break contact and armature 226 of relay TP6, conductor 3 of cable 335 and thence to the winding of relay TPC. This relay upon operating unlocks the holding circuit for relay HSC thereby interrupting the circuit to the winding of relay S2 so that no further impulses are transmitted by this relay during the remainder of the revolution of the distributor brushes TB.

No further operations occur until segment 43 of ring TR1 is crossed, at which time a circuit to release relay RL4 is completed to release the operated range relays IRA1 to IRA4 and the price relays TP5 to TP8, UP5 to UP8, and FP6 to FP8. This circuit extends from segment 43 of ring TR1, and conductor 1 of cable 322 to the winding of relay RL4. As brush TB crosses segment 44 of ring TR1 a circuit is completed from grounded segment 44, and conductor 3 of cable 322 to effect the transfer of the units digit of the price of the second channel 1 quotation from relays IUP1 to IUP4 into relays UP5 to UP8 in the manner described with reference to the first revolution. Engagement of the brush TB with segment 45 of ring TR1 grounds conductor 4 of cable 335, effecting the transfer of the tens digit of the price of the second channel 1 quotation from relays ITP1 to ITP4 into relays TP5 to TP8. A similar circuit extends from grounded segment 45 of ring TR3 over conductor 4 of cable 322, effecting the transfer of the fractions digit of the price of the second channel 1 quotation from relays IFP2 to IFP4 into relays FP6 to FP8. Engagement of the brush TB with the last segment 46 of ring TR1 causes relay RL5 to operate to release and prepare the intermediate price relays ITP1 to IFP4 for a succeeding quotation.

The brushes TB now come to rest on segments 1. This concludes the normal operation of the receiving, decoding and retransmitting apparatus. Briefly, in review, the functions performed during the first three revolutions of the receiving distributor RD are as follows: During the first revolution of distributor RD the first channel 1 quotation is received and transferred to the intermediate storage relays of the retransmitting and decoding apparatus. The stock number and range are recorded on the channel 1 monitor printer and a multiplex character is received and stored on intermediate storage relays and then transferred and stored on the multiplex printer MXP. The brush arm of the channel 1 retransmitting distributor TD1 is released for one revolution, during the first half of which it effects the transmission of the restoration impulses of a previous quotation and the hundreds, tens and units of the stock number of the first channel 1 quotation. During its second half revolution it transmits the range of the first channel 1 quotation and the price of the previous quotation. It also controls the transfer of the price of the first channel 1 quotation from the intermediate storage relays to the transmitting storage relays.

During the second revolution of the receiving distributor RD the signals corresponding to a channel 2 quotation are received and transferred to the channel 2 signal decoding and retransmitting apparatus. The price of the first channel 1 quotation is printed on the channel 1 monitor printer and the stock number and range of the channel 2 quotation is printed on the channel 2 monitor printer. The second multiplex signal is also received and recorded on the multiplex printer and the brush arm of the chan-

nel 2 retransmitting distributor (not shown) is released to transmit the stock number and range of the channel 2 quotation over a separate set of conductors from that controlled by the channel 1 retransmitting distributor TD1.

During the third revolution of the receiving distributor, the second channel 1 quotation is received and the price of the channel 2 quotation recorded upon the channel 2 printer, the stock number and range of the second channel 1 quotation being printed at the same time upon the channel 1 printer. Another multiplex character is also received and recorded on the multiplex printer MXP and the channel 1 transmitting distributor brushes TB are released for their second revolution, during the first half of which a switching and restoration impulse is transmitted over conductor R1 followed by the timing and restoration signals of the first channel 1 quotation and the stock number of the second channel 1 quotation. During the last half of the second revolution of the brushes TB the range of the second channel 1 quotation and the price of the first channel 1 quotation are transmitted.

This alternate reception of the channel 1 and channel 2 quotations on distributor RD, and the overlapping of the signals of each channel transmitted over distributor TD1 for channel 1 and corresponding distributor for channel 2 (not shown), continue as long as signals of the type assumed are continuously received on the distributor RD. However, if for any reason transmission should be discontinued at the central station this stopping of signals will always occur at the completion of the transmission of a channel 2 quotation, as previously described with reference to Figures 1—A and 1—B. When brushes RB1 and RB2 stop on their last or rest segments for longer than the normal period, the slow releasing phasing relay PH, Fig. 2—C, releases and in so doing interrupts the circuit from segment 17 of ring RR6 to either relay CH1 or CH2 depending upon whether slow releasing relay CP is deenergized or operated, so that all three of these relays become deenergized. Relay CP is made slow releasing to insure the engagement of locking armature 363 of relay CH2 with its make contact before the operating circuit of CH2 is opened at armature 297 and operated contact of relay CP, to insure reliable operation of the locking circuit for relay CH2.

Regardless of the condition of relays CH1, CH2 or relays CP, the releasing of the phasing relay PH automatically conditions the system to respond to the next quotation as a channel 1 quotation, the signals of which are distributed to the channel 1 monitor printer and to the channel 1 decoding and retransmitting apparatus. Therefore, the interruption which occurs automatically in the transmission of the permutation signals following every ninety-eighth quotation or rotation of the transmitting distributor, as well as every other interruption in the signals, restores the receiving apparatus into step with the transmitter (shown on Figs. 1—A and 1—B) so as to insure that the received quotation will be distributed over the proper channels.

If for any reason an incomplete stock number or range signal should be received, i. e., a quotation in which any digit of the stock number is missing or in which the range is omitted, it is desirable that this quotation be deleted and not retransmitted in its mutilated form to the subscriber's station since improper registration

of the indicators might result. Consequently the circuits are so arranged that, should this occur, release relay RL6, Fig. 2—D, will be operated to release all of the intermediate stock and range relays IHS1 to IRA4.

Assume, for example, that the tens digit of the stock number of a quotation incoming over channel 1 is missing. The remainder of the stock number is transferred to the intermediate relays as the receiving distributor brush RB2 crosses segment 11 of ring RR6 to operate relay C5. Certain intermediate relays of the hundreds and units digit of the stock number and range groups IHS, IUS and IRA respectively, Figs. 2—D and 2—E, will be operated at this time but since the tens digit is missing none of the tens intermediate stock number relays ITS1 to ITS4 will be operated. Subsequently, as brush RB2 engages segment 13 of ring RR5 and relay SNFP is operated thereby, ground is applied to segment 1 of ring TR4 of the channel 1 distributor TD1 over the following circuit: Grounded armature 241 and make contact of relay SNFP, conductor 4 of cable 264, contact 210 of relay CT1, conductor 2 of cable 284 to segment 1(R) of ring TR4. This ground is continued through brushes TB, segment 1 of ring TR2, conductor 369, winding of relay RL6, break contact and outer right-hand armatures 286 of relays ITS4 to ITS1 in series, and thence by the make contact and armature 286 of one of the operated relays of group IHS, conductor 287, to the make contact and operated armature of one of the relays of group IRA, and thence through armature 291 of IRA1 and resistance 292 to grounded battery 293, thereby operating relay RL6.

If the range signal is missing no relay of group IRA is operated, and the RL6 relay circuit will extend to battery 293 to the winding of relay RL6 through the break contacts and armatures 371, 288, 289 and 291 of relays IRA4 to IRA1 respectively in series.

If the hundreds digit of the stock number is missing, no relay in the IHS group, Fig. 2—D, is operated, and the RL6 relay circuit will be completed from the battery 293 through the break contacts and armature 286 of relays HS4 to HS1 in series, over conductor 287 to the make contact and operated armature of one of the relays of the group IRA, and thence through armature 291 of IRA1 and resistance 292 to grounded battery 293. Each of the above described circuits operates relay RL6 to release any of the relays in the groups IHS to IRA4 which may have been operated.

If the quotation having the missing range signal is the first of a series of quotations so that the price of no previous quotation is stored in relays TP5 to FP8, relay SW will be unoperated. Consequently as segment 1 of ring TR2 becomes grounded (to operate relay RL6) the circuit to start magnet RM1 will be incomplete. This circuit, it will be recalled, extends from segment 1 of ring TR4, brush TB and segment 1 of ring TR1, to the winding of magnet RM1, conductor 3 of cable 284, contact 209 of gang relay CT1, and conductor 1 of cable 284 to the armature 242 of relay SW. With this latter relay unoperated, the circuit continues from the associated break contact of relay SW, conductor 4 of cable 285, and the make contact and armature 286 of each of the relays IUS1 to IUS4, to the make contact and armature 286 of each of the relays ITS1 to ITS4, to the make contact and armature 286 of each of the relays

IHS1 to IHS4, and thence over conductor 287 through the make contacts and armatures 291, 289, 298 and 371 of relays IRA1 to IRA4 respectively through resistance 292 to grounded battery 293. With the above traced armatures of any complete group of these relays which are not operated (group ITS1 to ITS4 in the assumed example), the circuit to magnet RM1 will be incomplete and the brush TB will not be released. Consequently no stock number will be transmitted to the subscriber's station corresponding to the quotation having the mutilated stock number.

If, on the other hand, the quotation having the mutilated stock number or range signal is not the first of a series of quotations, so that the price of a previous quotation is stored in relays TP5 to FP8, the relay SW will be operated and the circuit for magnet RM1 will be completed at armature 242 of relay SW and its make contact, through resistance 371 directly to battery. Brushes TB will therefore be released and as they cross segments 4 to 23 of rings TR2 and TR3, ten impulses will be sent out by each of the transmitting relays S1, S3, S4 and one impulse will be sent out by relay S2. The impulses sent out by relay S1 are, of course, the restoration impulses for the previous quotation. The impulses sent out by relays S2, S3 and S4, however, correspond to an arbitrary number such, for example, as the number 100, which is indicative of a blank transmission, that is, no information relating to the mutilated quotation is sent to the subscriber. The transmission of the arbitrary number 100 to the receiving apparatus at the subscriber's station maintains the receiving equipment in synchronism with the transmitter at such time. As segment 6 of ring TR1 is engaged by the brush TB the hundreds cut-off relay HSC will be operated. The circuit for relay HSC extends from grounded segment 6 of ring TR1, conductor 1 of cable 220, break contact and armature 374 of relay IHS3, break contact and armature 375 of relay IHS2, break contact and armature 221 of relay IHS1, over conductor 1 of cable 285, armature 318 and break contact of relay TPC, to the winding of relay HSC. As segment 23 of ring TR1 is engaged by the brush TB, the tens and units cut-off relays TSC and USC will be operated. The circuit for relay TSC extends from grounded segment 23 of ring TR1 by way of conductor 10 of cable 221', break contact and armature 372 of relay ITS3, break contact and armature 373 of relay ITS2, break contact and armature 222 of relay ITS1, conductor 2 of cable 285, armature 325 and break contact of relay UPC, to the winding of relay TSC. A similar circuit extends from conductor 10 of cable 221' to the corresponding contacts and armatures of relays IUS3 to IUS1, conductor 3 of cable 285 to the armature 332 and break contact of relay FPC to the winding of relay USC. The operation of relays HSC, TSC and USC prepare circuits for the transmitting relays S2, S3 and S4 from segments 24 to 43 of rings TR2 and TR3 so that the price of the previous quotation may be transmitted. As segment 24 of ring TR1 is engaged, relay RAC operates to prevent the transmission of any range signals for the quotation having the mutilated stock number, the circuit for this relay extending from grounded segment 24 of ring TR1, conductor NR of cable 224, break contact and armature 344 of relay IRA3, break contact and armature 345 of relay IRA2, and break con-

tact and armature 225 of relay IRA1, over conductor 1 of cable 335 to the winding of relay RAC. Relay RAC locks over its armature 345 to ground at the break contact of relay RL5, as previously described, and is not released until segment 46 is reached at which time the latter relay is operated. As segment RLS of ring TR2 is reached, ground that this segment over conductor 8 of cable 316, through the break contact and armature 233 of relay USC (which released after the last digit of the fractions price of the succeeding quotation was transmitted) to the winding of relay S4 causes the operation of transmitting relay S4 to send out a negative impulse over line R2 which functions at the subscriber's board equipment as a release signal to condition the receiving apparatus for the reception of the next succeeding quotation transmitted from distributor TD1.

It will be noted therefore that whenever a digit of the stock number or range of a quotation is missing from the signals received on ring RR2 of distributor RD, if this occurs in the first quotation of a series, brush TB is not released and no signals are transmitted to the subscriber's station but, if it occurs in a quotation which is not the first of a series on the channel, then impulses corresponding to the arbitrary number 100 are transmitted to the receiving equipment followed by a release signal for normalizing the circuits of the receiving equipment. The function of the subscriber's equipment in response to these signals will be described subsequently with reference to Figures 4—A to 4—G and 4—H.

Whenever the tens digit of the price of a quotation is not to be changed, the change occurring entirely in the units and fractions portions of the price, a no-reset signal is transmitted. This signal, as hereinbefore stated, comprises any range combination having the third impulse marking, excepting the combination of impulses 2, 3, marking and 1, 4, spacing; 3, 4, marking and 1, 2, spacing; or 3 marking and 1, 2, 4, spacing. Whenever a no-reset range signal is received, as for example, the range "low" with the tens digit to remain unchanged, LO (UF), Fig. 7, having a combination of 1, 3, marking to operate the range storage relays RA1 and RA3 only, the armatures 271 of these relays will remove ground from conductor 269 through armature 268 and break contact of relay TUP, conductor 2 of cable 255, to the locking armatures 206 of relay TP1 to TP4 so that these latter relays will all be deenergized at the time the tens digit of the price is transferred to the intermediate transfer price relays ITP1 to ITP4. Consequently none of the intermediate tens relays will be operated.

The intermediate range relays IRA1 and IRA3 will be operated, however, and when this occurs (or any other combination including relay RA3 except combinations of relays RA2 and RA3 only, or RA3 and RA4 only, or RA3 alone, see range code, Fig. 7) a circuit will be prepared for the no-rest relay NR, Fig. 2—G, from the winding of this relay, conductor 2 of cable 335, make contact and armature 376 of relay RA3, make contact and armature 377 of relay RA1, through resistance 292 to grounded battery 293. This circuit is completed to operate relay NR when brush TB crosses segment 4 of ring TR1 thereby operating relay RL2. Relay NR locks up over its armature 377 and make contact thereof to the break contact 378 of the associated make-before-break contacts of relay RL2 to ground as

the latter relay releases when the brush TB leaves segment 4 of ring TR1.

Consequently, as brush TB comes into contact with the rest segment on ring TR3 at the beginning of the second revolution, a circuit is completed from this segment of ring TR3 over conductor 378, armature 240 and make contact of relay NR, to transmitting relay S2 to send a single positive impulse over line R2. This no-reset signal controls mechanism at the subscriber's board equipment to prevent the restoration of the tens digit indicators of the price of the selected stock by the subsequently transmitted restoration impulses.

It should be noted that as brush TB engages segment 2 (SW) of ring TR2 immediately following the transmission of the no-reset signal over conductor R2, relay S1 also operates as previously described to send a switching impulse over conductor R1, the purpose of which will be described hereinafter.

When testing operations are required, as for example, testing a new subscriber's installation before inauguration of service, means are provided in the retransmitting apparatus, Figs. 2—A to 2—G, for initiating quotations to be used for testing receiving equipment without making use of apparatus at the transmitting station 100. This testing apparatus comprises the tape transmitter TTX and cut-in relays TX1 to TX4, Fig. 2—A, for successively connecting the tape transmitter TTX to the relays HS1 to US4 and RA1 to RA4 successively in groups. A plurality of testing keys TKR, TKT, TKU, and TKF, Fig. 2—B, upon which are set up combinations corresponding to the range, tens, units and fractions portions of the various test quotations. The operation of this testing feature will now be described in detail.

It will be noted that the conductors extending from segments 1 to 12 and 18 to 32 of ring RR2 of the distributor RD, Figs. 2—A to 2—C, terminate in slip connections 205. These slip connections are removed from their associated jacks and replaced by slip connections 205', Figs. 2—A and 2—B, so that each terminal 205' is connected to the relay winding previously associated with correspondingly numbered segments of ring RR2. The tape used with the tape transmitter TTX has three rows of transverse perforations corresponding to the hundreds, tens and units digits of the stock number, followed by a fourth transverse series of perforations corresponding to the range of each selected stock. The stocks are arranged on the tape so that the first and every other alternate stock bears an odd-numbered stock designation corresponding to a channel 1 quotation, and the second and every other alternate quotation is a channel 2 quotation having an even-numbered stock designation. The key RA, Fig. 2—A, is in the closed position. A copious supply of perforated tape is introduced into the transmitter TTX and the key KS, Fig. 2—B, is operated to the position marked "tape."

Assume that the first quotation to be transmitted is for a stock designated 345 having an open range and that the tens, units and fractions keys TKT, TKU, and TKF are set to display the price 98%, keys TKT 1, 3 and 4, keys TKU 1 and 4, and keys TKF 2, 3 and 4 being closed.

With the key KS in the "tape" position, armature 204 of key KS is grounded causing the start magnet STM of the distributor RD to be energized over the following circuit: Ground at armature 204 of key KS, conductor 293, segment

2 of ring RR1, brush RB1, segment R of ring RR2, through the start magnet STM to grounded battery. As the brush RB2 comes into contact with segment 1 of ring RR6, relay C1 operates and at its operated armature 379 and make contact applies ground to conductor 1 of cable 381, contact and armature 382 of key KS, conductor 2 of cable 383 to winding of the relay TX1 causing this relay to operate.

The operation of relay TX1 closes circuits from ground 384 through operated armatures of transmitter TTX and relay TX1 to the windings of relays HS1 and HS4 corresponding to digit 3 of the stock number in the example assumed. As brush RB2 engages segment 2 of ring RR6, the relay C2 operates and closes its armature 385, causing the tape to advance to the next set of perforations by the operation of stepping magnet SM3 of the transmitter TTX over the following circuits: Grounded armature 385 and make contact of relay C2, conductor 2 of cable 381, contact and operated armature 386 of key KS, conductor 1 of cable 383, to the winding of magnet SM3. As the brush RB2 left segment 1 of ring RR6, relays C1 and TX1 released. As brush RB2 engages segment 4 of ring RR6, relay RA operates causing operation of cut-in relay TX2 over the following circuit: Grounded armature 267 and make contact of relay RA, conductor 3 of cable 381, contact and armature 387 of key KS, conductor 3 of cable 383, and thence to the winding of relay TX2.

The operation of relay TX2 causes relays TS2 and TS3 to operate in a manner similar to that described for the operation of the HS relays. As brush RB2 leaves segment 4, relays RA and TX2 release.

As brush RB2 engages segment 7 of ring RR6, relay C2 operates and at its armature 385 and make contact thereof supplies ground to conductor 2 of cable 381, causing the tape to be advanced to the third set of perforations corresponding to the units digit of the stock number. As the brush RB2 engages segment 8 of ring RR6, relay C4 operates and at its armature 388 and make contact thereof supplies ground to conductor 4 of cable 381 through the closed contact and armature 389 of key KS to conductor 4 of cable 383, causing the operation of relay TX3. As relay TX3 closes its contacts, relays US2 and US4 are operated from the ground 384 through corresponding operated tongues of the tape transmitter TTX. As brush RB2 leaves segment 8 of ring RR6, relays C4 and TX3 release. As brush RB2 engages segment 10, relay TUP operates closing a circuit at its armature 272 and make contact thereof to cause the operation of relay C2 which advances the tape in the transmitter TTX over a circuit previously described. As the brush leaves segment 10 of ring RR6, relays TUP, C2 and magnet SM3 release. As brush RB2 engages segment 11 of ring RR6, relay C5 is energized causing its armature 391 to apply ground to the make contact thereof, conductor 392 to the make contact and armature 393 of key KS, and thence over conductor 5 of cable 383 and closed key RA to the winding of relay TX4 which operates. When the contacts of relay TX4 close, circuits are completed from ground 384 through closed contacts and tongues of transmitter TTX to the windings of relays RA2 and RA3 corresponding to the open (TUF) range of the example assumed. Relays HS1 to RA4 lock in a manner previously described. As relay C5 operated, ground at its armature 394 and make con-

tact thereof was applied through conductor 395 to the keys TKT. It will be recalled that keys 1, 3 and 4 of the group TKT were operated corresponding to the tens digit 9; the ground from armature 394 is therefore continued through these closed keys to the windings of relays TP1, TP3 and TP4 which operate. As brush RB2 leaves segment 12 of ring RR6, relays C5 and T4 release. As brush RB2 engages segment 15 of ring RR6, relay C6 operates and applies ground at its armature 397 to conductor 1 of cable 396, through operated keys 1 and 4 of the group TKU to the windings of relays UP1 and UP4 in parallel, causing these relays to operate and store the signals corresponding to the units digit 8. The operation of relay C6 also applies ground at its armature 398 and make contact thereof to conductor 2 of cable 396, through closed keys 2, 3 and 4 of the TKF group, to the windings of relays FP2, FP3 and FP4 causing these latter relays to operate. Relays TP1 to FP4 lock in the manner previously described. As brush RB2 leaves segment 15 of ring RR6, relay C6 releases. As the distributor RD completes its first revolution, it continues to rotate for the second and also subsequent revolutions as the start magnet SM is held in the operated position by key KS which has been moved in the direction designated "tape." As the distributor RD makes its second revolution a channel 2 quotation is taken from the tape which is advanced one step for each digit of the stock number and range signals. The retransmission of these test signals from the transmitting distributor TD1 to the lines R1 and R2 and the operation of the monitor printers MP1 and MP2 occur in a manner similar to that previously described.

When the key KS was thrown to the "tape" position, armature 399 thereof opened the circuit between the grounded armature and marking contact M of the relay LR, and segment 1 of ring RR1 of the receiving distributor RD. As the brush RB1 crossed the segments 13 to 17 of ring RR2, relays MX1 to MX5 remained unoperated and no character designation signals were transmitted to the selecting magnets of the multiplex printer MXP. With all selecting magnets of the multiplex printer MXP unoperated, no character is printed on the tape of this printer, and the tape is not advanced when ground from armature 391 of relay C5 and its make contact is applied through conductor 392 to the sixth pulse magnet of this printer.

An alternative method of testing subscribers' installations by means of the transmitter TTX is to omit the range signal for each stock from the perforated tape thereby requiring only three transverse rows of perforations corresponding to the hundreds, tens and units digits of the stock number for each complete set of signals required for the transmission of a stock price. The TX4 relay is disconnected by opening the key RA, and the range signals are obtained by operating the proper combination of keys 1 to 4 of the group TKR. The open range could have been transmitted by operating keys 2 and 3 of the group TKR and opening key RA, and the apparatus would have operated in a manner similar to that just described except that when relay C5 operated, as the brush RB2 engaged segment 11 and caused ground at its armature 391 and make contact thereof to be applied to conductor 392, this ground would cause the operation of relays RA2 and RA3 through closed contacts of keys 2 and 3 of the TKR group respectively, instead of oper-

ating these relays through closed contacts of relay TX4 from ground 384 and closed contacts and operated tongues of transmitter TTX.

While the tape transmitter TTX is primarily intended for use as a testing device it will be understood that it is not limited to such use, it being my intention to transmit stock quotations by means of this tape transmitter TTX and keys TKT to TKF corresponding to quotations currently received over a stock ticker located at the retransmitting station, such apparatus providing a means of continuing service to customers' boards during a time when signals cannot be received on the distributor RD due to failure of line L or to some other cause. It will be understood that quotations of each channel must be perforated on the tape in spaced relation to one another as the retransmitting apparatus shown on Figs. 2—A to 2—G invariably transmits channel 1 and channel 2 quotations alternately except when quotations are transmitted from one channel only, with blank signals interspaced between successive quotations.

Repeater

The operation of the repeater equipment shown on Fig. 3 will now be described.

Referring to Fig. 3, the first four vertical rows of relays, counting from the left as viewed in Fig. 3, are used for repeating signals corresponding to channel 1 quotations and the following four vertical rows of relays are used for repeating the signals for channel 2 quotations. The first two vertical rows of relays repeat, over conductors 400 of channel 1, positive and negative signals incoming over conductor R1, and the third and fourth vertical rows of relays repeat over conductors 401 of channel 1, positive and negative signals incoming over conductor R2.

Assume, for example, two positive and two negative signals incoming over line R1 in the following order + - + -, which signals are to be repeated over outgoing conductors 400. When the first positive signal is received the first (+) polar relay is operated which closes a circuit from its grounded armature to the windings of one or more associated repeating relays RP (+) in series to grounded battery, causing each of these relays to operate and apply a positive potential at the make contact and operated armature of the relays, through a resistance 420, to the associated outgoing line 400. As negative potential is received over line R1, the (+) polar relay is released and the (-) polar relay operated. The release of the (+) polar relay releases the (+) repeating relays RP, and the operation of the (-) polar relay causes the (-) repeating relays RP to operate and place negative battery at their contacts and operated armatures through a resistance 420' to the line 400. The second positive signal received over the line R1 causes the operation of the (+) polar relay and the release of the (-) polar relay, thereby sending a second positive impulse over the line 400 of the various subscriber's circuits. The second negative impulse over the line R1 operates the (-) polar relay and releases the (+) polar relay, causing a second negative impulse to be transmitted over the various lines 400.

At the completion of the four pulses in the example assumed, the line R1 is opened at the contacts of relays S1 and S2, Fig. 2—G and the (-) polarized relay and associated repeating relays release. A positive signal over conductor 400 causes operation of a polarized relay P1,

Fig. 4—A, and a negative impulse over this same circuit causes a polarized relay P3 of each subscriber's installation to operate. The impulses incoming over conductor R2 are repeated, over lines 401, by the third and fourth vertical rows of relays RP in the same manner as above described with reference to conductor R1 and lines 400. A positive impulse over conductor 401 causes polarized relay P2, Fig. 4—A to operate and a negative impulse over this circuit causes polarized relay P4 of each subscriber's receiving equipment to operate. The fifth, sixth, seventh and eighth vertical rows of relays of Fig. 3 repeat from channel 2 retransmitting equipment, not shown, but which is similar to that of channel 1 transmitting equipment shown on Figs. 2—D to 2—G.

Description of selector

The apparatus and circuits of the receiving mechanism shown on Figs. 4—A to 4—H will now be described. Fig. 4—A shows the polarized line relays and signal regenerator units of the selector. Fig. 4—B shows the switching relays used to control various functions of the receiving apparatus during the time that the quotation is in progress. Fig. 4—C shows the counting relay chains for storing the range and hundreds digit of the stock number. Fig. 4—D shows two relay counting chains for storing the tens and units digits of the stock number.

Fig. 4—E shows the range relays for selectively completing circuits to one or more ranges of the selected stock or other item under control of the range relay counting chain shown on Fig. 4—C. Fig. 4—F shows a portion of the stock selecting relays for completing a circuit to any one of a plurality of stock indicating devices under control of the hundreds, tens and units relay counting chains shown on Figs. 4—C and 4—D and also discloses a plug and jack arrangement whereby flexible means are provided for conditioning the indicating devices of any stock for response to price digit information corresponding to any stock number. Fig. 4—G discloses a portion of the stock board and shows means for transferring the indicating devices of any stock for operation from either channel.

It will be recalled that each quotation is composed of four parts, stock number, range, restoration and actuation of the selected indicators, which are transmitted in the order here given, the entire transmission requiring two revolutions of the retransmitting distributor TD1, Fig. 2—G. These signals are received successively on the polarized line relays P1 to P4, Fig. 4—A. During one revolution of the transmitting distributor TD1, the signals corresponding to the stock number and range characteristics of one quotation are transmitted and stored in the selector, while restoration and actuation pulses corresponding to the previous quotation are being transmitted to the selected indicators of a previous quotation. This arrangement has been obtained by operating all regenerator units RGR1 to RGR4 under control of one polarized line relay P1 for restoration while a new stock number is being concurrently transmitted to the other three polarized line relays P2 to P4. Subsequently, while the signals corresponding to the various digits of the price of a previous quotation are being received by the three line relays P2, P3 and P4, the signals for the range selection for a succeeding quotation are being received by the line relay P1.

The manner in which restoration impulses are

transmitted simultaneously to the selected indicators by three regenerator units under control of signals from one line relay, and the various switching operations required for this feature will be described hereinafter.

The term regenerator or regenerator unit as herein referred to shall be defined as comprising relays A1 and AA1 of regenerator RGR1, Fig. 4—A, together with their interconnecting circuits, and may be of the type disclosed on Patent Number 1,965,377 issued July 3, 1934, to R. M. Hicks et al. The purpose of the regenerator unit is to provide signals of predetermined constant length for the operation of the indicator units. It will be understood that signals repeated by the line relays P1 to P4, Fig. 4—A, may not be most suitable for the fast operation of the indicator units required with the system herein described. Irregularities in the repeated signals are corrected by regenerator units in the following manner:

As the armature of line relay P1 moves to its operated position, a circuit is closed from battery at the make contact of relay P1 through the armature thereof over conductor 402 to the winding of relay A1, and thence to ground through the break contact and armature 403 of relay AA1, causing relay A1 to operate. It should be noted that battery 404 through resistance 405 is continuously connected to conductor 402 thereby causing energization of the winding of relay A1 which does not operate over this circuit due to the limitation of current by resistance 405. As relay A1 closes its armature 406, relay AA1 is energized and upon operation opens the circuit to the relay A1 at armature 403 of relay AA1. The relay AA1 is slow to operate, being restrained in the unoperated position by a spring 407 attached to its armature. The relay A1 now releases, opening the operating circuit to relay AA1 at armature 406 of relay A1. When relay AA1 has released, ground is again applied to one end of the winding of relay A1. This cycle of operation is repeated for each pulse received from the line relay P1, and thus provides for predetermined length signals to be transmitted from the regenerator unit. The battery 404, connected through resistance 405 to the winding of relay A1, is provided to maintain a fixed amount of flux in the ferric circuit of this relay, so that its operating time will not be greater during reception of a first pulse of a series of pulses than it is for the succeeding impulses.

Restoration and actuation impulses for the tens, units and fractions indicators of each range are transmitted from regenerators RG2, RG3 and RG4 respectively. Regenerator RG1 transmits ten impulses to regenerators RG2 to RG4 for restoration to blank of the selected indicators, and operates the various relays of the relay counting chain used for range selection. It will be noted that the apparatus shown on Figs. 4—A to 4—F for receiving signals and controlling the operation of indicators therefrom is duplicated within the selector for actuating the indicators of channel 2 stocks, the apparatus shown on Fig. 4—G being common to both channels.

If for example, it is desired to change the indicators of channel 1 stock 123, Fig. 4—G, to receive signals for a channel 2 stock number 456, the switch 408 would be moved to the right and the plug 409, Fig. 4—F, removed from jack number 123 of the jack panel 411 and inserted into

jack number 456 of the jack panel associated with the channel 2 system.

The quotations appearing on the stock board comprise the hundreds, tens, units and fractions digits of the previous closing price whereas the prices corresponding to the open, high, low and last quotations usually comprise but three digits, these being the tens, units and fractions digits of the various quotations.

Provision has been made, however, for actuating not only each of the previously mentioned indicators but also indicators corresponding to the hundreds digit of the open, high, low and last ranges. This feature of the invention is useful for indicating values corresponding to special services such as the posting of the volume of sales as will be hereinafter disclosed.

Operation of selector

The operation of the various circuits of the selector shown in Figs. 4—A to 4—G will now be explained.

In the foregoing explanation of the transmitting and repeating equipment, it was assumed that signals indicative of a quotation for a channel 1 stock having a stock number 123, unison range and a price of 98 $\frac{7}{8}$ were transmitted to the various subscriber's stations over conductors 400 and 401, Fig. 3. It will now be assumed that these signals are about to be received by line relays P1 to P4, Fig. 4—A. It will be understood that very frequently more than one of the following circuits are completed simultaneously, whereas in describing the same it will of course be necessary to describe them successively.

At the beginning of the quotation a negative impulse is received simultaneously over lines 400 and 401, Fig. 4—A, causing relays P3 and P4 to operate. Circuits completed by the operation of relay P3 will first be described. Battery at the make contact and armature of relay P3 is connected to conductor 2 of cable 412 and thence to armature 413 and break contact of relay S2, Fig. 4—B, conductor 1 of cable 414 to armature 415 and break contact of relay X3, Fig. 4—D, armature 416 and break contact of relay W3, break contact and armature 417 of relay Y3 to the winding of relay T1 which operates and locks on a circuit through its armature 419 and make contact in series with the winding of relay W3, break contact and armature of relay X3, conductor 418 to battery at the break contact and armature 419 of relay RLS, Fig. 4—B. Relay W3 does not operate at this time as both ends of its winding are connected to battery. When the negative pulse is removed from line 400, relay P3 releases and removes battery from one side of the winding of relay W3, permitting the latter relay to operate in series with relay T1 over the circuit just traced. As the second negative pulse is received over line 400 relay P3 again operates causing the operation of relay T2 over a circuit from battery at the armature of relay P3, conductor 2 of cable 412, armature 413 and break contact of relay S2, conductor 1 of cable 414, armature 415 and break contact of relay X3, armature 416 and make contact of relay W3, armature 421 and make contact of relay T1 to the winding of relay T2. Relay T2 operates and locks over its armature 419 and make contact through the winding of relay X3, break contact and armature of relay Y3 to battery on conductor 418. Relay X3 does not yet operate as its wind-

ing is short-circuited by the operated armature of relay P3. As the second negative pulse is removed from line 400 relay P3 releases thereby permitting the operation of relay X3 in series with relay T2. The opening of break contact and armature 430 by the operation of relay X3 caused relays T1 and W3 to release. The tens digit 2 of the stock number is now stored in the tens counting chain and as no more negative pulses are transmitted over line 400 during the time allotted for the transmission and reception of signals for the stock number, relay P3 will not again reoperate during this time.

As the first negative pulse is received over line 401 relay P4 operates and grounds conductor 3 of cable 412 thereby causing the operation of relay U1 of the units counting chain, Fig. 4—D. The circuit is completed from battery at the operated armature of relay P4 over conductor 3 of cable 412, armature 422 and break contact of relay S2, conductor 2 of cable 414, armature 415 and break contact of relay X4, armature 416 and break contact of relay W4, break contact and armature 417 of relay Y4 through the winding of relay U1 to ground. Relay U1 operates and locks over its operated armature 419 and make contact through the winding of relay W4, break contact and armature of relay X4, conductor 423, armature 424 and break contact of relay RLS to battery. As the first negative pulse is removed from line 401 to relay P4 releases and permits the operation of relay X3. As relay P4 operates in response to the second negative pulse over line 401, battery is again placed on conductor 3 of cable 412, to the armature 422 and break contact of relay S2, conductor 2 of cable 414, armature 415 and break contact of relay X4, armature 416 and make contact of relay W4, armature 421 and make contact of relay U1 and thence to the winding of relay U2 which operates and locks over its armature 419 in series with relay X4, break contact and armature of relay Y4, to battery on conductor 423. As the second negative impulse is removed from line 401 relay P4 releases causing the operation of relay X4. The opening of break contact and armature 430 by the operation of relay X4 causes the relays W4 and U1 to release. The third negative impulse over conductor 401 operates relay P4 thereby connecting battery to conductor 2 of cable 414, armature 425 and break contact of relay Y4, armature 426 and make contact of relay X4, armature 421 and make contact of relay U2, to the winding of relay U3 causing relay U3 to operate. Relay U3 locks over its armature 419 in series with relay Y4, break contact and armature of relay W4 to battery on conductor 423. As the third negative impulse is removed from line 401, relay P4 releases and removes the battery from one side of the winding of relay Y4, thereby permitting relay Y4 to operate in series with the U3 relay. The operation of relay Y4 causes relays X4 and U2 to release, the locking circuit of these latter relays being interrupted at break contact and armature 430 of relay Y4. The units digit 3 of the stock number is now stored in the units counting chain and no further negative impulses are received over conductor 401 during the time allotted for the transmission and reception of the stock number signals.

Immediately following the termination of the first negative impulse on lines 400 and 401, a positive impulse is applied to each of these two lines simultaneously causing relays P1 and P2 to operate. As the operation of relay P2 at this time

controls the counting chain relays Y2, X2, W2 and H1 to H9, Fig. 4—C, for registration of the hundreds digit of the stock number, the circuits under control of this relay will now be described.

As relay P2 operates in response to the first positive pulse over line 401, it connects battery through its armature to conductor 1 of cable 412, armature 427 and break contact of relay S2, conductor 428, make before break contact 429 of relay CLS, Fig. 4—C, conductor 431, armature 415 and break contact of relay X2, armature 416 and break contact of relay W2, break contact and armature 417 of relay Y2, and thence to the winding of relay H1 causing this latter relay to operate and lock over its contact 419 and make contact in series with relay W2, break contact and armature of relay X2, conductor 432, break contact and armature 433 of relay H9, conductor 434 to battery at the break contact and armature 435 of relay RLS. Relay W2 does not operate at this time as its winding is short-circuited by battery on the operated armature of relay P2. As the first positive pulse is removed from line 401, relay P2 releases and removes the short circuit from the winding of relay W2 which operates in series with relay H1. The digit 1 corresponding to the hundreds digit of the stock number in the example assumed, is now stored on the hundreds relay counting chain and as no more positive pulses will be transmitted over line 401 during the time allotted for the transmission and reception of stock number signals, relay P2 will not reoperate during this time.

It will be noted that ten impulses employed in the restoration of indicators to blank and for various timing purposes are transmitted to the receiving apparatus during the portion of the cycle wherein the signals for the stock number are received. These timing and restoration impulses are sent over line 400 and operate the relay P1 once for each pulse received. As the first positive pulse is applied to the line 400, it occurring simultaneously with the first positive impulse of the hundreds digit of the stock number on line 401, relay P1 operates. Battery at the closed contact and armature of relay P1, conductor 402 to the winding of the A1 relay of regenerator RGR1 and thence to the break contact and armature 403 of relay AA1 to ground, causes relay A1 to operate. As the operation of a regenerator unit has been previously described, it will henceforth be assumed that the operation of relay A of a regenerator in response to a received signal will cause the deliverance of a predetermined uniform signal, without further reference to the controlling action of the associated AA relay which operates and releases under control of the A relay. Henceforth, for the sake of brevity, the operation of relay A may be referred to as the operation of the regenerator unit.

Regenerators RGR2, RGR3 and RGR4 are at this time operated from regenerator RGR1 over the following circuits: grounded armature 403 and break contact of relay AA2, winding of relay A2, conductor 1 of cable 436, break contact and armature 437 of relay RT, Fig. 4—B, break contact and armature 438 of relay RT1, break contact and armature 439 of relay NR, armature 441 and break contact of relay S1, conductor 442, make contact and armature 443 of relay A1, conductor 444, break contact and armature 445 of relay SR to battery, thereby causing regenerator RGR2 to operate.

RGR3 operates on a circuit extending from the winding of relay A3 through conductor 2 of

cable 436, break contact and armature 445 of relay RT1, break contact and armature 446 of relay RT, armature 447 and break contact of relay S1, conductor 448, make contact and armature 449 of relay A1 to battery.

The circuit for operating regenerator RGR4 extends from the winding of relay A4 through conductor 3 of cable 436, break contact and armature 449 of relay RT1, break contact and armature 451 of relay RT, armature 452 and break contact of relay SR, conductor 453, make contact and armature 454 of relay A1 to battery.

The operation of regenerator RGR1 closed a circuit from battery at armature 455 and make contact of relay A1, conductor 456, armature 457 and break contact of relay S3, conductor 458, armature 415 and break contact of relay X1, armature 426 and break contact of relay W1, armature 417 and break contact of relay Y1 to the winding of relay LA causing this latter relay to operate and establish a locking circuit in series with the winding of relay W1, break contact and armature of relay X1, conductor 459, armature 461 of relay RLS to grounded battery at the break contact thereof. As relay A1 releases, battery is removed from one side of the winding of relay W1 which then operates in series with relay LA. As the first positive pulse is removed from line 400 relay P1 releases and subsequently regenerators RGR1 to RGR4 release. Regenerators RGR1 to RGR4 operate in the manner described in response to each of the ten positive timing and restoration impulses received over line 400. As the second positive impulse is received these regenerators again operate and a circuit is closed from grounded battery at the armature 455 and make contact of relay A1, conductor 456, armature 457 and break contact of relay S3, conductor 458, armature 415 and break contact of relay X1, armature 426 and make contact of relay W1, armature 421 and make contact of relay LA, to the winding of relay LL which operates and locks in series with the winding of relay X1, make contact and armature of relay Y1, to battery on conductor 459. When relay A1 releases, the battery is removed from one terminal of the winding of relay X1 causing this latter relay to operate and interrupt at its break contact and armature 430 the locking circuit for relays W1 and LA causing these relays to release.

As relay A1 reoperates in response to the third positive signal over line conductor 400, battery is again connected to conductor 458 through a circuit previously described, to armature 425 and break contact of relay Y1 from which the circuit is continued to the armature 426 and make contact of relay X1, armature 421 and make contact of relay LL, causing operation of relay HL. As relay HL operates it closes a locking circuit from its winding in series with the winding of relay Y1, break contact and armature of relay W1 to battery on conductor 459. Relay W1 operates in series with relay HL immediately following the release of relay A1, and the break contact and armature 430 of relay W1, opens a holding circuit for relays Y1 and LL causing the latter relays to release.

As relay A1 again closes its armature 455 and make contact in response to the fourth positive signal, battery is connected through a circuit previously traced to conductor 458 and thence to armature 425 and make contact of relay Y1, armature 462 and break contact of relay W1,

armature 421 and make contact of relay HL, to the winding of relay LO which operates and locks in series with the winding of relay W1, break contact and armature of relay X1, to battery on conductor 459. Relay W1 operates immediately following the release of relay A1, and opens through its break contact and armature 430 the holding circuit for relays Y1 and HL causing these relays to release. As the fifth positive pulse is received over line 400, relays P1 and A1 again operate causing battery to be applied to conductor 458, armature 415 and break contact of relay X1, armature 426 and make contact of relay W1, armature 421 and make contact of relay LO, to the winding of relay HI causing this latter relay to operate. As relay HI operates, it locks in series with the winding of relay X1, break contact and armature of relay Y1 to battery on conductor 459. As relay A1 releases at the termination of the fifth impulse, battery is removed from one side of the winding of relay X1 which then operates and at its armature 430 and break contact opens the holding circuit for relays W1 and LO causing these latter relays to release.

As relay A1 operates in response to the sixth positive impulse over line conductor 400, battery, through a circuit previously described is connected to armature 425 of relay Y1, armature 426 and make contact of relay X1, armature 421 and make contact of relay HI, to the winding of relay OP which operates and locks in series with relay Y1, break contact and armature 430 of relay W1, to battery on conductor 459. The release of relay A1 causes relay Y1 to operate in series with relay OP and at the opening of break contact and armature 430 of relay Y1 interrupt the holding circuit for relays X1 and HI, causing these latter relays to release. The seventh positive pulse causes relay A1 to operate, thereby connecting battery to armature 425 and make contact of relay Y1, armature 462 and break contact of relay W1, armature 421 and make contact of relay OP, and the winding of relay UN causing this relay to operate and lock in series with relay W1, break contact and armature 430 of relay X1, to battery on conductor 459. Following the release of relay A1, relay W1 operates in series with relay UN which causes the release of relays Y1 and OP by the interruption of their locking circuit at armature 430 and break contact of relay W1. As relay A1 operates in response to the eighth positive impulse over conductor 400, battery is again applied to armature 415 and break contact of relay X1, and thence to armature 425 and make contact of relay W1, armature 421 and make contact of relay UN, to the winding of relay CLS causing this relay to operate and lock in series with the winding of relay X1, break contact and armature of relay Y1, to battery on conductor 459. Relay X1 operates after relay A1 releases and at its break contact and armature 430 opens the holding circuit for relays W1 and UN which release.

As the ninth positive impulse is received relay A1 again closes its armature 445 thereby placing battery through a previously described circuit to conductor 458, armature 425 and break contact of relay Y1, armature 426 and make contact of relay X1, armature 421 and make contact of relay CLS, thereby operating relay CLH which locks in series with relay Y1, break contact and armature of relay W1, to battery on conductor 459. The release of relay A1 at the end of the ninth impulse causes relay Y1 to operate in series with relay

CLH. The opening of armature 430 and break contact of relay Y1 interrupts the circuit for relays X1 and CLS which release. As relay CLH closes its contacts, a circuit is completed from battery at break contact and armature 461 of relay RLS, conductor 459, armature 482 and break contact of relay S3, conductor 463, armature 464 and make contact of relay Y1, armature 465 and make contact of relay CLH, conductor 466, to the winding of relay SR causing this relay to operate. Relays S1 and AG now operate, as a circuit through their windings to battery is completed upon closure of armature 455 and its make contact, of relay SR. Relays AG and S1 lock through the armature 440 and make contact of relay S1 and thence by way of conductor 467 to battery at the break contact and armature 468 of relay LC. Relay SR is maintained in the operated position by means of two circuits which are commonly extended from the winding of the SR relay to armature 468 and make contact of relay S1, at which point the circuits divide, one continuing by way of conductor 469, make contact and armature 449 of relay A1 when operated, to battery, and the other parallel circuit is extended from the make contact of armature 468 of relay S1, armature and break contact 471 of relay RT1, conductor 4 of cable 436, make contact and armature 472 of relay A4, to battery when the latter relay is operated. Due to the slow to release characteristic of relay SR, it does not release until relays P1 and P4 cease to function at the termination of the series of positive pulses on line 400 and negative pulses on line 401, which immediately follow the operation of the SR relay.

As the tenth positive pulse is received, relay P1 and regenerator RGR1 operate. Regenerators RGR2, RGR3 and RGR4 do not now operate, as their operating circuits are open at armatures 441 and 447 of relay S1 and armatures 445 and 452 of relay SR. Relay S2 operates over a circuit extending from one terminal of its winding to the break contact and armature 473 of relay S3, conductor 474, make contact and armature 475 of relay CLH, break contact and armature 462 of relay W1, make contact and armature 425 of relay Y1, conductor 458, break contact and armature 457 and make contact and armature 460 of relays S3 and AG respectively in parallel, conductor 456, make contact and armature 455 of relay A1 to grounded battery. Relay S2 upon operating closes a locking circuit through its armature 450 and make contact, break contact 476 of make before break contacts of relay RLS, and thence to the winding of relay S3, the other side of which is connected to grounded battery. Relay S3 does not operate at this time as battery is now connected to both sides of its winding. Upon the release of relays P1 and A1 at the termination of the tenth positive impulse from line 400, the operating battery is removed from relay S2 which then maintains its operated condition by way of the locking circuit previously described, in series with relay S3, this latter relay then operating. The reception of this tenth or switching impulse from line 400 prepares the selector equipment for the proper utilization of the signals to be received over conductors 400 and 401 from the transmitting distributor TD1 during the second half of its revolution.

The operation of relay AG just described, grounded conductors AG1 and AG2 of cable 477, but since in the assumed example no previous quotation on channel 1 had been transmitted, these circuits are open at contacts of the various

stock relays such as shown on Fig. 4—G and are therefore now without effect.

It will be noted that relays H1, Fig. 4—C, T2 and U3, Fig. 4—D, have been operated in response to signals received indicative of the hundreds, tens and units digits of the stock number 123. The manner in which circuits through these relays are completed in part to select stock number 123 will now be described. Relay 10—30, Fig. 4—F operates in series with relay 20 over the following circuit: Winding of relay 10—30, conductor 478, armature 480 and make contact of relay T2, Fig. 4—D, conductor 479, winding of relay 20, conductor 481, make contact and armature 482 of relay S3, conductor 459, armature 461 and break contact of relay RLS to battery. It will be noted that the selection of relays 10—30 and 20 was determined by the tens digit characteristic of the stock number. Relay 110, Fig. 4—F, operates from a circuit extending from its winding through contact 483 of relay 10—30, conductor 484, armature 504 and make contact of relay H1, conductor 481, make contact and armature 482 of relay S3, conductor 459, armature 461 and break contact of relay RLS to battery. The selection of relay 110 is determined by the hundreds digit of the stock number in combination with the operated 10—30 relay. The circuit to jack 123 of jack panel 411, Fig. 4—F, follows:

As the multiple over which the restoration and actuation impulses are transmitted to the indicators of channel 1 terminates at contacts of all stock relays such as relay STK 123, Fig. 4—G, which have their switches 408 moved to the channel 1 position, it is apparent that the operating circuit for any stock relay will not be closed until after the indicators of a previously selected stock have been adjusted and the previously operated stock relay on the same channel has released.

As the eleventh positive pulse, which is the first of seven pulses required for the selection of the unison range for stock number 123 in the example assumed, is received over line 400 relay P1 and regenerator RGR1 again operate. Battery at armature 455 and make contact of relay A1 is applied to conductor 456, armature 460 and make contact of relay AG, conductor 458, armature 425 and make contact of relay Y1, armature 462 and break contact of relay W1, armature 475 and make contact of relay CLH, conductor 474, armature 473 and make contact of relay S3, conductor 497, to the winding of relay LA causing this latter relay to operate and lock in series with relay W1, break contact and upper armature of relay X1, conductor 459, armature 461 and break contact of relay RLS, to battery. Relay W1 does not operate, however, until relay A1 releases. As the eleventh positive pulse is removed from line 400 and relays P1 and A1 release and relay W1 operates, the locking circuit for relays CLH and Y1 is interrupted at the break contact and armature 430 of relay W1 causing relays CLH and Y1 to release. Relay A1 operates in response to the twelfth positive pulse on line 400 causing the operation of relay LL over the following circuit. Battery, armature 455 and make contact of relay A1, conductor 456, armature 460 and make contact of relay AG, conductor 458, armature 415 and break contact of relay X1, armature 416 and make contact of relay W1, armature 421 and make contact of relay LA, to the winding of relay LL and thence to ground. As relay LL operates and closes its locking armature a circuit is completed from the winding of relay LL, armature

419 and make contact thereof to the winding of relay X1, break contact and armature 430 of relay Y1, to battery on conductor 459. Relay X1 operates over this circuit when relay A1 releases. The operation of relay X1 opens the locking circuit for relays W1 and LA which release.

As the thirteenth positive impulse is received over line 400, relays P1 and A1 again operate causing the operation of relay HL in a manner previously described. It will be noted, however, that the operating circuit for the range relay counting chain for this cycle of operation includes the operated armature 460 and make contact of relay AG as a connecting means between conductors 456 and 458. It will be noticed that these conductors were previously connected by armature 457 and break contact of relay S3 for the first operation of the range counting chain.

As the thirteen positive pulse is removed from line 400, relays P1 and A1 release thereby removing battery from one side of relay Y1 which operates in series with relay HL and at its armature 430 and break contact interrupts the locking circuit for relays X1 and LL, thereby causing them to release.

As relay A1 operates in response to the fourteenth positive pulse, battery is placed on conductor 458 as previously described, armature 425 and make contact of relay Y1, armature 462 and break contact of relay W1, armature 421 and make contact of relay HL, to the winding of relay LO which operates and locks in series with relay W1, break contact and armature 430 of relay X1, to battery at conductor 459. As relay A1 releases, relay W1 operates and at its break contact and armature 430 interrupts the circuit for relays Y1 and HL, which release.

As the fifteenth positive pulse is received on line 400, relays P1 and A1 again operate and cause battery to be placed on conductor 458, armature 415 and break contact of relay X1, armature 426 and make contact of relay W1, armature 421 and make contact of relay LO, to the winding of relay HI which operates and locks in series with relay X1, break contact and armature 430 of relay Y1, to battery on conductor 459.

As the fifteenth impulse is removed from conductor 400, relays P1 and A1 release and relay X1 operates in series with relay HI and at its break contact and armature 430 interrupts the circuit to relays W1 and LO which release.

As the sixteenth positive impulse is received on line 400, relay A1 operates and places battery on conductor 458, armature 425 and break contact of relay Y1, armature 426 and make contact of relay X1, armature 421 and make contact of relay HI, to the winding of relay OP which operates and locks in series with the winding of relay Y1, break contact and armature 430 of relay W1, to battery on conductor 459.

As relay A1 is released at the end of the sixteenth positive pulse, relay Y1 operates and interrupts at its armature 430 and break contact the circuit to relays X1 and HI which release.

As the seventeenth pulse is received over line 400, relays P1 and A1 again operate, causing battery to be placed on conductor 458, armature 425 and make contact of relay Y1, armature 462 and break contact of relay W1, armature 421 and make contact of relay OP, to the winding of the unison range relay UN which operates and locks in series with relay W1, break contact and armature 430 of relay X1, conductor 459, armature 461 and break contact of relay RLS, to battery.

At the end of the seventeenth positive pulse, relays P1 and A1 release permitting the operation of relay W1 in series with relay UN. Relay W1 at its armature 430 and break contact interrupts the circuit of relays Y1 and OP which release.

It will be noted that the eleventh to seventeenth positive pulses operated relays LA to UN of the range counting chain respectively. As unison is the range corresponding to the stock in the example assumed, no further positive pulses for range selection are received on conductor 400 at this time.

Slow-releasing relay SR has been held operated over a circuit from its winding, conductor 466, armature 468 and make contact of relay S1, conductor 469, make contact and armature 449 of relay A1, to grounded battery during the reception of the signals for the range selection, as relay A4 does not operate at this time. After the seventeenth positive pulse has been removed from line 400, armature 449 of relay A1 remains in the unoperated position thereby interrupting the circuit to the winding of relay SR for a period greater than the release time of this relay causing relay SR to release.

Referring to Fig. 2—G, it will be seen that the seventh impulse for range selection, ring TR2 odd-numbered segments 25 to 41, occurred while the brush TB crossed segment 37 of distributor TD1. No additional impulses are transmitted on conductors 400 and 401 until brush TB comes into contact with segment RLS of ring TR2 at which time a negative impulse is transmitted on conductor 401, causing relay P4, Fig. 4—A, to operate.

As the armature of relay P4 moves to the operated position, grounded battery at the operated contact of relay P4 is placed on conductor 3 of cable 412, armature 422 and make contact of relay S2, armature 498 and break contact of relay SR, through the winding of relay LC and thence to ground, causing relay LC to operate. The locking circuit for relays S1 and AG is interrupted at the break contact and armature 468 of relay LC causing relays S1 and AG to release. The release of relay AG removes ground from conductors AG1 and AG2 of cable 477 but as no stock on this channel had been previously selected, these circuits were without effect.

Relay RA, Fig. 4—E, now operates over the following circuit: Winding of relay RA, conductor 1 of cable 499, break contact and armature 501 of relay CO, make contact and armature 468 of relay LC, to grounded battery. Relay RA locks over its operated contacts 500, conductor 1 of cable 502, make contact and armature 496 of relay S2, to battery. As brush TB, Fig. 2—G, leaves the RLS segment of ring TR2, the negative switching impulse is removed from line 401 and relays P4 and LC release.

It will be noted that as LC operated, the armatures 493, 530 and 638 thereof, removed battery from conductors 1, 2 and 3 of cable 503 thereby interrupting the locking circuits for range relays CLH1 to LA1, Fig. 4—E. As none of these range relays were operated at the time relay LC operated, these circuits were without effect. The release of relay LC prepared these circuits for subsequent operation.

The operation of relay RA completes a circuit for the operation of a stock relay, which in the example assumed is that relay associated with stock number 123 which operates as follows: Winding of stock relay STK 123, Fig. 4—G, by

way of conductor 505, flexible conductor 506, Fig. 4—F, plug 507, jack 123, contact 484 of relay 110, contact 485 of relay 20, conductor 486, armature 490 and make contact of relay U3, Fig. 4—D, conductor 487, armature 488 and break contact of relay T—O, conductor 489, operated contact 491 of relay RA, conductor 492, armature 493 and break contact of relay LC, armature 494 and break contact of relay AG, make contact and armature 496 of relay S2 to battery.

Relay UN1, Fig. 4—E, operates on a circuit from the winding of this relay, conductor 506, armature 640 and make contact of relay UN, Fig. 4—C, conductor 492, armature 493 and break contact of relay LG, armature 494 and break contact of relay AG, conductor 495, make contact and armature 496 of relay S2, to grounded battery.

The following range relays now operate under control of the operated relay UN1, OP1, HI1, LO1 and LA1, Fig. 4—E, in parallel, corresponding to the Open, High, Low and Last ranges comprising a unison range selection, over a circuit from their windings through the operated contacts of relay UN1, conductor 492, armature 493 and break contact of relay LC, armature 494 and break contact of relay AG, make contact and armature 496 of relay S2, to grounded battery. The relays OP1, HI1, LO1 and LA1 upon operating lock through an associated contact 670 thereon and thence to battery at armatures 530 and 638 of relay LC.

The stock relay STK 123 now locks by way of its contact 650, contact 660 of switch 408, conductor 21 of cable 507, through contacts of relays OP1 to LA1 in parallel, conductor 3 of cable 503, break contact and armature 680 of relay LC, to grounded battery.

The transmitting distributor TD1, Fig. 2—G, has now completed its first revolution during which signals corresponding to the stock number and range characteristics of a quotation for the stock number 123, price 98 $\frac{3}{4}$ and unison range have been received. During the time of this revolution the receiving apparatus of Figures 4—A to 4—G has operated to select the stock relay STK 123, Figure 4—G, and close circuits to the indicator units of the open, high, low and last ranges of this stock through operated contacts of relays OP1, HI1, LO1 and LA1 respectively to the contacts of regenerators RGR1, RGR2 and RGR3. The indicator units corresponding to the tens, units and fractions digits of these ranges will be subsequently actuated to display the quotation 98 $\frac{3}{4}$ on each of these four ranges. As this quotation is the first quotation on channel 1, it is assumed that all indicators of channel 1 stocks are now on their blank settings with the result that the following restoration impulses will not move these indicators from their blank settings. It will also be recalled that at this time stock relay STK 123 and range relays OP1 to LA1 are held operated through their locking contacts. As the description proceeds it will be noted that these relays do not release until after all impulses required for the operation of the indicators of the selected stock have been received.

A description of the operation of the receiving apparatus in response to signals from transmitting distributor TD1, Fig. 2—G, during the second revolution thereof, to display the quotation 98 $\frac{3}{4}$ on the indicators of the stock position 123, Fig. 4—G, whose selection was just completed, follows:

As the switching impulse is transmitted over line 400, relay P1 operates causing the operation

of regenerator RGR1 which in turn operates regenerators RGR2, RGR3 and RGR4 in unison. Regenerator RGR2 operates on a circuit from the winding of relay A2, conductor 1 of cable 436, break contact and armature 437 of relay RT, break contact and armature 438 of relay RT1, break contact and armature 439 of relay NR, armature 441 and break contact of relay SI, conductor 442, make contact and armature 443 of relay A1, conductor 444, break contact and armature 445 of relay SR, to grounded battery. Regenerator RGR3 operates over a circuit from the winding of relay A3, conductor 2 of cable 436, break contact and armature 445 of relay RT1, break contact and armature 446 of relay RT, armature 447 and break contact of relay SI, conductor 448, make contact and armature 508 of relay A1, conductor 444, break contact and armature 445 of relay SR, to grounded battery. Regenerator RGR4 operates over a circuit from the winding of relay A4, conductor 3 of cable 436, break contact and armature 449 of relay RT1, break contact and armature 451 of relay RT, armature 452 and break contact of relay SR, conductor 453, make contact of armature 454 of relay A1 to grounded battery.

The regenerator RGR1 also causes the operation of relay RLS, from ground at the winding of relay RLS, make contact and armature 509 of relay S3, break contact and armature 510 of relay AG, conductor 456, make contact and armature 455 of relay A1 to grounded battery. As relay RLS operates, it closes a circuit from ground through resistance 511 over its armature 512 and make contact to the winding of relay S3, thereby holding S3 operated. As armature 512 of relay RLS moves to its operated position, contact 476 of relay RLS opens and causes relay S2 to release.

As relay RLS moved its armature 461 to the operated position, battery was removed from conductor 459, armature 432 and make contact of relay S3, conductor 481, winding of relay 20, conductor 479, make contact and upper armature of relay T2, conductor 478, winding of relay 10-30, thereby causing relays 20 and 10-30 to release. Relay 110, Fig. 4-F, releases as its operating circuit is opened at armature 461 of relay RLS and at contact 483 of relay 10-30. Relays UN and Y1, Fig. 4-C, release as their holding circuit is opened at armature 461 of relay RLS. Relays UN1 and RA, Fig. 4-E, release as their locking circuits are opened at armature 496 of relay S2. Locking circuits for counting relay chains H1 to H9, T1 to T9, and U1 to U9 are opened at armatures 435, 419 and 424 respectively of relay RLS causing the release of relays H1 and W2, T2 and X3, U3 and Y4, which were operated as a result of signals transmitted during the first revolution of transmitting distributor TD1, Fig. 2-G.

As regenerators RGR2 to RGR4 operate, battery is applied to conductors T1 to T4, U1 to U4 and F1 to F4 of cable 512, through resistances 513, closed contacts of relays OP1, HI1, LO1, LA1, at which point the units leads U1 to U4 are diverted by way of conductors 6, 9, 12 and 15 respectively of cable 518, through armatures 519, 683, 684 and 685 and their break contacts of relay RT, to conductors 7, 10, 13 and 16 of cable 499, to conductors 7, 11, 15 and 19 of cable 507, in which cable conductors 6, 8, 10, 12, 14, 16, 18 and 20 are connected directly to the contacts of relays OP1, HI1, LO1 and LA1 which are associated with leads T1 to T4 and F1 to F4. The conductors 6 to 20 of cable 507 extend the cir-

cuits through contacts of switch 403, Fig. 4-G, and contacts of relay STK-123, to indicators of the ranges OP, HI, LO, and LA, and the commutators thereof over conductors 514 and 515, contacts of relay STK-123 and switch 498, through conductors AG1 and AG2 of cable 477 to armatures 521 and 639 of relay AG which are at this time in their unoperated position. Since, in the example assumed, all indicators of stock 123 are in their blank position prior to the transmission of the price 98 $\frac{3}{8}$, unison range, all of the indicators of stock 123 will have their switches 516 moved to the left as shown on Fig. 4-G, and consequently none of these indicators will respond at this time to the 10 restoration pulses of which the first pulse has just been received.

As the switching impulse is removed from line 400, relay P1 and regenerators RGR1 to RGR4 release. Relay A1 at its armature 455 removes battery from conductor 456, armature 510 and break contact of relay AG, armature 509 and make contact of relay S3, to the winding of relay RLS causing this latter relay to release. As relay RLS moves its armature 512 to the unoperated position the holding circuit for relay S3 is opened and relay S3 releases.

As in the assumed example only one quotation is to be transmitted on channel 1. The transmitting apparatus shown on Figs. 2-A to 2-G sends the stock arbitrary number 100 as a release signal to the selector.

As brush TB, Fig. 2-G, engages segment 4 of the transmitting distributor TD1, a signal of negative polarity is transmitted from rings TR2 and TR3 simultaneously over conductors 400 and 401, causing the operation of relays P3 and P4 respectively. The operation of relay P3 causes relay T1, Fig. 4-D, to operate in response to the first pulse for the tens digit 0 and the operation of relay P4 operates relay U1 to register the first pulse of the units digit of the arbitrary number 100. As brush TB passes over even-numbered segments 6 to 22 of rings TR2 and TR3, nine additional negative pulses are sent over lines 400 and 401 causing the operation of the tens and units counting chains shown on Fig. 4-D, until relays T9 and U9 are operated following the reception of the 10th negative impulse over lines 400 and 401 respectively. As the 10th pulse is removed from these lines relays P3 and P4 release, relay W3 operates in series with relay T9, and relay W4 operates in series with relay U9.

As the brush TB engages segment 5 of ring TR3, a positive pulse is sent over line 401 causing relays P2 and H1 to operate and register digit one corresponding to the hundreds digit of the number 100. The release of relay P2 following the removal of the positive pulse from line 401 causes relay W2 to operate in series with relay H1.

As brush TB, Fig. 2-G, comes into contact with segment 5 (RES) of ring TR2, a signal of positive polarity is again placed on conductor 400 thereby causing relay P1, Fig. 4-A, to operate. As relay P1 moves its armature to the operated position, regenerators RGR1 to RGR4 operate in the manner previously described.

Relay LA of the range counting chain operates on a circuit from the winding of this relay, break contact and armature 417 of relay Y1, break contact and armature 416 of relay W1, break contact and armature 415 of relay X1,

conductor 458, break contact and armature 457 of relay S3, conductor 456, make contact and armature 455 of relay A1 to grounded battery. Relay LA locks in series with relay W1, break contact and armature 430 of relay X1, conductor 459, armature 461 and break contact of relay RLS to grounded battery. As brush TB leaves segment 5 (RLS) of ring TR2 of distributor TD1, the positive signal is removed from conductor 400 causing the release of relay P1 and regenerators RGR1 to RGR4 and the operation of relay W1 in series with relay LA as previously described. As regenerators RGR2, RGR3 and RGR4 operated in response to the second positive signal, battery was applied through conductors T1 to F4 of cable 512 to the indicator units of ranges OP, HI, LO, and LA, but as herein before mentioned these pulses are without effect at this time, it being assumed that the indicators are now on blank, as this is a first quotation.

As brush TB passes over segments 7 to 21 of distributor TD1 eight additional positive pulses are applied successively to conductor 400, causing the operation of relay P1 and regenerators RGR1 to RGR4 in response to each of these pulses and the operation and release of relays LL to UN, Fig. 4—C, and the operation of relay CLS of the range relay counting chain, as the ninth positive pulse is removed from conductor 400, relays A1, P1 releases and relay X1 operates in series with relay CLS. As the tenth positive pulse is applied to conductor 400, relays P1, A1 and CLH operate and as the tenth positive impulse is removed from line 400 relay Y1 operates in series with the locking circuit for relay CLH over a circuit from grounded battery, break contact and armature 461 of relay RLS, conductor 459, armature 430 and break contact of relay W1, winding of relay Y1, make contact and armature 419 of relay CLH, thence through the winding of relay CLH to ground. As relay Y1 operated, the locking circuits of relays CLS and X1 were opened at the break contact and armature 430 of relay Y1 causing relay CLS and X1 to release.

Relay SR operates over a circuit from its winding, conductor 466, make contact and armature 465 of relay CLH, make contact of relay Y1, break contact of relay S3, conductor 459, armature 461 and break contact of relay RLS to grounded battery. Relays AG and S1 operate in parallel when armature 455 of relay SR moves to its operated position.

Relay SR as previously mentioned is slow to release and remains operated on subsequent pulses from regenerators RGR1 and RGR4 over a circuit from the winding of relay SR, armature and make contact 468 of relay S1, conductor 469, make contact and armature 449 of relay A1 to battery, and a circuit from relay SR, armature 468 and make contact of relay S1, armature 471 and break contact of relay RT1, conductor 4 of cable 436, make contact and armature 472 of relay A4 to grounded battery.

As relay AG closed its armatures 521 and 639, ground is applied through conductors AG1 and AG2 of cable 477 to the windings of the indicators of stock STK 123 thereby preparing these indicators for operation in response to additional impulses over lines 400 and 401.

Relay S1 locks over a circuit to the break contact and armature 468 of relay LC and holds relay AG operated.

As the 11th positive impulses is applied to con-

ductor 400 by the passage of brush TB, Fig. 2—G, across segment 23 of ring TR2, relays P1 and A1, Fig. 4—A operate, but regenerators RGR2, RGR3, and RGR4 do not operate therefrom as their operating circuits are opened at contacts of relays SR and S1, the circuit to relay A2 is open at armature 441 and the circuit to relay A3 is open at armature 447 of relay S1, the battery supply to both of these circuits being opened at armature 445 of relay SR, and the operating circuit for relay A4 is open at armature 452 of relay SR.

Relay S2 operates over a circuit from its winding, break contact and armature 453 of relay S3, conductor 474, make contact and armature 475 of relay CLH, break contact and armature 462 of relay W1, make contact and armature 425 of relay Y1, conductor 458, make contact and armature 460 of relay AG in parallel with the break contact and armature 457 of relay S3, conductor 456, make contact and armature 455 of relay A1 to grounded battery.

Relay S2 locks over armature 450 and make contact thereof, contact 476 of relay RLS thence through the winding of relay S3 to grounded battery. Relay S3 does not operate at this time as its winding is short circuited by armature 455 and make contact of relay A1.

As the 11th positive pulse is removed from line 400, relays P1 and A1 release, thereby causing the operation of relay S3 in series with the locking circuit of relay S2.

When armature 482 of relay S3 moves to the operated position, a circuit is closed from battery at armature 461 of relay RLS, conductor 459, armature 482 and make contact of relay S3 conductor 481, armature 525 and make contact of relay T0, conductor 526, make contact and armature 527 of relay UO, conductor 528, and the winding of relay CO to ground, thereby operating relay CO.

A circuit is also closed from battery at armature 461 of relay RLS, conductor 459, armature 482, and make contact of relay S3, conductor 481, armature 525, and make contact of relay T0, conductor 526, resistance 529, Fig. 4—F, to the winding of relay 01—09 and thence to ground, causing relay 01—09 to operate.

As in the example assumed the signals for one quotation only are being transmitted and received, no additional pulses of positive character will be transmitted to line 400 at this time.

As the brush TB, Fig. 2—G, crosses segment 24 at the beginning of the second half of the second revolution of transmitting distributor TD1, negative battery is applied to conductors 400 and 401 thereby operating polarized relays P3 and P4, to receive the first signal of the units and fraction portions of the price.

As relay P3 operates, a circuit is closed from battery at the armature of this relay through conductor 2 of cable 412, armature 427 and make contact of relay S2, armature 447 and break contact of relay RT, armature 445 and break contact of relay RT1, conductor 2 of cable 436 to the winding of relay A3 causing this latter relay to operate. As relay A3 operates, the first actuation pulse is sent to the units indicators of the open, high, low, and last ranges of the selected stock STK 123.

The circuits for the operation of the units digit indicator of each of the four ranges open, high, low, and last will now be traced: battery at armature 684 and make contact of relay A3, conductor U1 of cable 512, resistance 513, contact 517 of re-

lay OP1, conductor 6 of cable 518, armature 519 and break contact of relay RT, conductor 7 of cable 499, conductor 7 of cable 507, contact of switch 408, contact of relay STK—123 through the winding of the unit digit indicator of the range OP, contact of switch 516, conductor 514, contact of relay STK—123, contact of switch 408, conductor AG2 of cable 477, armature 521 of relay AG and make contact thereof to ground. The circuit for operating the unit digit indicator of the high range of stock 123 is completed from battery at armature 685 and make contact of relay A3, conductor U2 of cable 512, resistance 513, contact of relay HI1, conductor 9 of cable 518, armature and break contact of relay RT, conductor 10 of cable 499, conductor 11 of cable 507, contact of switch 408, contact of relay STK—123, winding of the unit digit indicator of the HI range, conductor 514, contact of relay STK—123, contact of switch 408, conductor AG2 of cable 477, armature 521 and make contact of relay AG to ground. The circuits for the operation of the unit digit indicator of the low and last ranges from contacts of relay A2 through conductors U3 and U4 respectively are similar to the circuits just described, and will, therefore, not be traced.

As relays P3 and A3 release, battery is removed from the winding of the units indicators of the selected ranges causing these indicators to become positioned to display the digit 1. As the indicators are moved from their normal or blank position the switch 516 of each indicator is moved to the right hand contact and remains so moved until the blank position is again reached. As each switch 516 is moved to the right, due to the operation of the associated indicator from blank, the winding of the indicator is disconnected from ground on conductor AG1 or AG2 and connected to ground 522.

As the stock price to be displayed is 98 $\frac{7}{8}$ in the example assumed, seven additional negative signals will be applied to conductor 400 causing the operation of relay P3 and regenerator RGR3 to respond and transmit 7 additional pulses to the units indicators of the unison range to display the units digit 8. No additional negative pulses on line 400 are received immediately following the 8th negative impulse.

It will be noted that relay P4 and regenerator RGR4 responded to 7 signals of negative polarity over conductor 401 during the time that the first 7 negative signals were received on line 400, causing the operation of the indicator units of the fractions portion of the stock price of the ranges OP, HI, LO, and LA from contacts and armatures 686 and 687 of relay A4 through conductors F1, F2, F3 and F4 of cable 512.

As the circuits for the operation of each of these fractions indicators is similar, the circuit for the operation of the fraction indicator of the open range only will be described. Battery at armature 686 and make contact of relay A4, conductor F1, cable 512, resistance 513, contact 523 of relay OP1, conductor 8 of cable 507, contact of switch 408, operated contact of relay STK—123, winding of fractions indicator of open range, switch 516, conductor 414, contacts of relay STK—123 and switch 408, conductor AG2 of cable 477, armature 521 of relay AG to ground at the make contact thereof. As previously explained, the windings of the various indicators are disconnected from conductors AG1 or AG2 and reconnected to ground 522 as the indicators are moved from their blank positions.

Seven negative pulses only are transmitted on

conductor 461 to display the fraction portion of the price $\frac{7}{8}$, and thereafter no further negative impulses are transmitted on conductor 401 during the time allotted for the transmission and reception of the fraction price signals.

As brush TB crossed segment 25 of transmitting distributor TD1, a positive pulse was transmitted on conductor 401 causing the operation of relay P2 and regenerator RGR2. Relay A2 of this regenerator operated on a circuit from its winding, conductor 1 of cable 436, break contact and armature 437 of relay RT, break contact and armature 438 of relay RT1, make contact and armature 524 of relay S1, make contact and armature 427 of relay S2, conductor 1 of cable 412, armature and make contact of relay P2 to grounded battery. As relay A2 operates, battery is applied by armatures 642 and 638 and their respective make contacts of relay A2, to conductors T1, T2, T3 and T4 of cable 512 through resistances 513, and thence through circuits previously described to the windings of the tens digit indicators of the open, high, low and last ranges, causing these indicators to operate.

Eight additional impulses of positive polarity on conductor 401 caused the indicators of the tens digit of the unison range (UN), to operate to display the digit 9, each successive pulse causing the selected indicators to step one position to display the next higher number. No further signals are transmitted on conductor 401 during the time allotted for the transmission of signals for the tens price digit, therefore, for the remaining time relays P2 and A2 remain unoperated. The slow to release relay SR which had been previously operated as hereinbefore described, was constantly maintained in its operated condition by the closure of a circuit at armature 472 and its make contact of regenerator RGR4 each time this regenerator operated in response to the seven negative impulses received on conductor 401. The termination of the series of impulses caused relay SR to release.

When brush TB, Fig. 2—G, comes into contact with segment RLS of ring TR2, a signal of negative polarity is applied to conductor 401 causing relay P4 to operate and apply battery to conductor 3 of cable 412, armature 422 and make contact of relay S2, armature 493 and break contact of relay SR to the winding of relay LC which operates. The opening of the armatures 530, 638 and 680 of relay LC removes battery from conductors 1, 2 and 3 of cable 503 causing the release of range relays OP1 to LA1 and the stock relay STK—123, relays S1 and AG release as their locking circuits are interrupted at armature 468 and break contact of relay LC.

As brush TB, Fig. 2—G, leaves segment RLS at the end of the second revolution of distributor TD1, relay P4 releases and at its armature opens the operating circuit of relay LC which then releases and restores battery to conductors 1 and 2 of cable 503 thereby preparing these circuits for locking the range relays, Fig. 4—A, one or more of which will be operated during the transmission of a subsequent quotation. The release of relay LC also applied battery through conductor 503 to a contact on each of the range relays in parallel, which upon operation of one or more of these range relays is applied by way of conductor 21 of cable 507 to the locking contact 650 on each of the stock relays STK, Fig. 4—G, for maintaining the selected stock relay STK in the operated position for reception of the subsequent impulses to the associated indicators. This lock-

ing battery is carried through contacts on the range relays to provide ample time for a previously selected stock relay to release, before locking battery is again applied to the contacts of all gang relays of the channel 1 group.

The release of relay LC completed a circuit from battery at armature 496 and make contact of relay S2, conductor 495, break contact and armature 494 of relay AG, break contact and armature 493 of relay LC, armature 361 and make contact of relay CO, conductor 402, winding of relay A1, break contact and armature 403 of relay AA1 to ground thereby operating relay A1 of regenerator RGR1. Regenerators RGR2, RGR3 and RGR4 operate from regenerator RGR1 as previously described, but perform no other function at this time.

Relay RLS operates on a circuit from its grounded winding, make contact and armature 509 of relay S3, break contact and armature 510 of relay AG, conductor 456, make contact and armature 455 of relay A1. Relays S2, CLH and Y1, 01-09 and CO release as their several locking circuits are interrupted at break contacts and armatures 476 and 461 of relay RLS.

As armature 496 of relay S2 moves to the unoperated position relay A1 releases causing the release of regenerators RGR2 to RGR4. As armature 455 of relay A1 moves to the unoperated position, battery is removed from the winding of relay RLS causing this latter relay to release. Relay S3 releases as the holding circuit thereof is opened at armature 512 and make contact of relay RLS.

No-reset of tens digit indicators

As is well known the price of stocks appearing on a ticker tape may include the units and fractions characters only of the stock price, the tens and hundreds digits thereof if any not being shown. It will be understood that this condition frequently arises during the trading hours of the stock exchange, as for example, a stock designation may appear on a ticker tape followed by the price $4\frac{1}{2}$, it being understood that the current price of this stock is in the order of \$34.00 per share. Assuming that the previously displayed last price of this stock on the quotation board is $33\frac{3}{8}$, and it is desired to display a last price of $34\frac{1}{4}$, a movement of the units and fractions indicators only is required, as the tens indicator is already positioned to display the digit 3. Therefore, the indicator for displaying the tens price digit is not operated.

My invention, therefore, provides means for transmitting impulses for normalizing and actuating the units and fractions indicators only when so desired, of any stock in the following manner:

To change a stock price of $33\frac{3}{8}$ to a new price of $34\frac{1}{4}$ in the last range without resetting the tens digit indicator, the operator at the transmitting station prepares a tape having perforations corresponding to the 3 digits of the stock number followed by the perforations corresponding to the range code last LA (UF), price code digits blank, 4 and 1 respectively. It will be noted that the operation of the range key last LA (UF) results in a transmission of a range signal of marking, spacing, spacing, marking, Fig. 7, and the operation of the blank key results in the transmission of a tens price code having all spacing signals.

The signals for this quotation are received on distributor RD of the retransmitting apparatus,

Figs. 2—A to 2—G. As brush RB1 crosses segments 18 to 24 of ring RR2, relays RA1, RA3 and RA4 are operated to store the signals for the range selection of the quotation. The circuits controlled by these relays will now be described.

Relays RA1, RA3 and RA4 cause the operation of the intermediate storage relays IRA1, IRA3 and IRA4 respectively, as previously described, these latter relays closing a circuit in part to the winding of relay NR, Fig. 2—G. As the brush TB, Fig. 2—G of retransmitting distributor TD1 engages segment 4 of ring TR1, relay RL2 operates and closes a circuit from ground at its make contact and armature 632, through the winding of relay NR, conductor 2 of cable 335, make contact and armature 376 of relay IRA3, make contact and armature 377 of relay IRA1, through resistance 292 to grounded battery 393, causing relay NR to operate. As brush TB leaves segment 4 of ring TR1, relay RL2 releases and closes a circuit at its grounded contact 378, through the make contact and armature 377 of relay NR to the winding thereof, holding relay NR locked under control of relay RL2. As brush TB engages segment 2 (NR) of ring TR3, a circuit is closed from grounded segment of TR4, brush TB, segment NR of ring TR3, armature 240 and make contact of relay NR to the winding of relay S2, causing this latter relay to operate and transmit a no-reset signal of positive polarity on conductor R2. This no-reset signal is repeated by the repeating apparatus shown on Fig. 3 to conductor 401 extending to the various subscribers' stations. The function of this no-reset signal at the selector will be described hereinafter.

As brush TB leaves segment NR, this no-reset signal is removed from conductors R2 and 401. As brush TB engages segment 4, relay RL2 operates and at its contact 378 opens the locking circuit to relay NR which releases, provided however, that the next quotation to be transmitted on this channel does not also contain a no-reset combination.

Referring to Figure 7, it will be noted that any combination of the range code containing the third unit thereof marking, other than the combinations 2 and 3 for open (OP), 3 and 4 for close tens, units and fractions (YCL—TUF), and 3 alone for unison (UN) will cause the operation of relay NR which causes the transmission of a no-reset signal of positive polarity to relay P2, Fig. 4—A, over conductor 401.

It will be noted that the locking circuit of the tens digit relays TP1 to TP4, Fig. 2—B, is connected through break contacts 271 of range relays RA1 to RA4 in such a manner as to cause the locking circuit for relays TP1 to TP4 to be opened when a no-reset signal is received. This circuit is provided in order that any of the relays TP1 to TP4 which may have become inadvertently operated, will be released so that their settings will not be transferred to the associated relays ITP1 to ITP4.

With relays TR1 to TP4 in their released positions, relays ITP1 to ITP8 do not operate, and as the brush TB of retransmitting distributor TD1 engages segment 24 of ring TR1, a circuit is closed from grounded segment of ring TR4, brush TB, segment 24 of ring TR1, conductor NR of cable 224, break contact and armature 341 of relay TR8, break contact and armature 342 of relay TP7, break contact and armature 226 of relay TP6, conductor 3 of cable 335, winding of the tens price cut off relay TPC to battery,

causing relay TPC to operate. The operation of relay TPC prevents any of the pulses generated by the passage of brush TB over odd-numbered segments 25 to 43 of ring TR3 which control the tens price digit of the selected stock, from being transmitted.

It will be recalled that restoration impulses for the indicators of a selected stock are transmitted to the selector over a single conductor. The manner in which the selector prevents these restoration pulses from restoring the tens indicator to blank, of the last range in the example assumed will now be described:

It will be noted that the transmission of a no-reset signal occurs just in advance of the restoration signals. As the armature of relay P2, Fig. 4—A, closes its contact in response to the no-reset signal over conductor 401, a circuit is closed from battery at armature of P2, conductor 1 of cable 412, armature 427 and make contact of relay S2, armature 524 and break contact of relay S1, to the winding of relay NR and thence to ground, causing relay NR to operate and lock through its operated armature 633 and make contact thereof to the break contact and armature 634 of relay LC and thence to battery. Relay NR at its armature 439 interrupts the operating circuit for regenerator RGR2 so that regenerators RGR3 and RGR4 only will respond to restoration signals on line 400 under the control of relay P1 and regenerator RGR1. In this manner, restoration impulses are transmitted to the units and fractions indicators only of the last range. As relay LC operates at the end of the quotation, the locking circuit for relay NR is opened at armature 634 of relay LC, and relay NR releases.

Displaying the previous closing price

The transmitting and receiving apparatus disclosed on the accompanying drawings provides for the control of a maximum of 3 indicators in the various range positions on the quotation boards during any single transmission. It has been stated hereinbefore that the previous close range comprises one indicator unit for displaying the hundreds digit of the price, in addition to the three indicators for the tens, units and fractions positions of the price, making a total of four indicators in this range for each stock.

To display the price 111½, two separate transmissions are required. No appreciable disadvantage results from the use of two transmissions for stock quotations having a previous closing price greater than 99½ as these quotations are preferably transmitted outside of the regular trading period of the stock exchange, during which time the speed of the system may be less than that required during market hours. When displaying the previous closing price not greater than 99½ one transmission only is required.

The operation of the system to display the previous closing quotation 111½ for the stock number 123 will now be described: The operator at the transmitting station depresses stock selection 123, range key YCL (H) and price keys 1, blank, blank, respectively. It will be noted, referring to Fig. 7, that the range YCL (H) has the second unit of the range code marking and the first, third and fourth units of this code spacing. As the brush RBl passes over segments 18 to 21 of the receiving distributor RD, Figs. 2—A to 2—C, relay RA2 only of the range relays RA1 to RA4 is operated and this

setting is subsequently transferred to the intermediate range relays IRA1 to IRA4, Fig. 2—E, relay IRA2 only of this group being operated.

It will be recalled that during the first half revolution of the retransmitting distributor TDI, Fig. 2—G, the range counting relays were operated a sufficient number of times to cause the operation of relay CLH. As brush TB, Fig. 4—G, engages segment 24 of ring TR1 a circuit is closed from the grounded segment of ring TR4, brush TB, segment 24 of ring TR1, conductor NR of cable 224, break contact and armature 635 of relay IRA3, break contact and armature 636 of relay IRA4, make contact and armature 345 of relay IRA2, break contact and armature 225 of relay IRA1, conductor 1 of cable 335, to the winding of relay RAC and thence to grounded battery, causing the range cut-off relay RAC to operate and lock over the following circuit:

Winding, make contact and armature 345 of relay RAC, conductor 2 of cable 322, break contact and armature of relay RL5 to ground. The operation of relay RAC at its armature 232 opens the circuit to transmitting relay S1 so that no positive pulses will be transmitted over conductors R1 and 400 as brush TB passes over segments 25 to 41 of retransmitting distributor TDI. Referring now to the selector, Figs. 4—A to 4—G, the operation of relay CLH in response to the first series of positive pulses for timing and restoration closed a circuit to subsequently operate relay CLH1, Fig. 4—E, as follows:

Battery at armature 496 and make contact of relay S2, conductor 495, break contact and armature 494 of relay AG, break contact and armature 493 of relay LC, conductor 492, make contact and armature 637 of relay CLH, conductor 6 of cable 634, contact 639 of relay RA and thence to winding of relay CLH1. CLH1 operates over the circuit just traced and locks by way of its make contact 670, conductor 2 of cable 503, break contact and armature 638 of relay LC to battery. Relay CLH1 closed the following circuit to the hundreds indicator of the close range of stock STK—123, Fig. 4—G: Ground at make contact and armature 639 of relay AG, conductor AG1 of cable 477, closed contact and armature of switch 408, make contact of relay STK—123, switch 516 and winding of hundreds close indicator, make contact of relay STK—123, contact of switch 408, conductor 1 of cable 507, contact 641 of relay CLH1, resistance 513, conductor T1 of cable 512, make contact and armature 642 of relay A2 to battery. As relay P2 operates once in response to a signal of positive polarity on conductor 401, which is transmitted immediately after the timing and restoration signals have been completed, relay A2 will operate therefrom and cause the hundreds close indicator to move from blank to the first position, thereby displaying the digit 1. The operation of relay LC toward the end of the revolution of the transmitting distributor TDI, Fig. 2—G, releases relay CLH1, thereby interrupting the circuit between regenerator RGR2 and the hundreds indicator of the range position in which the previous close is displayed. It should be understood that during the foregoing description of the operation of the system necessary for the display of the hundreds digit of a stock price in the previous close range, that only those circuits having to do with the selection of the desired range and the operation of the indicator therein, were described, all other control circuits during that time op-

erating as hereinbefore described for displaying a quotation in the last range.

To display the remaining portion of the previous close price as in the example assumed having tens and units digits 1 and fractions $\frac{1}{8}$, the operator at the central station successively depresses stock selection keys 1, 2 and 3 as before, range key YCL (TUF) and price keys 1, 1 and $\frac{1}{8}$. Perforations in the tape resulting from the depression of the range key YCL (TUF) cause the transmission of a range signal having the third and fourth units of the range code marking and the first and second units spacing, Fig. 7. This range signal causes relays IRA3 and IRA4, Fig. 2—E, to operate in a manner hereinbefore described and close a circuit from grounded segment of ring TR4, brush TB, segment 40 of ring TR1, conductor 8 of cable 224, make contact and armature 345 of relay IRA4, make contact and armature of relay 344 of relay IRA3, break contact and armature 345 of relay IRA2, break contact and armature 225 of relay IRA1, conductor 1 of cable 335, to the winding of relay RAC and thence to grounded battery to operate relay RAC which at the armature 232 thereof interrupts the circuit of transmitting relay S1 after 8 range pulses of positive polarity have been transmitted to relay P1, Fig. 4—A, during the passage of brush TB over segments 25 to 39 of ring TR2 of retransmitting distributor TD1.

These 8 range signals cause the operation of relay CLS of the range relay counting chain, Fig. 4—C, which at its armature 643 closes the following circuit to operate relay CL1:

Battery at armature 496 and make contact of relay S2, conductor 495, break contact and armature 494 of relay AG, break contact and armature 493 of relay LC, conductor 492, make contact and armature 643 of relay CLS, conductor 5 of cable 634, contact 690 of relay RA, winding of relay CL1 to ground. Relay CL1 operates over the circuit just described and locks through the make contact 670 thereof, conductor 2 of cable 503, break contact and armature 338 of relay LC to grounded battery. Relay CL1 closes circuits between contacts 642, 684 and 686 of relays A2, A3, A4 and tens, units and fractions indicators respectively of the previous close range of stock STK—123.

The circuit for the tens indicator unit of this range only will be traced as the circuits for the units and fractions indicators are similar. Ground at make contact and armature 639 of relay AG, conductor AG1 of cable 477, contact of switch 408, contact of relay STK—123, conductor 515, switch 516 and winding of tens indicator unit T of range CL, contact of relay STK—123, contact of switch 408, conductor 2 of cable 507, contact 644 of relay CL1, resistance 513, conductor T1 of cable 512, make contact and armature 642 of relay A2 and thence to grounded battery. A signal of positive polarity on conductor 401 during the time allotted for transmission of price signals causes the operation of polarized relay P2 and relay A2 to close the circuit just traced and cause the tens indicator to be moved into position to display the digit 1. A signal of negative polarity on conductor 400 operates relay P3 and regenerator RGR3 and causes the units digit indicator U to be moved to its number 1 position. A signal of negative polarity on conductor 401 operates relay P4, and regenerator RGR4 thereby moving the fractions indicator into position to display the fraction $\frac{1}{8}$. When relay LC operates it opens the holding circuit for relay CL1 and the stock relay STK which release.

Displaying statistical data

The operation of the system for displaying statistical information as for example, the "volume of sales" at various times during the trading period of the New York Stock Exchange, will now be described:

At each subscriber's station a stock space in the display board bearing the designation Vol. sales may be provided having 4 indicator units in each of the 5 range positions thereof, making a total of 20 indicator units in this space. As each notice of total sales for a given period of time appears on the ticker tape during various portions of the trading period, this statistical data is displayed in a range position of the space "vol. sales," the first of such notices being displayed in the previous close range position, and each succeeding such notice is displayed in successive range positions. It is understood that three zeros are to be mentally added to each horizontal row of indicator units, the display representing thousands of shares sold. If one thousand shares is to be displayed, the indicator located in the fractions position would display the digit 1 and the indicators located in the hundreds, tens and units positions would be in their blank positions. If three million shares are displayed, the indicator in the hundreds position would display the digit 3 and the indicators located in the tens, units and fractions positions would each display the digit zero.

A display comprising only the indicators located in the units and fractions positions would require one transmission, all other displays for "volume of sales" requires two transmissions.

Assuming the first notice of sales appearing on the ticker tape showed a total of 1,246,000 shares sold. The operation of the system to display this information in the uppermost or close range position of the stock space "vol. sales" will be described:

It is required that an arbitrarily assigned number having the hundreds digit 6 thereof, be used for the selection of the "vol. sales" indicators, as for example, code number 611. The plug 409, Fig. 4—F, for example, will be inserted into jack 611 of the jack panel 411 of the channel 1 portion of the selector. The operator for the channel 1 quotations will, therefore, transmit the "volume of sales" data, although it will be understood that by placing the plug 409 into jack 611 of jack panel 411 of the channel 2 portion of each subscriber's selector, the channel 2 keyboard may be used for transmitting this information.

To transmit the digits 1 and 2 corresponding to the millions and hundred thousands digits of the "volume of sales" 1, 246, (000), the operator depresses the keys of her keyboard in the following order: Selection keys 711, range YCL (TUF), price keys 1, 2 and blank.

As the signals corresponding to the stock number 711 are received in the selection relays H7, T1 and U1, Figures 4—C and 4—D, are operated and locked through their associated relays W2, W3 and W4 to relay RLS. Armatures 504 of relay H7 and relay H8 are connected in parallel to the corresponding armature 504 of relay H6, so that the operation of relay H7 or relay H8 will result in the selection of a stock having the hundreds digit 6. Thus, the operation of relays H7, T1 and U1 cause battery to be applied to jack 611 and thence thru plug 409 and flexible conductor 506 to the winding of the multi-contact relay in the stock space "vol. sales" (not

shown but similar to stock position STK—123, Fig. 4—G) causing this latter relay to subsequently operate from the RA relay just before the retransmitting distributor TD1 starts the succeeding revolution thereof to transmit restoration and setting impulses to the selected indicators.

Relay RT has its operating circuit closed simultaneously with the operating circuit for the multi-contact relay operated by code number 611. This circuit is traced from battery at armature 496 and make contact of relay S2, break contact and armature 494 of relay AG, break contact and armature 493 of relay LC, conductor 492, contact 645 of relay RA, conductor 646, armature 647 and make contact of relay HT, conductor 1 of cable 648, break contact and armature 649 of relay RT1, through the winding of relay RT and thence to ground. Relay RT locks from ground through the winding, make contact and armature 651 of relay RT, break contact and armature 634 of relay LC to battery. The operation of relay RT connects by its armature 437 and make contact, polarized relay P2 to regenerator RGR3 and the armature 446 and make contact of relay RT connects relay P3 to regenerator RGR2, and relay RT also transfers by the armatures 653, 519, 683, 684 and 685 the various control circuits of the regenerator RGR3, from the units indicator conductors 4, 7, 10, 13 and 16 to conductors 2, 5, 8, 11 and 14 all of cable 499, Fig. 4—B.

It will now be apparent that the operation of relay RT has switched the circuits in the selector so that the signals, indicative of the millions and hundred thousands digits of the sales volume 1,246,000, which are transmitted in the tens and units price positions will be displayed in the hundreds and tens positions of the selected "vol. sales" display position under control of the selected range. These circuits will now be described in detail: As relay P2 operates in response to the positive pulse for the millions digit 1 transmitted in the tens price position, a circuit is closed from battery at the armature of relay P2, conductor 1 of cable 412, armature 427 and make contact of relay S2, armature 524 and make contact of relay S1, armature 433 and break contact of relay RT1, armature 437 and make contact of relay RT, armature 445 and break contact of relay RT1, conductor 2 of cable 436, winding of relay A3, break contact and armature of relay AA3 to ground causing relay A3 to operate. As relay A3 operates, it applies battery to conductor U1 of cable 512, resistance 513, contact 652 of relay CLH1, conductor 3 of cable 518, armature 653 and make contact of relay RT, conductor 2 of cable 499, conductor 1 of cable 507, and to the following circuit of equipment not shown, but similar to STK—123, Fig. 4—G, contact of switch 408, contact of relay "vol. sales," winding and switch 516 of hundreds indicator HCL, contact of relay "vol. sales," contact of switch 408 and thence to conductor AG1 of cable 477, armature 639 and make contact of relay AG1 to ground, causing the operation of the indicator in the close hundreds position of the "vol. sales" position to display the digit 1.

As relay P3 operates in response to the negative impulses comprising the hundred thousands digit 2 of the assumed example, which are transmitted in the units price position, battery is applied to conductor 2 of cable 412, armature 413 and make contact of relay S2, armature 446 and make contact of relay RT, conductor 1 of cable

436 through winding of relay A2, break contact and armature of relay AA2 to ground causing relay A2 to operate. As regenerator RGR2 operates, battery is applied to conductor T1 of cable 512, resistance 513, contact 644 of relay CL1, conductor 2 of cable 507, and thence to the following circuit of equipment not shown, but similar to STK—123, Fig. 4—G, contact of switch 408, contact of relay "vol. sales," winding and switch 516 of the tens indicator T of the close range CL, contact of relay "vol. sales," contact of switch 408 and thence to grounded conductor AG1, causing the close tens indicator to display the digit 2 in response to 2 pulses over this circuit. The subsequent operation of relay LC interrupts the locking circuit for relay RT causing the latter to release together with the range relay CL1 and the "vol. sales" relay operated under control of code number 611.

To transmit the digits 4, 6 corresponding to the ten thousands and thousands digits of the "volume of sales," 1,246,000 the operator depresses the keys of her keyboard as follows: Selection keys 811, range YCL (TUF), price keys 4, 6 and blank. Relays H8, T1 and U1, Figures 4—C and 4—D, in the selector are operated and locked in a manner heretofore described, to relay RLS. This combination of relays causes the selection of the "vol. sales" relay under control of code number 611 by the armature 504 of relay H8 being connected to the corresponding armature 504 of relay H6.

Relay RT1 operates from battery at armature 496 and make contact of relay S2, conductor 495, break contact and armature 494 of relay AG, break contact and armature 493 of relay LC, conductor 492, contact 645 of relay RA, conductor 646, armature 654 and make contact of relay H8, conductor 2 of cable 648, armature 655 and break contact of relay RT, winding of relay RT1 to ground. Relay RT1 locks over a circuit from the winding, armature 656 and make contact of relay RT1, break contact and armature 634 of relay LC to grounded battery.

The operation of relay RT1 by its armature 438 and make contact, connects polarized relay P2 to regenerator unit RGR3 and the armature 445 and make contact of relay RT1 connects relay P2 and regenerator RGR4, in order that the four pulses transmitted in the tens price circuit may actuate the indicator in the units position of the close range position of the volume of sales display position, and the six impulses transmitted in the units price circuit may cause the indicator in the fractions position of "vol. sales" position to operate. The digits 4 and 6 transmitted in the tens and units price positions of the tape and subsequently displayed by the indicators in the units and fractions positions respectively of the volume of sales display position, represent the ten thousands and thousands digits of the sales volume, 1,246,000 as in the example assumed, the millions and hundred thousands digits having been previously displayed as hereinbefore described. Following is a description of the operation of the selector equipment for displaying the digits 4 and 6 in the units and fractions position of "vol. sales" position.

As relay P2 operates in response to the first positive pulse on conductor 401, a circuit is closed from battery at the armature of relay P2, conductor 1 of cable 412, armature 427 and make contact of relay S2, armature 524 and make contact of relay S1, armature 438 and make contact of relay RT1, conductor 2 of cable 436, winding

of relay A3, break contact and armature of relay AA3 to ground causing regenerator RGR3 to operate. As the armatures of relay A3 engage their make contacts, battery is placed on conductors U1, U2, U3 and U4 of cable 512, of which only conductor, U1 is connected to an indicator unit at this time, due to range relay CL1, Fig. 4—E, being operated, the other conductors U2 to U4 are open at contacts of unoperated range relays OP1 to LA1. The circuit for the operation of the tens indicator of the previous close range is traced from battery at the uppermost armature and contact of relay A3, conductor U1 of cable 512, resistance 513, contacts 652 of relay CL1, conductor 3 of cable 518, armature 653 and break contact of relay RT, conductor 4 of cable 499, conductor 3 of cable 507, and then through the following circuit of equipment not shown but similar to STK—123, Fig. 4—G, contact of switch 408, contacts of relay "vol. sales," winding and switch 516 of the indicator in the units position of range CL, contacts of relay "vol. sales" and switch 408, and thence to conductor AG2 of cable 477, armature 521 and make contact of relay AG to ground.

The circuits for the operation of regenerator RGR4 and the indicator in the fractions position of the close range will now be described. Battery at the operated armature of relay P3, conductor 2 of cable 412, armature 413, and make contact of relay S2, armature 446 and break contact of relay RT, armature 445 and make contact of relay RT1, conductor 3 of cable 436, winding of relay A4, break contact and armature of relay AA4 to ground causing the operation of regenerator unit RGR4. As relay A4 operates, battery is applied through its armature 642 and make contact to conductor F1 of cable 512, resistance 513, contacts 657 of relay CL1, conductor 4 of cable 507, and then through the following circuit of equipment not shown but similar to STK—123, Fig. 4—G, contact of switch 508, contact of relay "vol. sales," winding and switch 516 of the indicator unit in the fractions position of range CL, contact of relay "vol. sales," switch 408 and thence to grounded conductor AG2 thereby causing the indicator to operate to display the thousands digit of the "volume of sales." The operation of relay LC by the release signal causes the release of relays RT1, CL1 and "vol. sales." To display the "volume of sales" in the open range, the open (TUF) key is depressed. It will be seen that to display the "volume of sales" in any range position requires the depression of the corresponding range (TUF) key, the first transmission in a display having hundred thousands or millions digits invariably requires a hundreds code number 7 for operation of the relay RT and the second transmission for the last two digits of the display is invariably sent with the code number 3 for the hundreds digit to cause operation of the relay RT1.

Request quotations

If through accident or otherwise a quotation should be erroneously displayed at any receiving station, means are provided for transmitting signals which effect only the subscriber's station requiring correction of the erroneous display, the other display boards not being responsive to these signals. If, for example, a failure of the power supply should occur at the beginning of the trading period of the Exchange at a particular receiving station, no quotations will appear until this

condition has been remedied. An attendant at the receiving station would immediately after correcting the trouble, notify the central control station of such failure.

Upon receipt of such notice, the central control station force would, in addition to transmitting current quotations as they appear on the ticker tape, also transmit quotations taken from the monitor stock board which occurred during the failure period.

In all systems of this character heretofore devised, the transmission of quotations in response to a request from a subscriber would cause the operation of the displayed devices of all receiving stations thereby creating an erroneous impression of increased market activity. My invention provides means at each receiving station whereby request quotations are normally ineffective to operate the indicating devices at said station, but permitting them to respond to current quotations as they appear on the ticker tape. The manner in which this control is exercised and the operation of that portion of the system necessary for a complete understanding of this feature will now be described.

Assume that a request has been received for the last quotation of Western Union which is displayed on the monitor stock board at 34½ and that the stock number arbitrarily assigned to this stock is 235. When making such a request the attendant at the receiving station opens the switch RR, Fig. 4—C, of the selector.

The operator at the central control station depresses the keys of her keyboard perforator in the following order:

Selection keys 2, 3, 5, range key last LA (TUF), back spacer lever of the punch unit of her keyboard, key RR, price keys 3, 4 and ½. As the last LA (TUF) key was depressed, perforations were made in the tape having code units 1 and 4 marking and 2 and 3 spacing. As the back spacer lever was depressed the tape was stepped back one position so that the range perforations were again in line with the punches of the punch block. As key RR was depressed an additional perforation was made in the 5th position of the tape in alignment with the two previously made perforations of the range signal so that the range signal now contains code units 1, 4 and 5 marking and units 2 and 3 spacing in character. It will be noted that upon depression of the price key ½ corresponding to the fractions characteristic of the price, only 7 transverse rows of perforations appear in the tape thereby operating the auto-stop AC1, Fig. 1—A, in the same manner as when the keyboard is operated to transmit quotations taken directly from the ticker tape.

An optional arrangement of the keyboard provides a duplicate set of range keys corresponding to the range designations shown on Fig. 7, except that this duplicate set would also cause the perforating of an additional hole, always in the fifth position, together with the usual range combination perforations thereby eliminating the back spacing operation above referred to. These added range keys would be used only for transmitting request quotations, and their key caps could bear a distinctive color to make them readily distinguishable from the other range keys used for regular quotations.

As the brush B2, Fig. 1—A, engages segment 11 of ring R3, relay CR4 is operated and the range perforations of the tape will have been brought into engagement with the tongues of the

tape transmitter TX1 by passage of the brush B2 over segments 1, 5 and 9 of ring R3. As this range signal contains a 5th code unit, marking ground is applied to the 5th tongue of the tape contact of relay C1, conductor 659, armature 661 and make contact of relay CR4, conductor 662 to the winding of relay SRT and thence to battery causing relay SRT to operate and lock over its armature and make contact, conductor 663, to break contact and armature of relay LR4 to ground. The operation of relay SRT interrupted the circuit to the tongues of the multiplex tape transmitter MTX and connected the MUX segments to positive and negative potentials so that segments 13, 14, 15 and 17 of ring R2 are connected to positive potential and segment 16 of the MUX segments is connected to negative potential. As relay SRT operated it interrupted the circuit to the stepping magnet MSM of the multiplex tape transmitter so that the multiplex tape is not advanced as brush B2 crosses segment 21 of ring R3. As the brush B1 crosses the MUX segments 13 to 17 of ring R2 a rewrite signal is transmitted over the line L consisting of the following code units marking, marking, marking, spacing, marking. As the brush B1 traverses the range segments 18 to 21 of ring R2 a range signal of marking, spacing, spacing, marking is sent to the line L. As the brush B2 crosses segment 18 of ring R3, the tape is advanced in tape transmitter TX1 so that the perforations corresponding to the tens digit of the price are brought into engagement with the tongues of the tape transmitter. As the brush B2 engages segment 23 of ring R3 relay LR4 operates and removes ground from conductor 663 causing relay SRT to release. As relay SRT releases the rewrite signal is removed from the MUX, segments of ring R2 and these segments are again connected to the tongues of the multiplex tape transmitter MTX. As relay SRT released the circuit between segment 21 of ring R3 and the stepping magnet MSM of the multiplex transmitter was completed so that the multiplex message may be continued with subsequent revolutions of the distributor TD.

As the brush RB1 of the receiving distributor RD, Figs. 2A to 2C, crosses the MUX segments 13 to 17 of ring RR2, relays MX1, MX2, MX3 and MX5 are operated, and relay MX4 remains unoperated in response to the rewrite signal received over the line L, and as the brush RB1 crosses the range segments 18 to 21, the range relays RA1 and RA4 are operated, and relays RA2 and RA3 remain unoperated. It will be noted that armature 663 of relays MX1 to MX5 are connected together and that their corresponding contacts are also connected together, but that armature 663 of each of the relays MX1, MX3 and MX5 is provided with a make contact and the armature 663 of relay MX4 is provided with a break contact. As relays MX1 to MX5 are operated in response to the rewrite signal, the circuit to the armatures 665 of these relays is interrupted, thereby preventing the completion of circuits to the selection magnets of the monitor printer MXP as relay TUP operates.

As relays MX1, MX2, MX3 and MX5 operated, each of these relays locked over their armature 206 and make contact, conductor 4 of cable 255, break contact and armature 266 of relay RA to ground, and remain locked up until relay RA is

operated by the brush RB2 engaging segment 4 of relay RR6 during the subsequent revolution of the receiving distributor RD. As the brush RB2 engages segment 1 of ring RR6 during the subsequent revolution of the receiving distributor RD, relay C1 operates and connects ground at its armature 355 and make contact to conductor 1 of cable 353, armature and break contact of relays MX1, MX2, MX3 in series, armature and make contact of relay MX4, armature and break contact of relay MX5, conductor 4 of cable 353 to the winding of relay SR and thence to battery causing relay SR to operate and lock through armature 356, and make contact of relay SR, conductor 357, break contact and armature 294 of relay C6 and thence to ground. As brush RB2 engages segment 15 of ring RR6, relay C6 operates and causes relay SR to release. As brush RB2 engages segment 26 of ring RR4, the circuit between this segment and relay MT1 is not closed as armature 354 of relay SR is in the operated position. Relay MT1 therefore, transmits a signal of positive polarity to the monitor printer MP1 at this time causing this monitor printer to print a character on the tape which indicates that the quotation appearing thereon, and immediately preceding this symbol, is a request quotation.

As the brush TB of the retransmitting distributor TD1 engages segment SR of ring TR3 a circuit is closed from the grounded segment of ring TR4, brush TB, segment SR of ring TR3, conductor 666, closed contacts of relay CT2, conductor 8 of cable 264, make contact and armature 667 of relay SR, conductor 5 of cable 264 to the winding of transmitting relay S2 and thence to grounded battery causing relay S2 to operate and transmit a signal of positive polarity, to conductor R2 as an indication to the selector that the transmitted signals are those of a request quotation. It will be noticed that the SR relay is common to both channels, but the time relation of its operation with that of the various retransmitting equipment is such that it is only effective for the particular channel chosen by the operator at the central station.

Referring now to the selector shown on Figures 4-A to 4-G, the operation in response to this special signal will now be described: It will be recalled that the stock number 235 had been assigned to the stock for which the request quotation was transmitted. Relays H2, T3 and U5, Figs. 4-C and 4-D have accordingly been operated and locked in series with X2, Y3 and X4 respectively in a manner hereinbefore described, and during this period of operation a series of 10 timing and restoration impulses operate the range relay counting chain, Fig. 4-C. As the 8th of this latter series of impulses is received, relays CLS and X1 are operated.

Normally this quotation does not appear at the receiving stations, consequently the switch RR is in the closed position and the operation of relays CLS and X1 complete a circuit from the tongue of polarized relay P2 so that when this relay operates in response to the rewrite signal on conductor 401 following the 8th restoration impulse, battery at the tongue of relay P2 is connected to conductor 1 of cable 412, armature and break contact of relay S2, conductor 428, operated contacts 669 of relay CLS, conductor 671, armature 672 and make contact of relay X1, conductor 673 to the winding of relay H9, closed contacts of switch RR to ground, causing relay H9 to operate and close a circuit from the wind-

ing of relay H9 through the make contact and armature 674 of this relay, winding of relay Y2, make contact and armature 433 of relay RR, conductor 434, armature 435 and break contact of relay RLS to battery, which circuit causes the operation of relay Y2 after relay P2 releases. As armature 433 of relay H9 moved to the operated position, battery at the armature thereof was removed from conductor 432 causing the release of relays H2 and X2. With no one of the hundreds counting relays H2 to H8 operated, the stock selection circuit is incomplete and no stock relay as shown on Fig. 4—G can be operated. With no stock relay operated, the impulses for restoring and actuating indicators are not effective at the receiving station. Relays H9 and Y2 are held operated from ground through switch RR, winding, make contact and armature 674 of relay H9, winding of relay Y2, conductor 675, make contact and armature 433 of relay H9, conductor 434, armature 435 and break contact of relay RLS to battery and are released as relay RLS operates during the first portion of a subsequent revolution of the retransmitting distributor TD1.

It will be recalled that in the assumed example the switch RR at the receiving station was opened at the time of the request for the rewrite. This switch RR being open prevents operation of relay H9 in response to the rewrite signal of positive polarity on conductor 401. The operation of relay P2 as this rewrite signal was received, is therefore not effective in causing the release of a previously operated relay of the hundreds counting chain. The request quotation is therefore, displayed on the quotation board of this station. It will be noted that there is an RR key for each of the two channels of the selector in order that a request for a quotation on one channel may be received without making the selector equipment of the other channel responsive to request quotations on that channel which may be required for other stations. After the request rewrites have been received, both RR switches are restored to their normally closed position.

Wipe-out

At the beginning of a trading period of the New York Stock Exchange, all stock quotation boards have the indicators of the open, high, low and last ranges set on their blank positions and the indicators of the previous close range have taken settings corresponding to the prices of the various stocks at the close of the previous trading period. The manner in which the quotations are "wiped out" after the close of trading period will now be described. The last price of each stock is transferred to the YCL range by the operators at the Central Control Station by means of their keysets. After this has been done the operators prepare tapes having perforations corresponding to the stock selection number and unison (TUF) range. Immediately following the depression of the stock selection and range keys, the operator depresses the blank key of her keyboard three times, thereby advancing the tape three steps and operating the auto-stop for each quotation. As no price digit keys have been depressed, none of the relays TRR, VPR or FPR, Fig. 1—B, will be operated and the price signals transmitted from the distributor TD will all be spacing in character. None of the relays TP1 to FP4, Figs. 2—B and 2—C, nor TP6 to IFP4, Figs. 2—E and 2—F, will be operated. As the brushes TB, Fig. 2—G, of the retransmitting distributor TD1 sweep over their respective segments, no signals will, there-

fore, be transmitted to the selector corresponding to the price portion of the message.

The selector, Figs. 4—A to 4—G, will operate to select unison range of the various stocks and transmit impulses which blank all indicators of the ranges, but as no price signals are received on conductors 400 and 401, the indicators of these ranges will remain in their blank positions.

Operation of auxiliary selector

One of the requirements of a complete stock quotation system is provision for operating a plurality of automatic stock boards on the premises of a subscriber. In systems heretofore disclosed, each requires a complete control mechanism for each of the display boards, but in the system herein disclosed one complete selector in conjunction with the apparatus shown on Fig. 4—H, controls the operation of a main display board as well as an additional board, thereby reducing the first cost in place of the entire installation at such a receiving station, and also lowering the maintenance cost.

The operation of the auxiliary selector and associated auxiliary stock board will now be described. Referring to Figure 4—H which shows the apparatus and wiring of the auxiliary selector, it will be noted that this equipment comprises three regenerator units RGR2A, RGR3A and RGR4A together with range relays CLHA to LAA and relay RTX, making a total of 13 relays within the auxiliary selector. The auxiliary stock board which is similar to Fig. 4—G and so referred to on Figure 4—H, is identical in wiring and equipment with the main stock board, its size however, including the number of stocks or other information displayed, is entirely independent of the main board and may be larger or smaller as the case may be.

The operation of regenerator RGR2A is under control of regenerator RGR2 and the operation of regenerators RGR3A and RGR4A are under control of regenerators RGR3 and RGR4 respectively. When RGR2 operates a circuit is closed from grounded battery, armature 676 and make contact of relay A2, conductor 1 of cable 512, winding of relay AX2, break contact and armature of relay AAX2 to ground, causing relay AX2 to operate. When armature 677 of relay A3 engages its make contact battery is applied to conductor 2 of cable 512, winding of relay AX3, break contact and armature of relay AAX3 to ground causing relay AX3 of regenerator RGR3A to operate. As the armature 678 of relay A4 operates, battery is applied to conductor 3 of cable 512 causing the operation of regenerator RGR4A. Thus each time regenerators RGR2 to RGR4 operate, the corresponding regenerators RGR2A to RGR4A of the auxiliary selector are caused to assume their operated position. Regenerators RGR2A to RGR4A transmit restoration and actuation impulses to the selected group of indicators of the auxiliary stock board concurrently with the transmission of corresponding impulses to the set of indicators for the same stock or other item selected on the main stock board. The selection of the group of indicators of the auxiliary stock board to be actuated is under control of the selected item and range thereof.

By way of illustration, Fig. 4—H shows connections to stocks STK—123 and STK—101 corresponding to the same stocks shown on Figure 4—G which is a fragmentary part of the main stock board. It will be understood, however,

that stocks may appear on the auxiliary board which are not shown on the main board and vice versa.

When in the previously assumed example battery was applied to jack 123 of the plug board 411 to cause the operation of relay STK—123, Fig. 4—G, a circuit is traced from battery at jack 123, Fig. 4—F, and thence through the double plugs 507 and 679, conductor 1 of cable 681 to the winding of relay STK—123 of the auxiliary stock board to ground causing relay STK—123 of the auxiliary stock board to operate simultaneously and in parallel with relay STK—123 of the main stock board. As relay STK—123 of the auxiliary board locks over conductor 21 of cable 507, conductor 7 of cable 682, operated contacts of one or more of the range relays CLH1 to LA1 in parallel, Fig. 4—E, conductor 3 of cable 503, break contact and armature of relay LC to battery, the selected stock relay of the auxiliary stock board is held operated over the circuit just traced until relay LC subsequently operates.

It will be noted that the grounded winding of range relay CLHA is connected in parallel with the grounded winding of range relay CLH1, the circuit being traced from grounded winding of relay CLHA, conductor 1 of cable 682 to the grounded winding of CLH1. Similarly the windings of relays CLA to LAA are connected in parallel to the windings of relays CL1 to LA1 respectively by way of conductors 2 to 6 of cable 682. As each of the range relays CLH1 to LA1 operates, the corresponding range relay CLHA to LAA of the auxiliary selector is also operated and held in the operated position by means of the locking contact of each of the first named relays. The operation of relay LAA completes circuits between contacts of relays AX2, AX3 and AX4 and the windings of indicator units T, U, and F of the last range LA of the auxiliary stock board similar to the circuits previously described for operating the corresponding indicators of the main stock board. Briefly stated, regenerator units RGR2A to RGR4A repeat pulses from regenerators RGR2 to RGR4 for operating the selected indicators of the auxiliary stock board, the selection of the group of indicators to be so actuated being under control of the stock and range selection relays of the main selector.

Relay RTX, Fig. 4—H, has its winding connected in parallel with relay RT over grounded winding of relay RTX, conductor 2 of cable 502 to grounded winding of relay RT. Thus, as battery is applied to the winding of relay RT, relay RTX is caused to operate and as armature 651 of relay RT engages its contact relay RT locks and holds RTX operated until the locking circuit is opened. The operation of relay RT, it will be recalled, occurs when selection signals are received which include signals corresponding to the digit 7 for the hundreds digit of the stock number. RTX therefore operates only when signals for a stock number having hundreds digit 7 are received, and transposes the circuit connections between the regenerators RGR2A and RGR3A in such a manner that signals received during the tens and units price portion of the message are transmitted to the hundreds and tens indicator units of the auxiliary stock board required for posting special information such as "volume of sales." As no interchange of connections is required between regenerators RGR3A and RGR4A and the units and fractions indi-

cators of the auxiliary stock board for displaying the units and fractions digits, special information such as "volume of sales" under control of a stock number having the hundreds digit 8, relay RTX is unoperated during the setting of these indicators.

Transmission of multiplex messages

Referring to the distributor, Figures 1—A and 1—B, segments 13 to 17 thereof are used for the operation of the message printer MXP shown on Figures 2—A and 8. Associated with the multiplex transmitter MTX is an auto-stop AC3 arranged to close its contact when a copious supply of perforated tape T3 used for the transmission of multiplex characters is available. With the switch MC open the auto-stop AC3 is not effective in controlling the operation of the start magnet ST of the transmitting distributor TD and multiplex messages are transmitted under control of the keyboard perforators in accordance with the activity of the market. If no quotations appear on the ticker tapes and no request quotations remain unanswered, the transmitting distributor TD will come to rest and the transmission of multiplex characters will cease. Despite the fact that additional multiplex characters may be awaiting transmission, it is desirable to transmit these characters regardless of the state of activity of the stock market particularly in view of the possibility of the multiplex message comprising information of considerable importance.

To enable the transmission of multiplex characters over the system herein disclosed at a time when the system would otherwise be idle due to the inactivity of the stock market, the switch MC and auto-stop AC3 is provided. Closure of the switch MC connects ground to the auto-stop AC3 so that when a multiplex message is awaiting transmission the contacts of the auto-stop are closed and the ground is extended to the winding of the start magnet ST of the transmitting distributor and thence to grounded battery causing the start magnet to be continuously energized until the contacts of the auto-stop AC3 are open. The continued operation of the start magnet ST causes the transmitting distributor to rotate continuously and transmit one character of the multiplex message until all characters thereof have been transmitted and the contacts of the auto-stop AC3 have opened the circuit between the switch MC and start magnet releasing the magnet ST and thereby causing the transmitting distributor to come to rest at the end of the next even numbered revolution. If, however, during the revolutions of the transmitting distributor either prior to or coincident with the opening of the contacts of the auto-stop AC3, either or both auto-stops AC1 or AC2 had closed their contacts, the operation of the transmitting distributor would be jointly controlled by the auto-stop AC3 and the other auto-stop or auto-stops contacts which had been closed.

Phasing

It will be recalled that quotations are transmitted alternately over the distributor TD, Figs. 1—A and 1—B, so that the first quotation of a series of quotations is transmitted on channel 1 and each alternate quotation thereafter is a channel 2 quotation. When the first quotation to be transmitted is initiated by the channel 2 keyboard, a blank quotation is transmitted during

that portion of a cycle of operations normally occupied by the first channel 1 quotation.

These quotations are received by the receiving distributor RD of the retransmitting apparatus, Figs. 2—A to 2—G, one complete quotation being received during each revolution of this distributor. Assuming that as the result of a fault in the line L, the tongue of relay LR, Fig. 2—B, is moved into engagement with the contact S at a time when the brushes of the receiving distributor RD are in the position shown on the drawings, a circuit is closed from the grounded armature of relay LR and contact S, closed contact and spring 204 of key KS, conductor 203, segment 2 of ring RR1, brush RB1 and segment R of ring RR2 of the receiving distributor RD, through the winding of the start magnet STM to grounded battery causing the start magnet to operate and release the brushes RB1 and RB2 for one revolution.

If at any time during this revolution of the distributor RD after the brush RB1 has passed segment 1 of ring RR2, the first selection signals for a quotation should be received, it is evident that the signals for the various portions of the message would not be stored on their respective relays HS1 to FP4, and a mutilated message would result. Subsequent quotations if transmitted in continuous succession will also be mutilated until the brushes RB1 and RB2 are brought into contact with their rest segments at a time when a start signal is received over the line L.

One of the features of my invention is to provide means at the central control station for automatically bringing the receiving distributor RD into proper phase relation with the transmitting distributor TD if for any cause these two distributors are out of phase with one another. The operation of this phasing feature will now be described.

The operation of relay PH2, Fig. 1—B, at the end of each 100 revolutions of the transmitting distributor TD, caused the transmitter to be disconnected from the line L and a steady marking or rest condition to be placed on the line as a phasing signal. As this phasing signal of negative polarity is impressed upon the line L, the tongue of relay LR, Fig. 2—B, is moved against its marking contact M and ground is removed from the spacing contact S of relay LR, thereby insuring that the stop magnet STM of the receiving distributor RD will be in a released condition as the brush RB1 engages segment R of ring RR2, and the brushes RB1 and RB2 will come to rest on their rest segments until a start signal is received over the line L indicating the transmission of quotation signals.

It will be recalled that the retransmitting distributors TD1, Fig. 2—G, for channel 1 and TD2 for channel 2 quotations are operated at approximately half the speed of the receiving distributor RD. As the receiving distributor RD is brought to rest in response to the phasing signal, distributors TD1 and TD2 continue to operate until their rest segments are reached at which time these distributors also come to rest, and the entire retransmitting apparatus shown on Figs. 2—A to 2—G is in condition to receive a channel 1 quotation.

Although a complete system for stock quotations has been described in Figs. 1—A to 8, including a transmitting central station operated by perforated tapes, and a complete retransmitting and receiving station comprising a distributor, regenerator units, storage relays, stock selecting mechanism, price selector and quotation board;

it will be understood that each of these units is capable of use independently and in combination with other units or other systems.

Also, the illustrative form of transmitter shown in Figs. 1—A and 1—B may be replaced by other transmitters suitable for the purpose for sending the signals over line L to the retransmitter shown in Figs. 2—A to 2—G and 8.

For brevity in the specification and claims, the term "step-by-step" impulses or signals is employed, in its usual sense in the art, to define stepping pulses adapted to cause electromagnetic devices, e. g., indicators, relay counting chains and the like, to step to different settings in accordance with the number of such stepping pulses in each signal transmitted, in contradistinction to the well known permutation code signals; the term "plural channel" transmission circuit defines a circuit comprising a plurality of channels, or subchannels, each of which transmits a part of a message which is apportioned between the channels; and the term "cancelling" a message defines the step of preventing a mutilated message from being transmitted to the various subscribers' stations.

For purposes of illustration this invention has been described in connection with a stock quotation system, but it is obviously not so limited, being adapted for use in various systems for the dissemination of information. Also, the embodiment of the invention may take other specific forms without a departure from the spirit or principles herein described. The present embodiment is therefore illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes within the meaning and range of equivalency of the claims are intended to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:

1. In a quotation system, a plurality of groups of electrically operated indicators for posting information regarding stocks or other items, a distributor having elements for transmitting a plurality of groups of character code quotation signals in succession, means responsive to said signals for selecting and actuating certain indicators of a selected stock or other item, and means for enlarging the capacity of the system for disseminating information comprising transmitting elements in said distributor for interspersing additional intelligence signals with said quotation signals, means responsive to said additional intelligence signals for receiving the information represented thereby, and means operable at will for causing said distributor to transmit said additional intelligence signals irrespective of whether quotation signals are being transmitted.

2. In a quotation system, a plurality of groups of electrically operated indicators for posting information regarding stocks or other items, a distributor having elements for transmitting a plurality of groups of quotation signals in succession, means responsive to said signals for selecting and actuating certain indicators of a selected stock or other item, means including transmitting elements in said distributor for interspersing additional intelligence signals with said quotation signals, a transmitter including a group of keys on which the item selection and price signals of the quotation are set up, said transmitter having means for initiating transmission of a quotation during a cycle of operation of said distributor in which said additional intelligence

signals are being transmitted, and means for preventing said distributor from sending quotation signals in response to the operation of said initiating means until the distributor has completed its current cycle of operation.

3. In a quotation system, a plurality of subscribers' stations each comprising a plurality of groups of electrically operated indicators for posting information regarding stocks or other items, a transmitting station having means including a one wire distributor for transmitting over a channel groups of item selection, range and price permutation code signals comprising quotations relating to said stocks or other items, a retransmitting station comprising means for receiving and translating said signals into step-by-step item selection, range and price signals for transmission over a plural channel transmission circuit, said retransmitting station including a transmitting distributor for allocating the signals to the channels of the plural channel transmission circuit, means including the last named distributor controlled by the received permutation code signals for causing the transmission of said step-by-step item selection, range and price signals over said plural channel transmission circuit to selectively actuate said indicators, and means for transmitting restoration stepping impulses sufficient to normalize the selected indicators prior to actuation thereof to new settings, means in the subscribers' stations responsive to the step-by-step item selection and range signals for selecting the group of indicators corresponding to a particular item and also certain indicators representative of a particular range in the selected group, and means operable when said selection is effected for causing the restoration stepping impulses and price signals to normalize the selected indicators and actuate them to new settings.

4. In a quotation system, a plurality of subscribers' stations each comprising a plurality of groups of electrically operated indicators for posting information regarding stocks or other items, a transmitting station having means including a one wire distributor for transmitting over a channel groups of item selection, range and price permutation code signals comprising quotations relating to said stocks or other items, a retransmitting station comprising means for receiving and translating said signals into step-by-step item selection, range and price signals for transmission over a plural channel transmission circuit, said retransmitting station including a transmitting distributor for allocating the signals to the channels of the plural channel transmission circuit, means including the last named distributor controlled by the received permutation code signals for causing the transmission of said step-by-step item selection, range and price signals over said plural channel transmission circuit to selectively actuate said indicators, means in the subscribers' stations responsive to the item selection and range signals for selecting the group of indicators corresponding to a particular item and also certain indicators representative of a particular range in the selected group, and means including said last named distributor for transmitting a fixed number of impulses for normalizing the selected indicators prior to actuation thereof by the price signals to a new setting.

5. In a market quotation system, a transmitter, a subscriber's receiving station including a plurality of groups of electrically operated indi-

cators for posting quotations regarding stocks or other items, a transmission line connecting said transmitter and receiving station, said transmitter including distributor structure operable to transmit a plurality of quotations concurrently over said transmission line for actuating selected groups of said indicators, said distributor structure including means for transmitting step-by-step signals comprising portions of two quotations concurrently during one half cycle of operation thereof and one complete quotation during a cycle of operation thereof.

6. In a market quotation system, means including rotary distributor structure operable to transmit two quotations concurrently, said distributor structure including means for sending step-by-step signals comprising portions of two quotations concurrently during a revolution of said distributor structure and one complete quotation during two successive revolutions thereof.

7. In a market quotation system, a plurality of subscribers' stations each including a plurality of groups of electrically operated indicators for posting quotations regarding stocks or other items, a first transmission line, a transmitter for sending over said line permutation code signals comprising said quotations, a retransmitting station connected to said first transmission line and positioned intermediate said transmitter and said subscribers' stations, means including a second transmission line for connecting said retransmitting station with said subscribers' stations, said retransmitting station including transmitting distributor structure for retransmitting said quotations over said second transmission line by step-by-step signals corresponding to said received code signals, said distributor structure being operable to transmit two quotations concurrently.

8. In a quotation system for stocks or other items, a first transmission channel, a first distributor associated with said first channel for transmitting step-by-step quotation signals, a second transmission channel, a second distributor associated with said second channel for transmitting step-by-step quotation signals, means for alternately initiating operation of said distributors, and means operable during the first part of the transmitting cycle of said second distributor to cause the latter to transmit the same portion of the second channel quotation that the first distributor transmitted relative to the channel one quotation during the first part of its transmitting cycle.

9. In a quotation system of the character disclosed in which the indicators are first selected by item selection impulses and then are restored to normal by restoration impulses prior to actuation of the indicators to new settings, a rotary transmitting distributor having means associated therewith for causing it to transmit during the first part of one of the revolutions of its transmitting cycle the indicator restoration impulses relating to a first quotation and the item selection impulses of a second quotation.

10. In a quotation system of the character disclosed in which the indicators are first selected by item selection impulses and range signals and then are restored to normal by restoration impulses prior to actuation of the indicators by price signals to new settings, a rotary transmitting distributor having means associated therewith for causing it to transmit during the first part of one of the revolutions of its transmit-

ting cycle the indicator restoration impulses relating to a first quotation and the item selection impulses of a second quotation, and means operable during the second part of said one of the revolutions for causing the distributor to transmit the price signals of said first quotation and the range signals of said second quotation.

11. In a quotation system for stocks or other items in which the indicators are selected by item selection and range signals prior to actuation of the indicators by price signals to new settings, a transmitting distributor having means associated therewith for causing it to transmit the range signals of successive quotations alternately with the item selection signals thereof and to transmit said range signals concurrently with the price signals of said quotations.

12. In a quotation system for stocks or other items in which the indicators are first selected by item selection signals and then are normalized by restoration signals prior to actuation of the indicators by price signals to new settings, a transmitting distributor having means associated therewith for causing it to transmit restoration signals of successive quotations alternately with the price signals and concurrently with the item selection signals of said quotations.

13. In a quotation system, a transmission circuit comprising a first channel and a second channel, transmitting means for sending permutation code signals comprising channel one quotations and channel two quotations alternately over their respective channels, a retransmitting station associated with said first and second channels for receiving and decoding the received permutation code signals, a plurality of subchannels associated with said first channel at said retransmitting station and a plurality of subchannels associated with said second channel at the retransmitting station, said subchannels extending to a plurality of subscribers' stations each comprising a plurality of groups of indicators for displaying said quotations, means in said retransmitting station for alternately transmitting over said groups of subchannels step-by-step indicator selection and indicator operating impulses to each of the subscribers' stations, and means in said retransmitting station for generating impulses for restoring to normal the selected indicators of the subscribers' stations prior to actuation of the indicators by said operating impulses to new settings, said means for generating restoration impulses being common to said subscribers' stations.

14. In a quotation system for stocks or other items, a plurality of subscribers' stations each having a plurality of electrically operated indicators for posting quotations, said indicators being arranged in at least two groups respectively associated with two quotation transmitting channels, means including a plurality of transmitters and a transmission line including a first channel for transmitting permutation code signals comprising channel one quotations and a second channel for transmitting permutation code signals comprising channel two quotations, a receiving distributor associated with said transmission line, a signal storage unit common to both channels, retransmitting and decoding apparatus associated with said distributor, means in said apparatus operable during the first part of a cycle of operation of the distributor for receiving and storing the signals comprising a channel one quotation in said common storage unit, a second

storage unit individual to said first quotation channel, means operating in timed relation with said distributor for transferring said stored signals from said common storage unit to said second storage unit, means operable during the second part of said cycle of operation of the distributor for receiving and storing the signals comprising channel two quotations in said common storage unit, a third storage unit individual to the second quotation channel, and means operating in timed relation with said distributor for transferring the channel two stored signals from said common storage unit to said third storage unit, said first channel and said second channel each including a plurality of subchannels connecting said decoding and retransmitting apparatus with said subscribers' stations, means for retransmitting the stored first and second channel quotations by means of step-by-step impulses over said subchannels for selecting and actuating certain indicators in said subscribers' stations, said last named means comprising two retransmitting distributors respectively associated with said second and third storage units and said first and second groups of subchannels, and means at said subscribers' stations responsive to said step-by-step impulses for selecting and actuating said indicators.

15. In a quotation system for stocks or other items, retransmitting apparatus comprising means for receiving a plurality of groups of permutation code item selection signals, said apparatus including means for decoding said signals and retransmitting step-by-step item selection signals corresponding thereto, a plurality of subscribers' stations each comprising a plurality of groups of indicators and means responsive to said step-by-step signals for selecting certain of said indicators, and means in said retransmitting apparatus common to said plurality of subscribers' stations for simultaneously transmitting indicator restoration impulses to said stations, and means in said subscribers' stations responsive to said restoration impulses for normalizing the selected indicators prior to actuation thereof to new settings.

16. In a quotation system for stocks or other items, retransmitting apparatus comprising means for receiving a plurality of groups of permutation code range signals, said apparatus including means for decoding said signals and retransmitting step-by-step range signals corresponding thereto, a plurality of subscribers' stations each comprising a plurality of groups of indicators, selection means including means responsive to said step-by-step range signals for selecting certain of said indicators, and means in said retransmitting apparatus common to said plurality of subscribers' stations for simultaneously transmitting indicator restoration impulses to said stations, and means in said subscribers' stations responsive to said restoration impulses for normalizing the selected indicators prior to actuation thereof to new settings.

17. In a signaling system, means for transmitting a message comprising a predetermined number of signals, apparatus for receiving and displaying said message, retransmitting apparatus intermediate said transmitting means and receiving apparatus and normally operative to retransmit said message to the receiving apparatus, said retransmitting apparatus having means controlled by said signals for cancelling said message when certain of said signals are not

properly transmitted to the retransmitting apparatus.

18. In a quotation system for stocks or other items, transmitting apparatus comprising a distributor for transmitting a quotation including item selection signals, apparatus for receiving and displaying said quotation, retransmitting apparatus intermediate said transmitting and receiving apparatus and normally operative to retransmit said quotation to the receiving apparatus, said retransmitting apparatus having means controlled by said signals for cancelling said quotation when one or more of said item selection signals are not properly transmitted to the retransmitting apparatus.

19. In a quotation system for stocks or other items, transmitting apparatus comprising a distributor for transmitting a quotation including range signals, apparatus for receiving and displaying said quotation, retransmitting apparatus intermediate said transmitting and receiving apparatus and normally operative to retransmit said quotation to the receiving apparatus, said retransmitting apparatus having means controlled by said signals for cancelling said quotation when one or more of said range signals are not properly transmitted to the retransmitting apparatus.

20. In a signaling system for disseminating information regarding various items, means for transmitting a message comprising a predetermined number of signals including item selection signals, apparatus for receiving and displaying said message, retransmitting apparatus intermediate said transmitting means and receiving apparatus and normally operative to retransmit said message to the receiving apparatus, said retransmitting apparatus having means controlled by said signals for cancelling said message when one or more of said signals are not properly transmitted to the retransmitting apparatus, and apparatus for recording the mutilated messages in all cases except when the first item selection signal is not transmitted.

21. In a system of the character described, a group of indicators for displaying the volume of sales or other information in regard to stocks or other items, the indicators of said group respectively corresponding to digits of a number and each actuatable selectively to display any of the digits 1 to 9 and 0, said indicators being disposed in the hundreds, tens, units and fractions positions ordinarily employed for item quotation purposes, means for transmitting signals for actuating each of the indicators to display any of the digits 1 to 9 and 0 for posting said volume of sales or other information including means for transmitting in succession two different signals each comprising item selection impulses, switching mechanism responsive to one of said signals to control the actuation of the indicators in the hundreds and tens positions only of said group of indicators, and switching mechanism responsive to the other of said selection signals for controlling the actuation of the indicators in the units and fractions positions only of said group.

22. In a quotation system, a plurality of receiving stations each comprising groups of electrically operated indicators for posting information regarding stocks or other items, a distributor having elements for transmitting quotation signals, means at said receiving stations responsive to said quotation signals for selecting and actuating certain indicators of a selected stock or other item, means comprising transmitting ele-

ments in said distributor for interspersing additional intelligence signals with said quotation signals, means for transmitting special signals with the quotation signals, means at said subscribers' stations normally operative to prevent display of the quotations accompanying said special signals but operable at will to condition the same to respond to said special signals to cause the accompanying quotations to be displayed on the selected indicators, and means operable at will for substituting said special signals for said additional intelligence signals during the operation of said distributor.

23. In a quotation system, a plurality of subscribers' stations each comprising a plurality of groups of indicators for displaying quotations regarding stocks or other items, means for transmitting quotations for actuating certain of said indicators of a selected stock or other item, means for transmitting a special signal with the signals comprising a quotation, deleting means in each of said subscribers' stations responsive to said special signal for preventing said quotation signals from actuating said indicators, and means operable at will for disabling said deleting means to cause said quotation signals to actuate the selected indicators.

24. In a system of the character described, a plurality of subscribers' stations each comprising a plurality of groups of indicators for displaying quotations regarding stocks or other items, means in each subscribers' station for selecting said indicators including item selector mechanism, hundreds digit selecting control mechanism and stock relays, means for transmitting quotations for actuating certain of said indicators of a selected stock or other item, means for correcting the indicators of any subscriber's station to the exclusion of the other subscribers' stations, comprising means for transmitting a special signal with the signals comprising a quotation, means responsive to said special signal for rendering the item selector mechanism ineffective by releasing the hundreds digit selecting control mechanism to prevent the operation of any stock relay, and means operable at will to prevent said special signal from rendering the item selector mechanism ineffective.

25. In a quotation system, a transmission circuit including a plurality of transmitting channels, receiving apparatus including a plurality of line relays respectively associated with said channels, regenerator units in said receiving apparatus, one of which units is invariably connected to one of the line relays, and switching means responsive to quotation signals for alternately connecting the remaining regenerators to their respective line relays and to the first regenerator unit.

26. In a quotation system, a transmission circuit including a plurality of transmitting channels, receiving apparatus including a plurality of line relays respectively associated with said channels, regenerator units in said receiving apparatus, one of which units is invariably connected to one of the line relays, and switching means responsive to quotation signals for alternately connecting the remaining regenerators to their respective line relays and to the first regenerator unit, and selecting counting chains respectively operated by the line relays which operate the said remaining regenerator units.

27. In a quotation system, a transmission circuit including four transmitting channels, receiving apparatus including four line relays respec-

tively associated with said four channels, four regenerator units in said receiving apparatus, one of which units is invariably connected to one of the line relays, switching means responsive to quotation signals for alternately connecting the three remaining regenerators to their respective line relays and to the first regenerator unit, a relay chain for receiving range signals, said first regenerator unit operating said relay chain to receive range signals alternately with the operation of the other three regenerator units.

28. In a quotation system, a receiving station comprising a plurality of groups of electrically operated indicators for posting the prices of stocks or other items, a transmitter for transmitting quotation signals for selecting and operating said indicators, said transmitter including means for transmitting restoration impulses to the indicators for normalizing the selected indicators prior to actuation thereof to a new setting, switching means in said receiving station for preparing the circuits of the selected indicators for actuation by the impulses corresponding to the price portion of the quotation, and impulse counting means actuatable by certain of said restoration impulses for timing the operation of said switching means.

29. In a quotation system in which the indicators are first selected and then are restored to normal by restoration impulses prior to actuation of the indicators to new settings, means including distributor structure for transmitting concurrently series of impulses representative of at least two quotations, said impulses including indicator restoration impulses, and means associated with said distributor for causing it to transmit the restoration impulses associated with one quotation concurrently with impulses comprising another quotation.

30. In a quotation system, a plurality of subscribers' stations each comprising a plurality of groups of indicators for posting quotations regarding stocks or other items, means for transmitting quotations for actuating certain of said indicators of a selected stock or other item, means for transmitting a special signal with the signals comprising a quotation, and means in each of said subscribers' stations actuatable at will to either of two positions, said means in one position preventing the quotations accompanied by a special signal from being posted on the indicators and in its other position causing the quotations accompanied by said special signal to be posted on the selected indicators.

31. In a quotation system having receiving apparatus comprising a plurality of selectable groups of digits and fractions indicators for posting the prices of stocks or other items, and means ordinarily associated with the digits and fractions indicators, respectively, for transmitting coded signals corresponding to the digits and fractions of the price of a quotation to actuate the indicators of the selected item, the fractions signal transmitting means having a sufficient number of code unit transmitting elements to transmit selectively the fractions of the price but insufficient to transmit selectively the digits 1 to 9 and 0; means in said receiving apparatus for displaying the volume of sales or other information, said last named means comprising a group of indicators respectively corresponding to digits of a number and each actuatable selectively to display any of the digits 1 to 9 and 0, one of the indicators of said group being disposed in a position in the system ordinarily associated

with said fractions signal transmitting means, means for selecting said group of indicators, means for causing coded digit signals transmitted by the digits signal transmitting means to actuate said one of the indicators selectively to display any of the digits 1 to 9 and 0, and means for causing other coded digit signals transmitted by the digits signal transmitting means to actuate the other indicators of said group.

32. In a quotation system, a transmitting station for transmitting in succession groups of permutation code signals comprising quotations regarding stocks or other items, a retransmitting station, a plurality of subscribers' stations, circuits connecting said subscribers' stations with said retransmitting station, said retransmitting station having means for receiving and translating said permutation code signals into item selection and price signals each comprising a series of stepping impulses for transmission over said circuits, and also having means for adding restoration impulses, said subscribers' stations each comprising a plurality of groups of indicators operable to different positions for displaying quotations and having means for restoring the indicators to normal, and means responsive to said stepping impulses transmitted by the retransmitting station for selecting and operating certain of the indicators of the selected stock or other item in each of the subscribers' stations and responsive to said restoration impulses for normalizing the same.

33. In a quotation system, a receiving station comprising a plurality of groups of electrically operated indicators for posting the prices of stocks or other items, a transmitter for transmitting quotation signals respectively comprising trains of impulses transmitted in succession for selecting, normalizing and resetting said indicators to a new price, means in said receiving station responsive to said signals, said last named means including switching means for preparing the circuits of the selected indicators for actuation by the signals corresponding to the price portion of the quotation, and means including a chain of fast operating relays for counting the successive impulses in said normalizing train of impulses for timing the operation of said switching means.

34. In a quotation system for stocks or other items, a quotation receiver comprising groups of indicators for posting quotations in regard to said items, a first transmission channel extending to said receiver, transmitting apparatus including a first distributor means associated with said first channel for transmitting channel one quotation signals including indicator selection impulses and indicator operating impulses to said receiver, a second transmission channel extending to said receiver, said transmitting apparatus including a second distributor means associated with said second channel for transmitting channel two quotation signals including indicator selection impulses and indicator operating impulses to said receiver, and means for causing said first and second transmitting distributor means to intersperse the indicator operating impulses of a channel one quotation with the indicator operating impulses of a channel two quotation.

35. In a quotation system for stocks or other items, a transmitter having storage means for storing quotations to be transmitted and distributor means associated with said storage means for transmitting signals representing the stored quotations, a receiver having groups of

indicators individual to the various items and apparatus responsive to said signals for selecting desired groups of indicators and actuating them to new settings to post the quotations, said receiving apparatus having an operated position for resetting the indicators and a released position, means including said transmitting distributor means controlled by said storage means for

automatically sending a special code signal to the receiving apparatus when no quotations are stored in the transmitter, and means in the receiver responsive to said special code signal for causing said receiving apparatus to be restored to its released position.

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