

June 10, 1941.

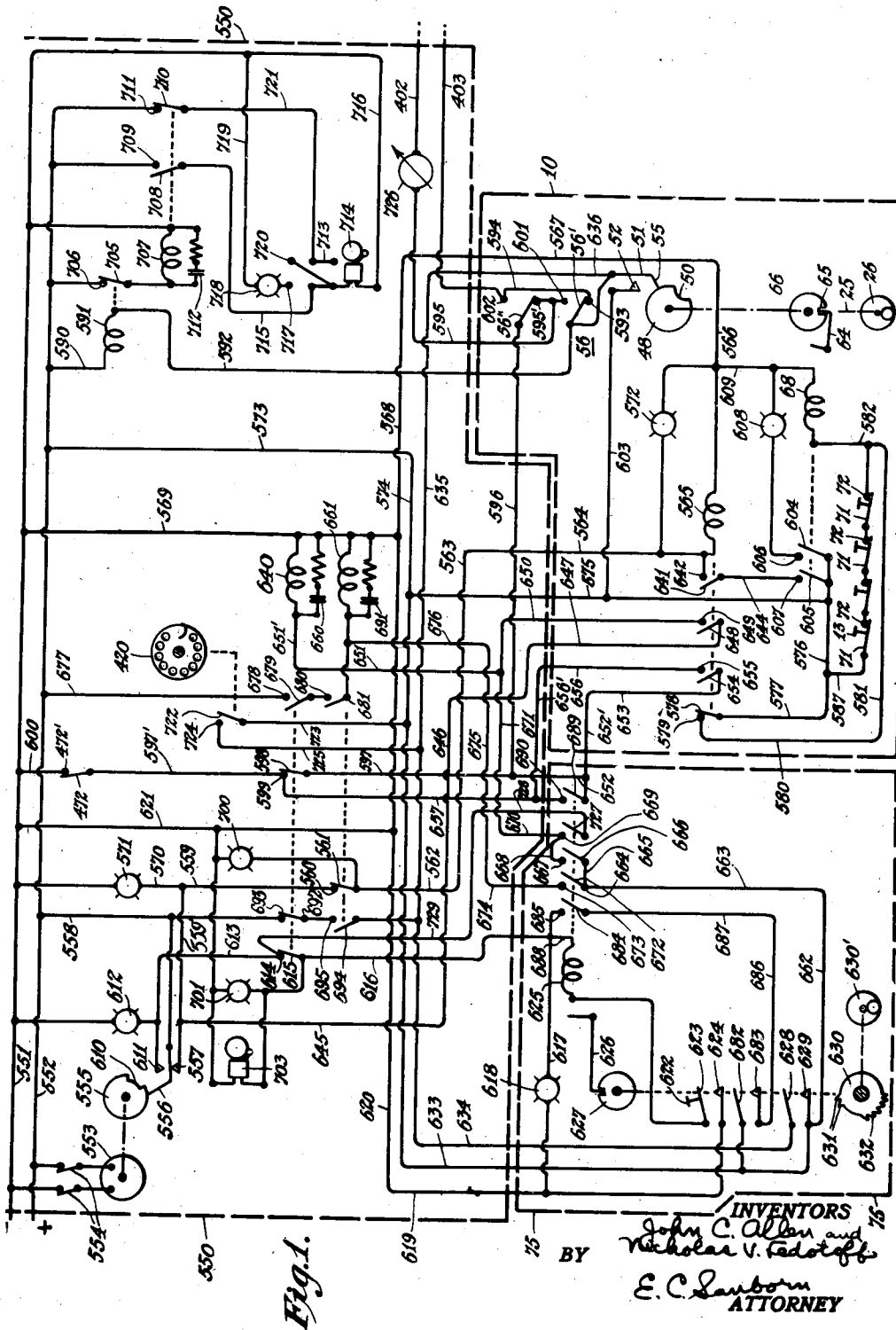
J. C. ALLEN ET AL

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METHOD AND MEANS FOR TRANSMITTING AND INDICATING INFORMATION

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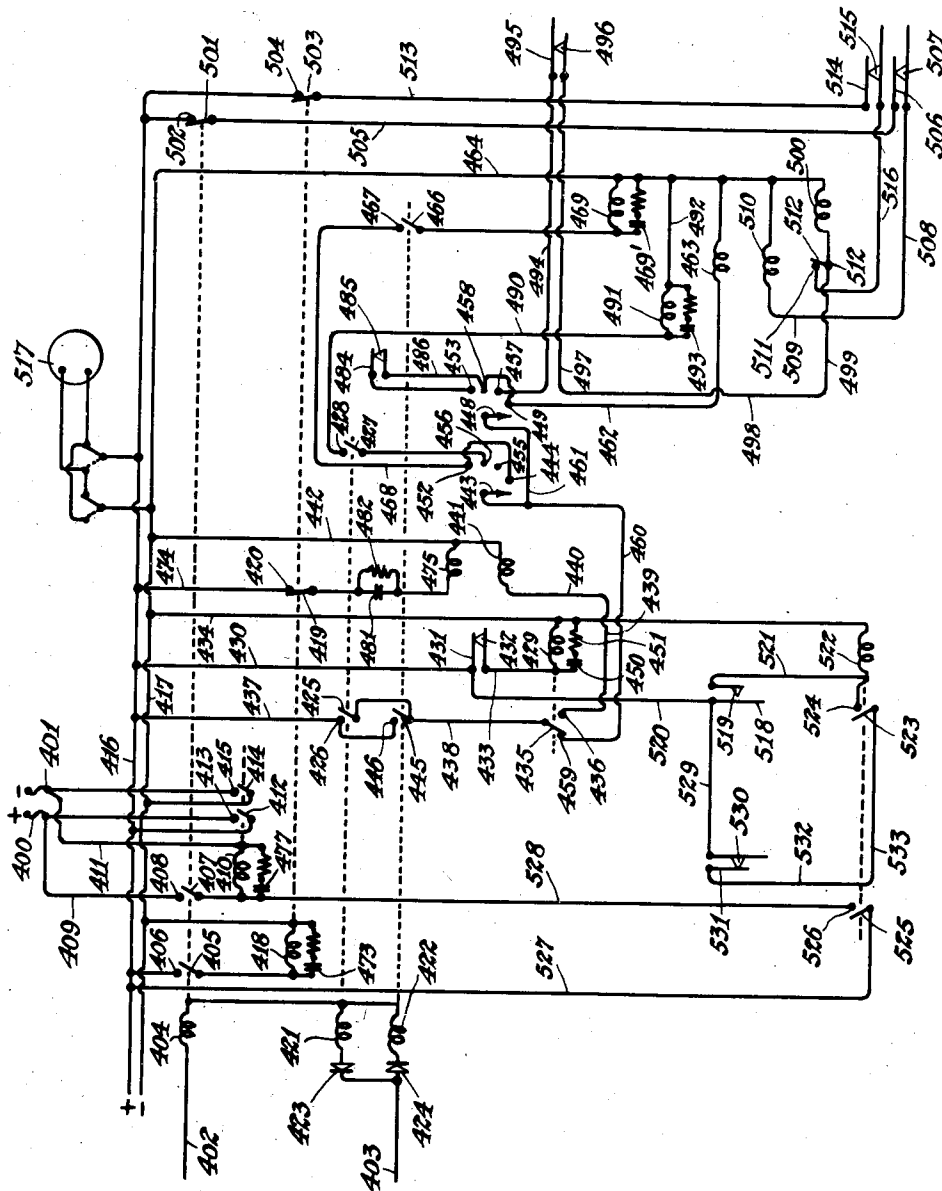
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Fig. 2.



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Fig. 3.

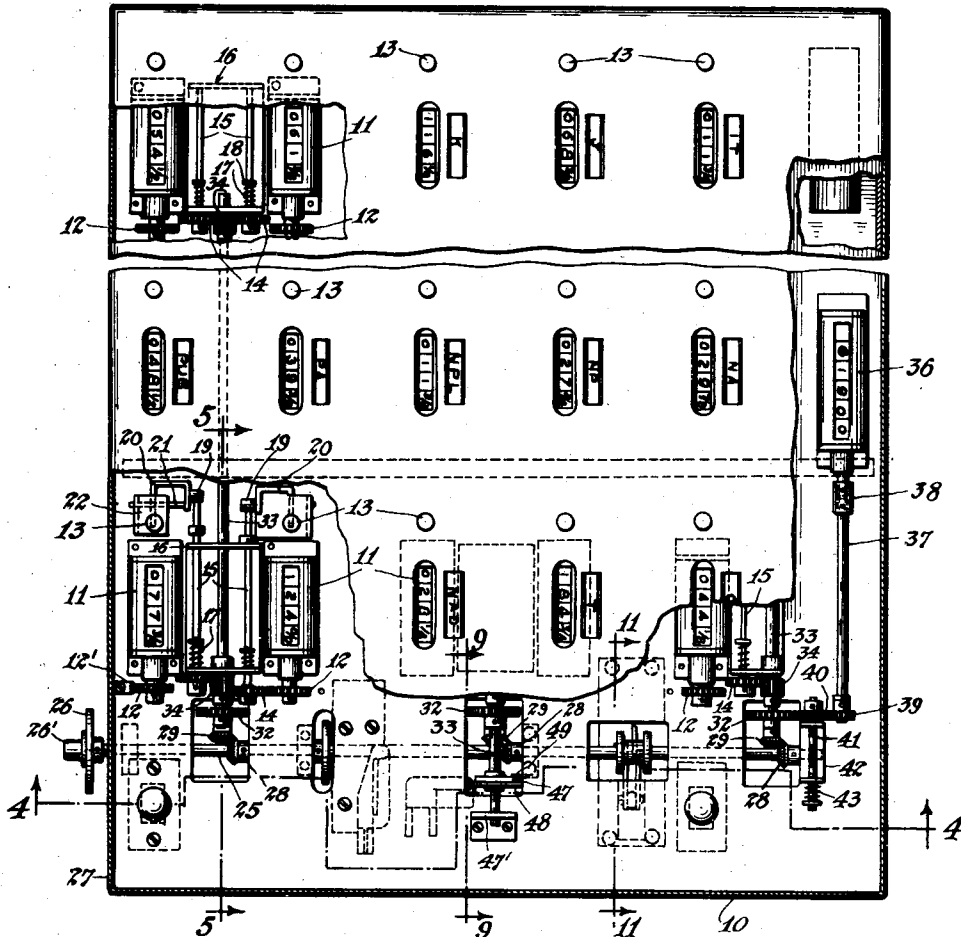
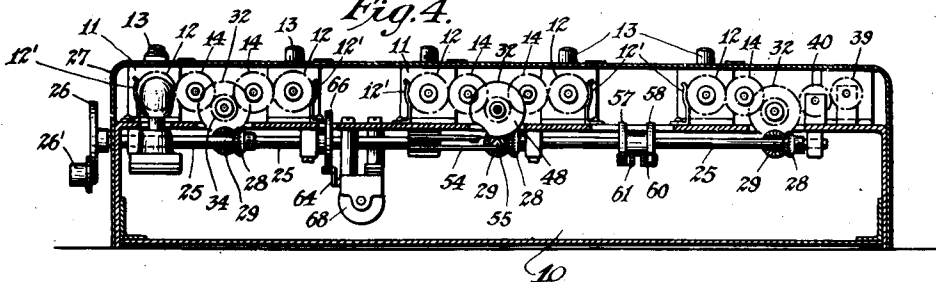


Fig. 4.



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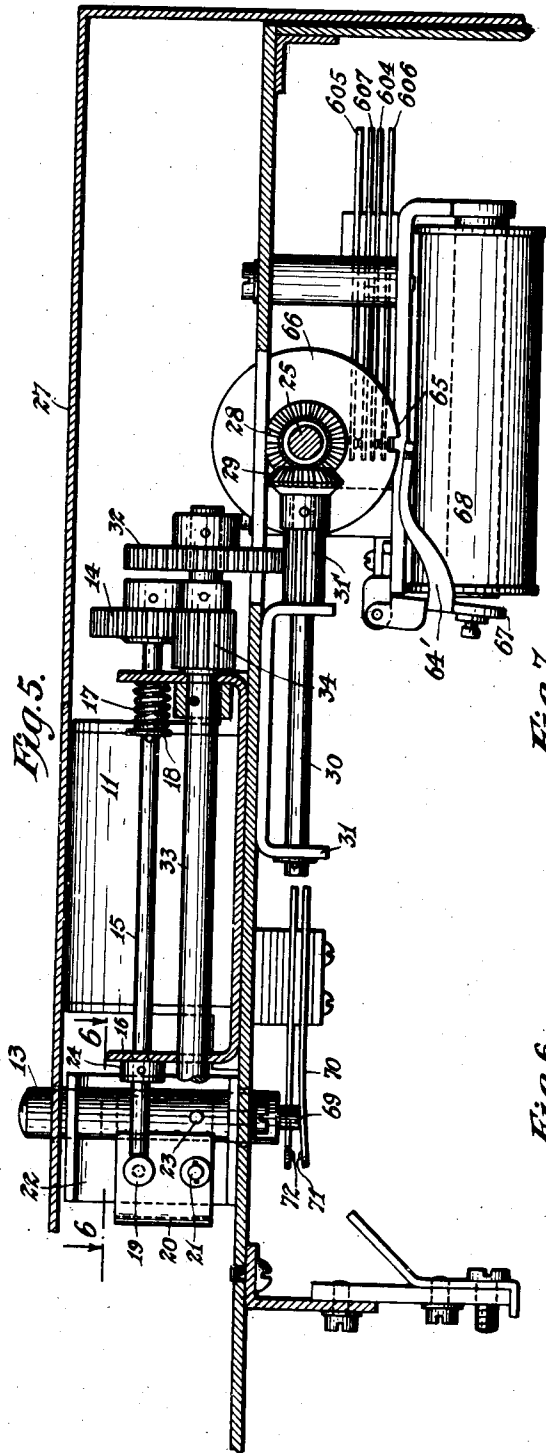


Fig. 5.

Fig. 7.

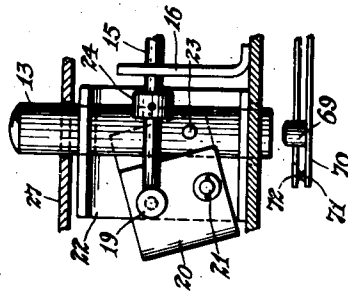
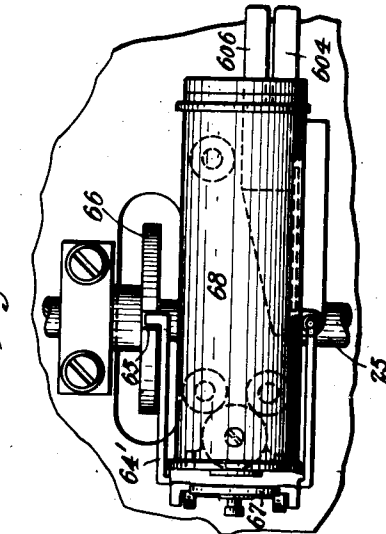


Fig. 6.

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Fig. 9.

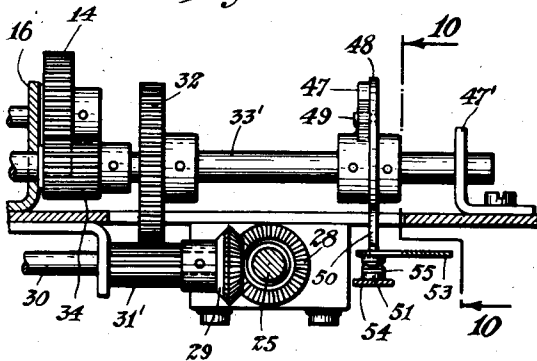


Fig. 10.

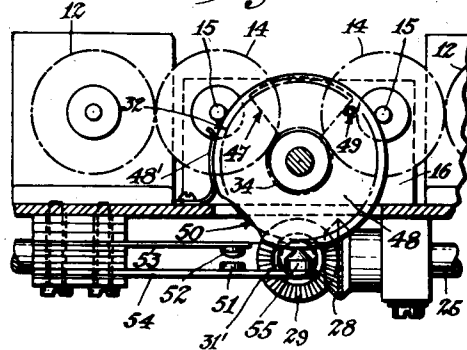


Fig. 11.

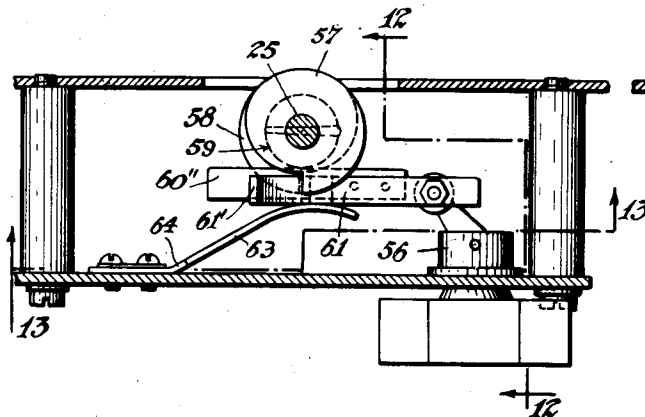


Fig. 12.

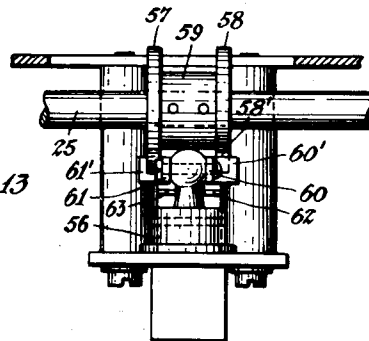
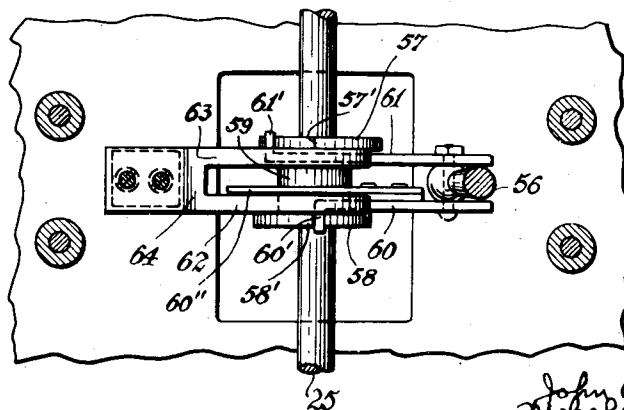


Fig. 13.



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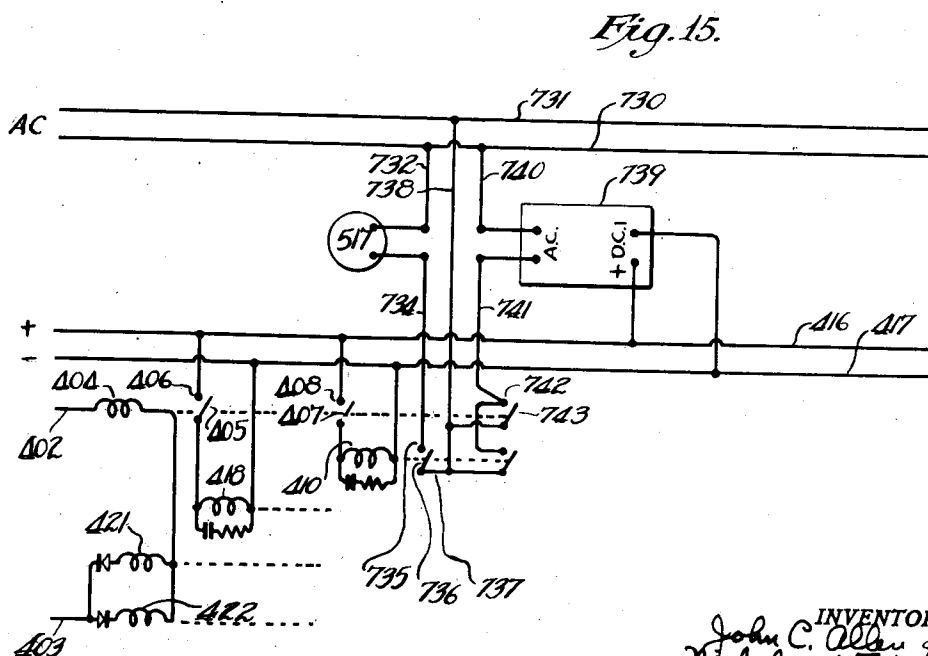
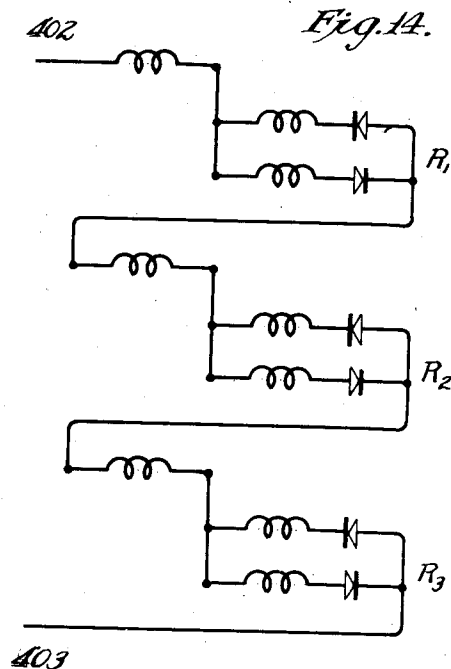
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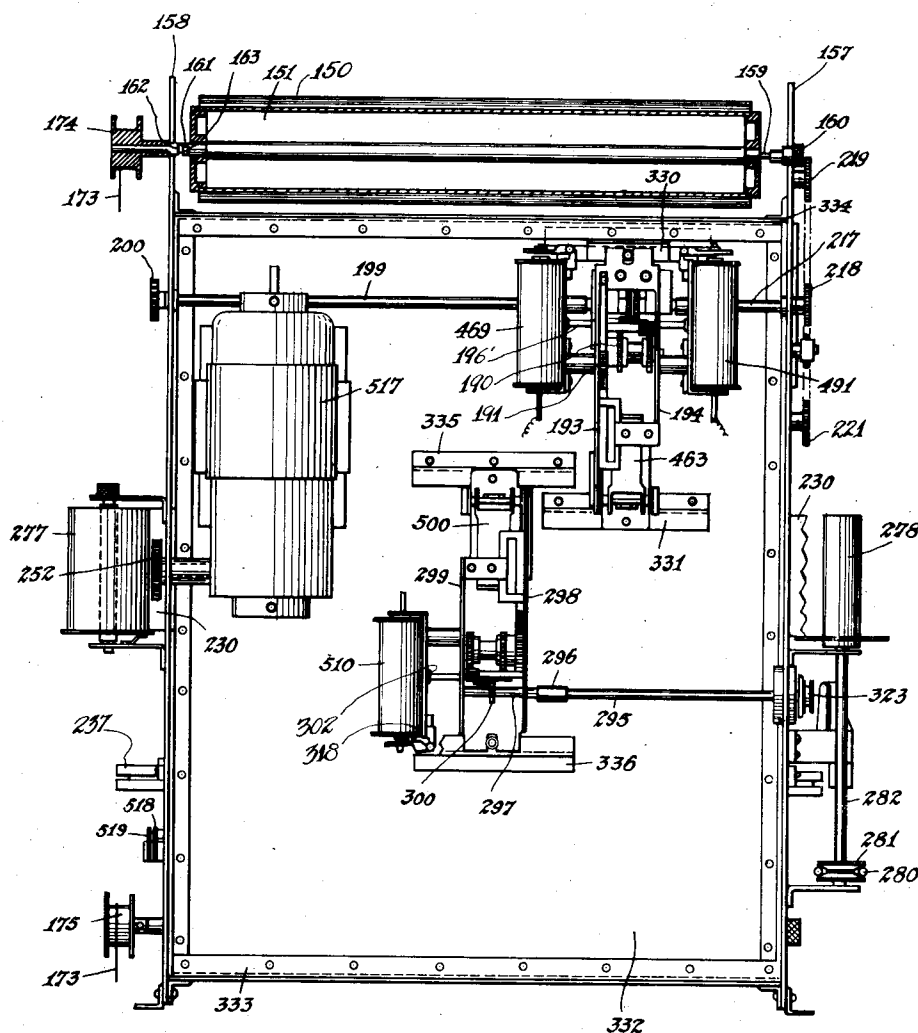
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Fig. 17.



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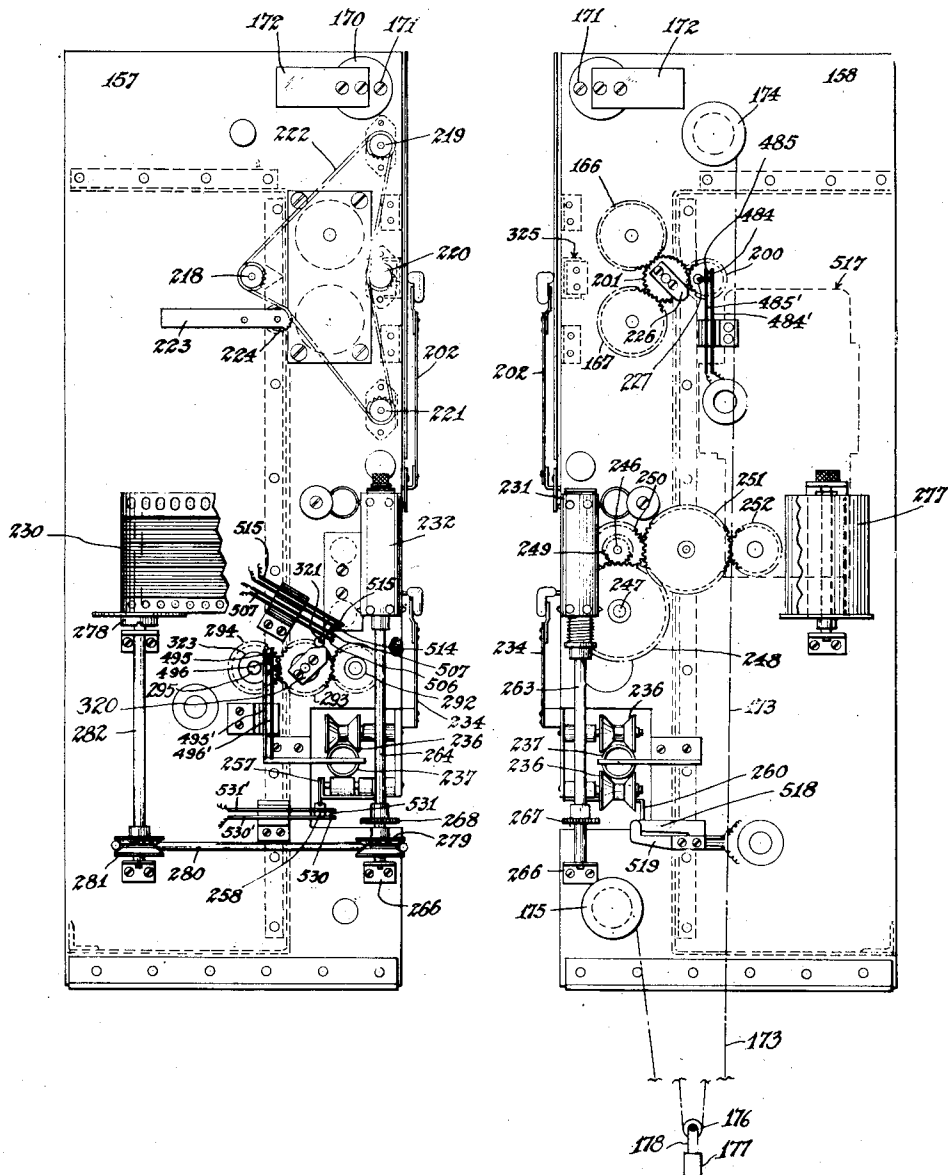
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Fig. 18.

Fig. 19.



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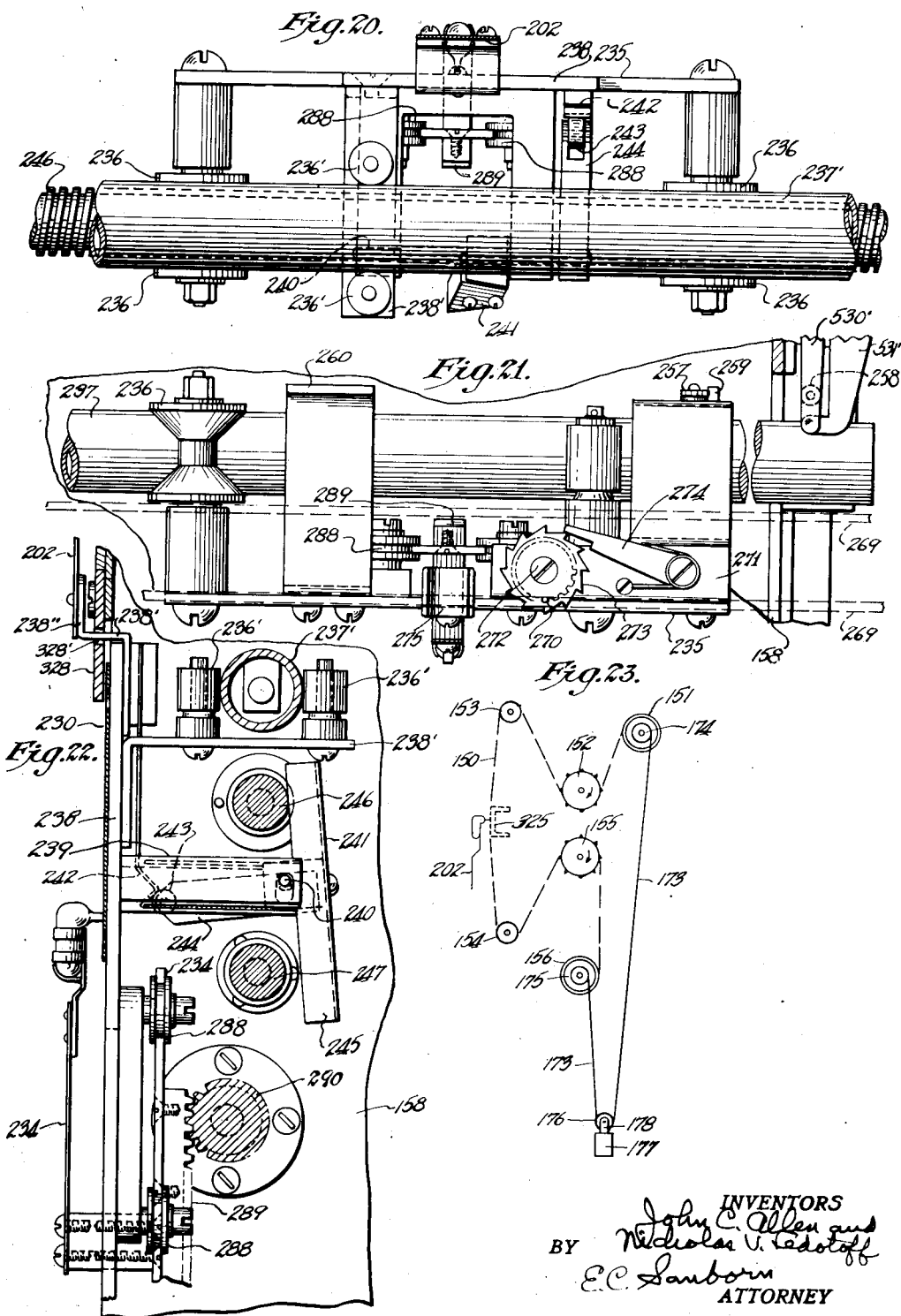
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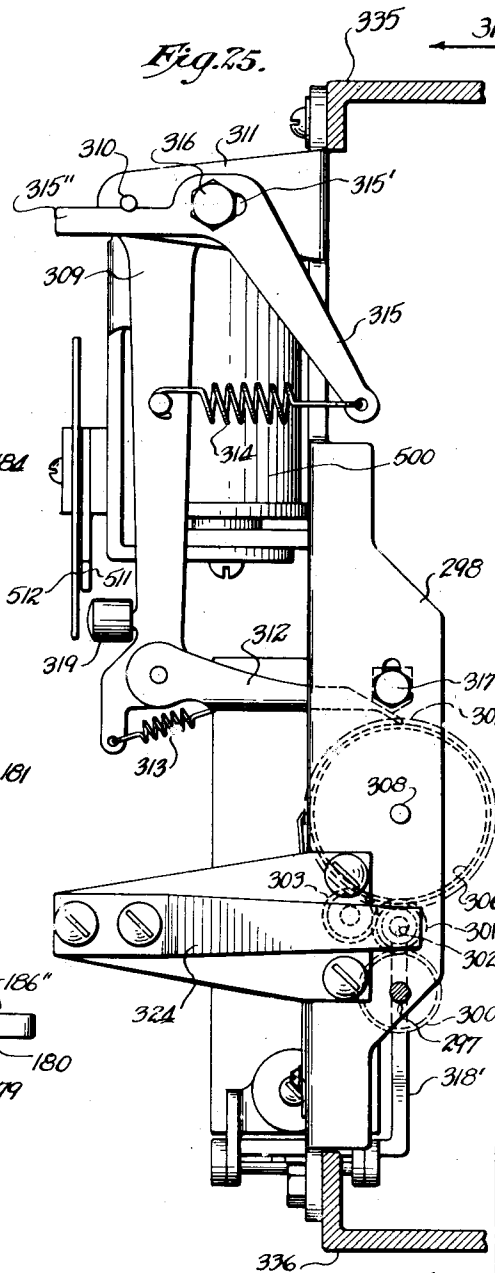
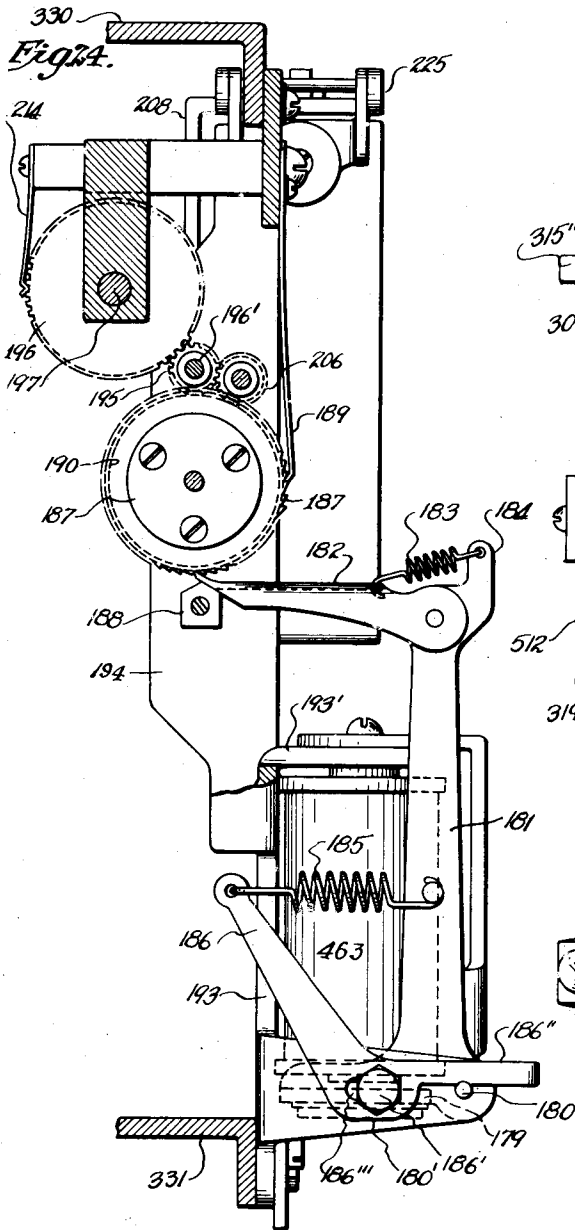
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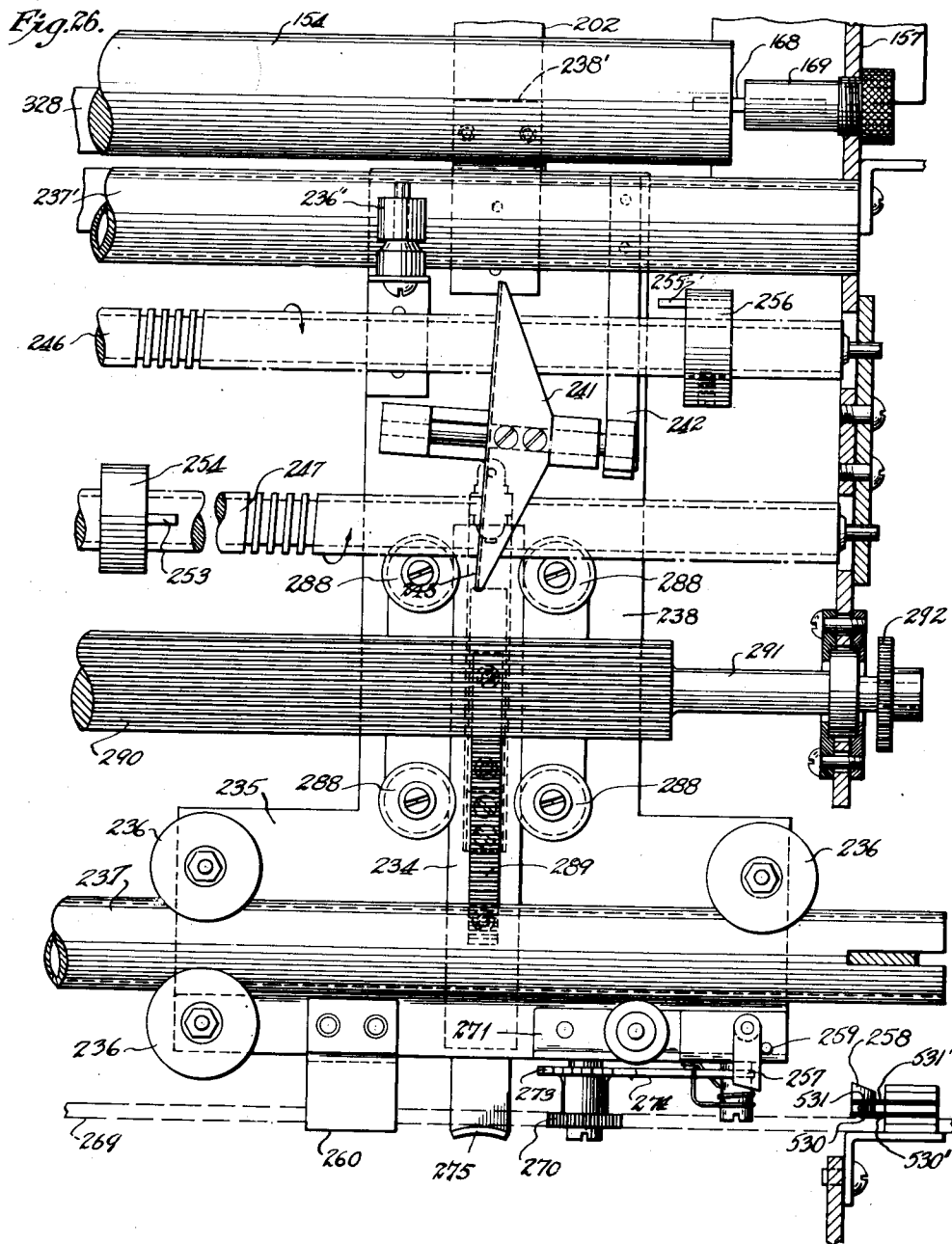
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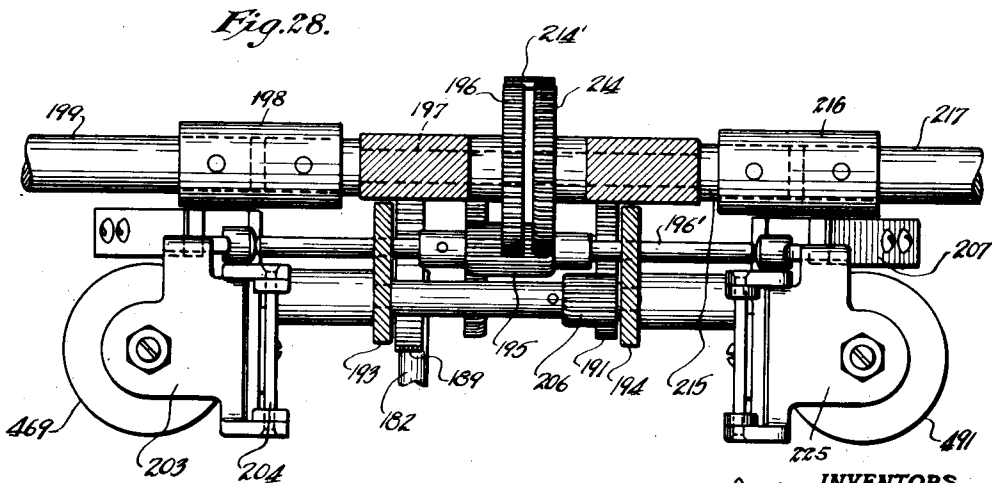
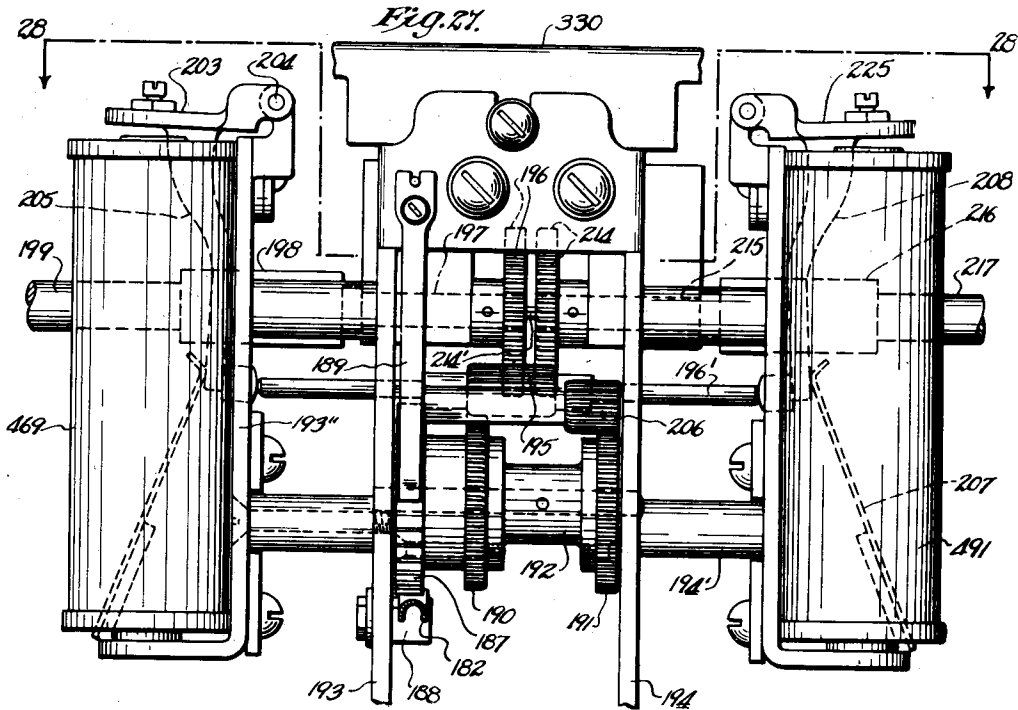
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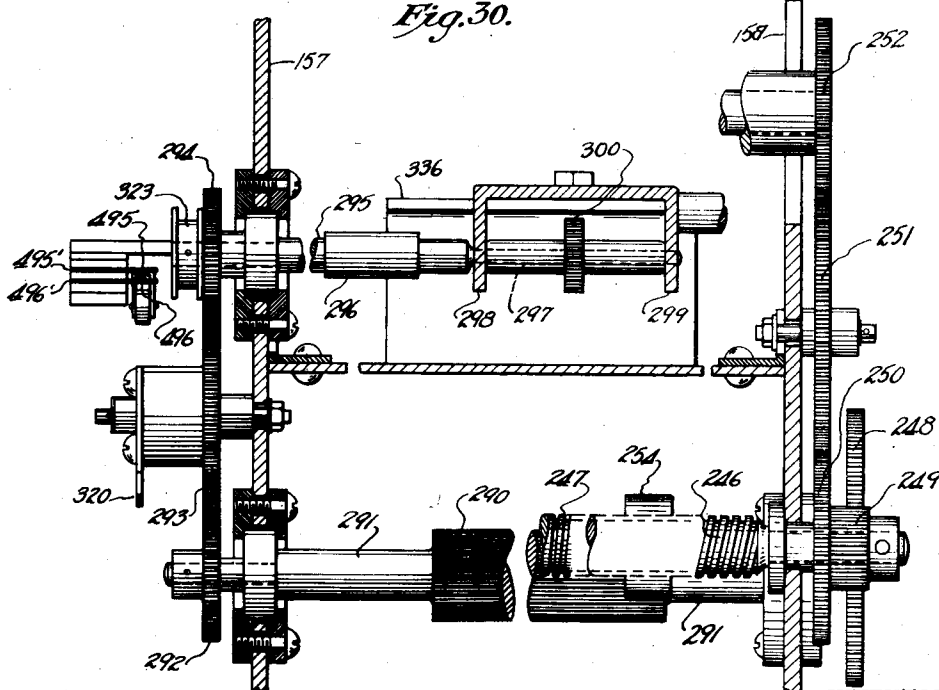
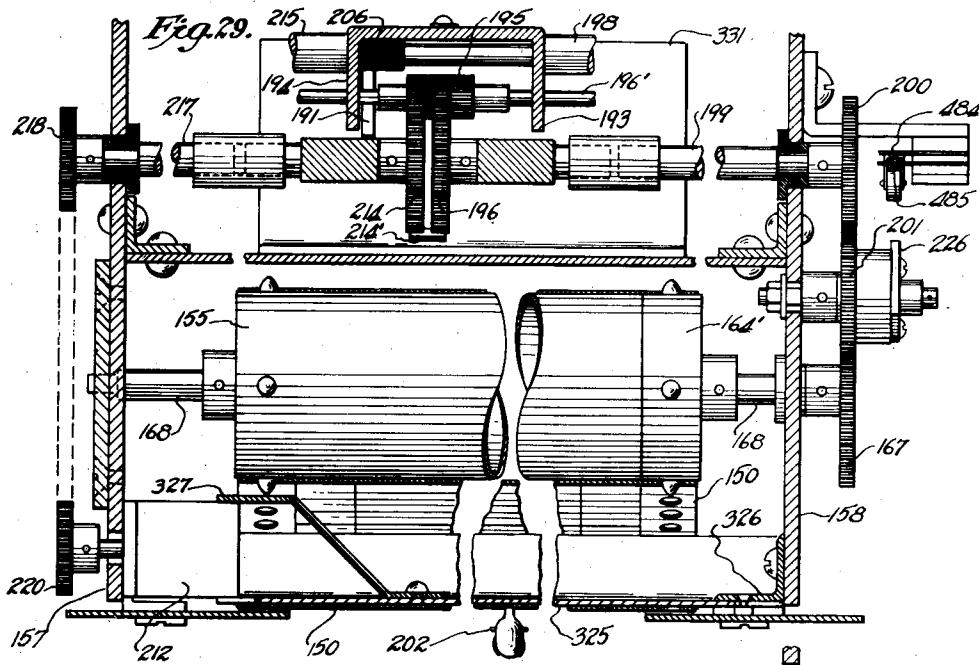
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Fig. 31.

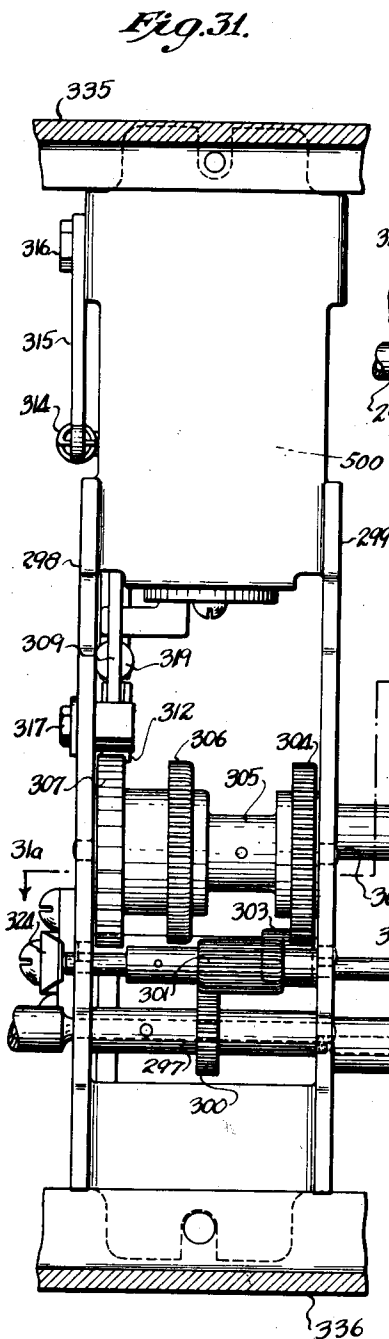
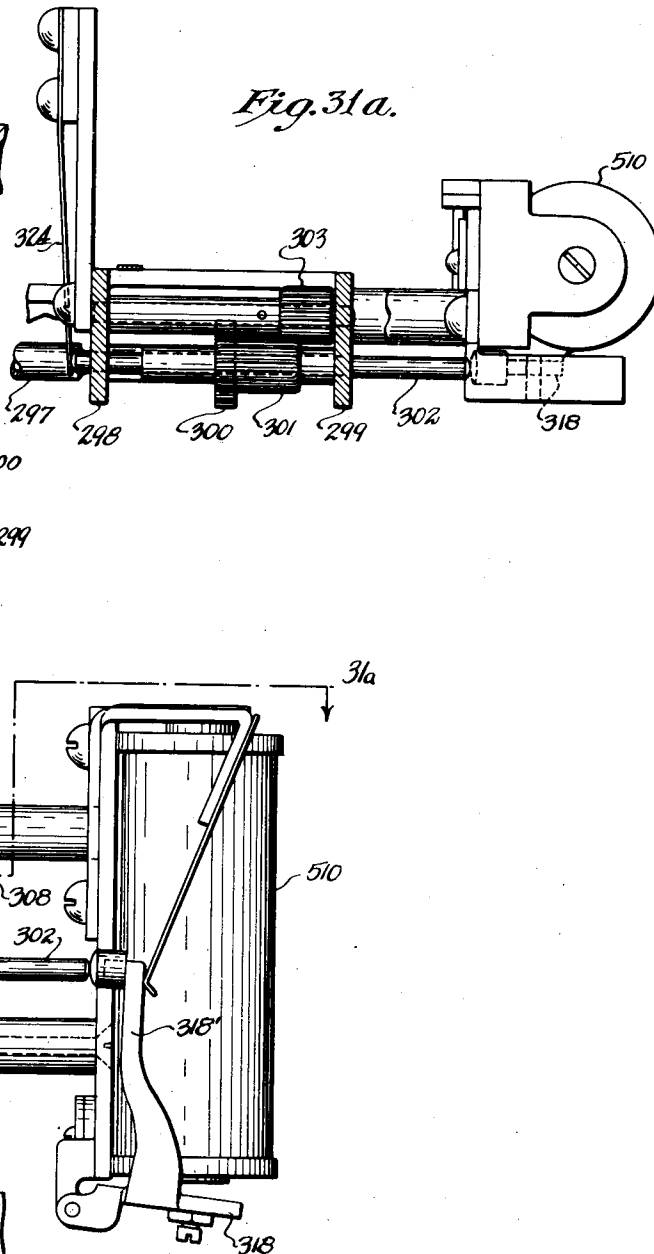


Fig. 31a.



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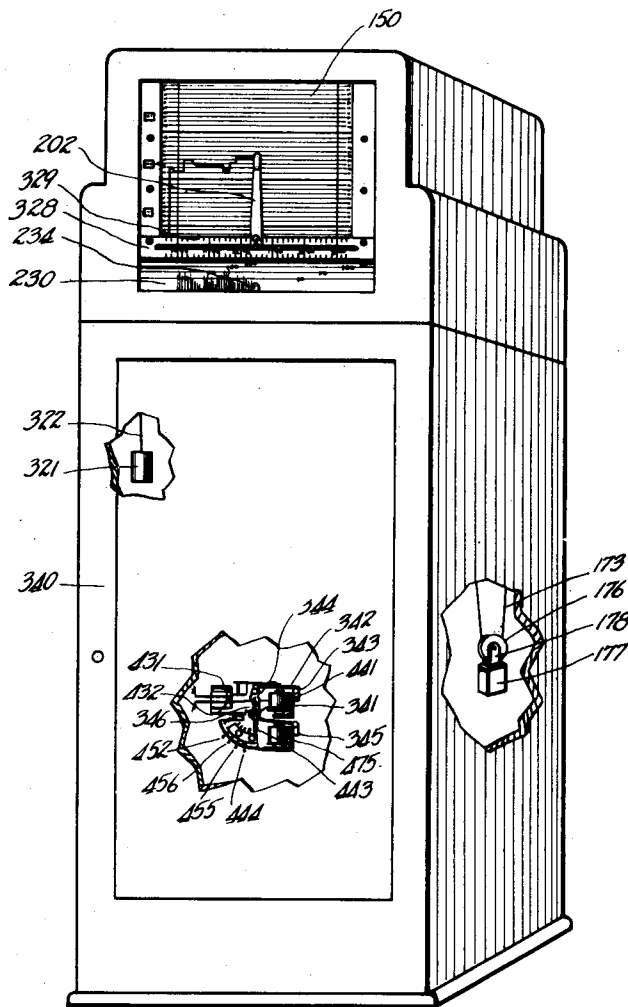
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Fig. 32.



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Fig. 33.

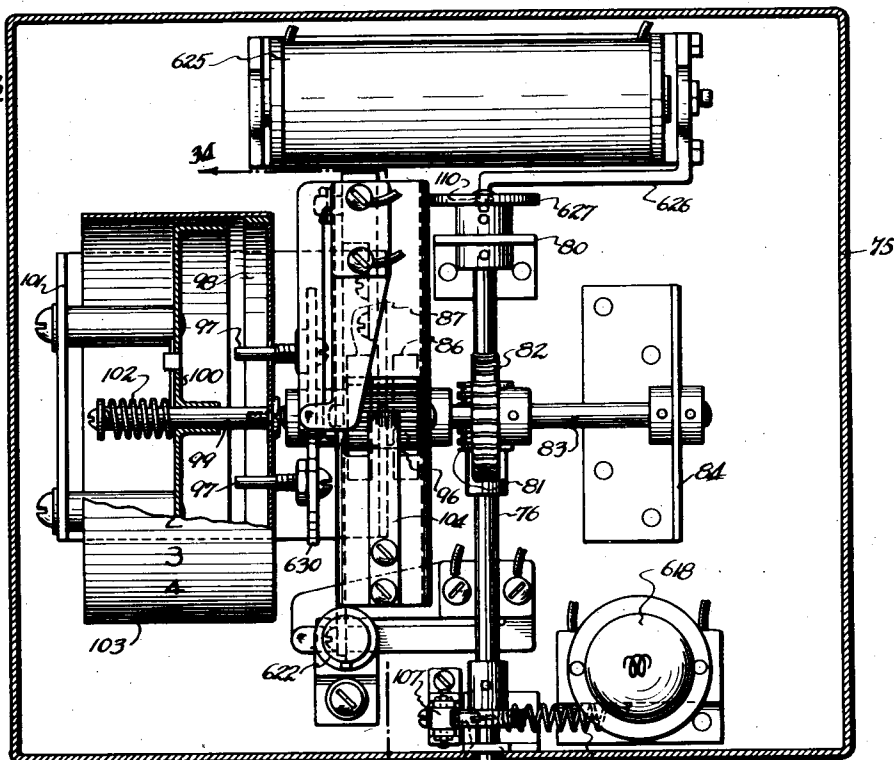
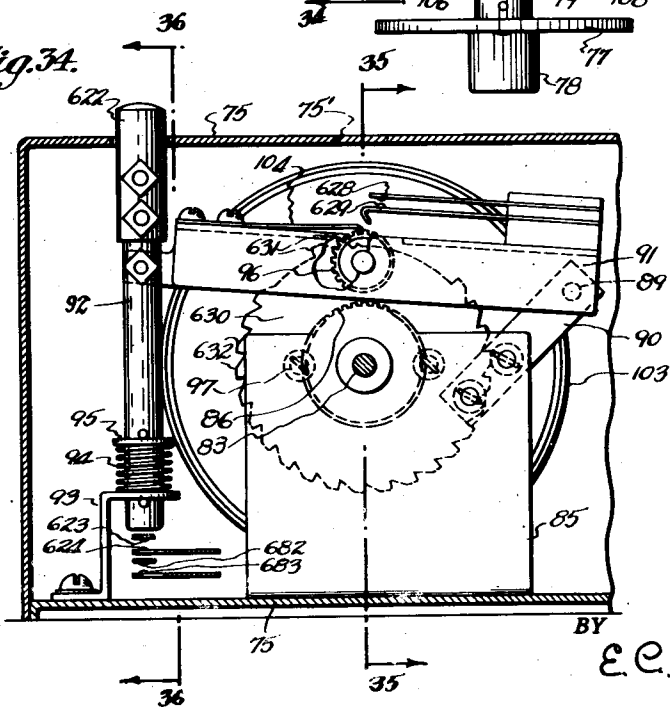


Fig. 34.



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Fig. 35.

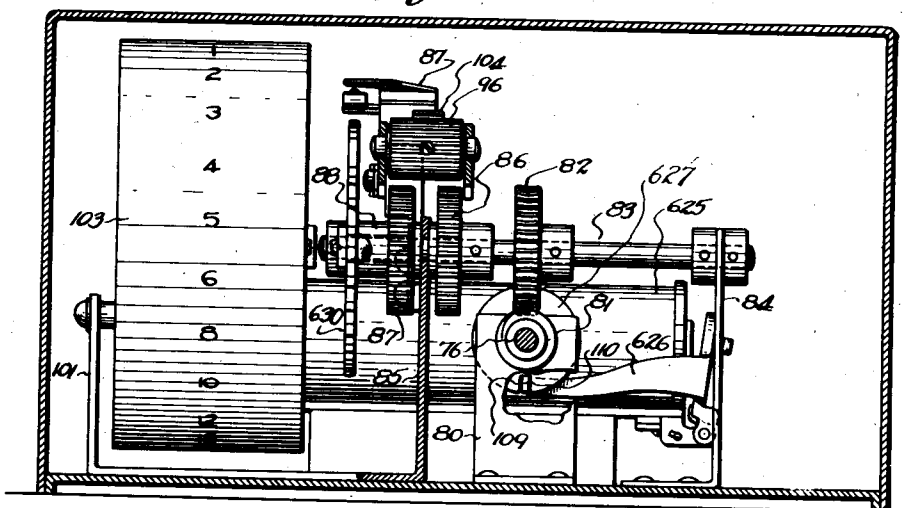
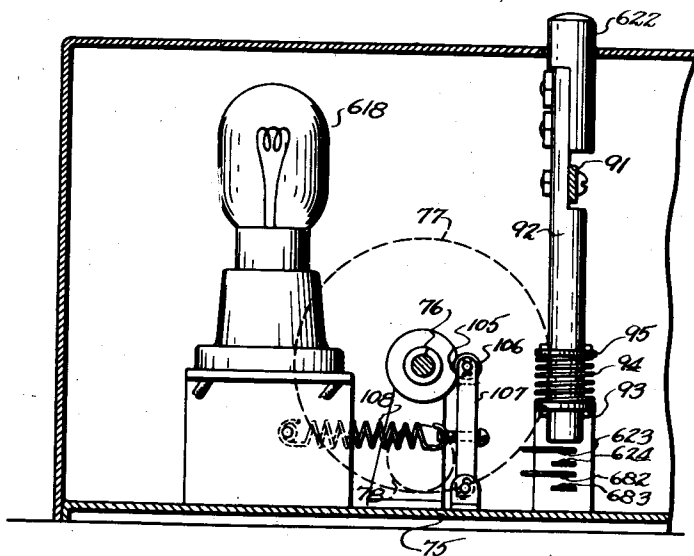


Fig. 36.



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UNITED STATES PATENT OFFICE

2,244,665

METHOD AND MEANS FOR TRANSMITTING
AND INDICATING INFORMATION

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Application January 23, 1937, Serial No. 122,088

19 Claims. (Cl. 177—353)

This invention relates to the transmission of information from a sending station to a remote receiving station and to the indicating of said information at said receiving station. An object of the invention is the provision of novel and effective means whereby different kinds of information may be transmitted over a single line to a receiver. Another object comprises the provision of means for sending different kinds of information, in combination with means operating to establish different cyclical periods for the respective kinds of information to be transmitted.

The invention further comprises provisions for enabling the transmission of one kind of information to be completed if, at the time a cyclical period assigned to another kind of information is established, the transmission of the first mentioned information has not been completed. In this connection means are also provided for preventing the transmission of one kind of information while another kind is being transmitted. Another object is to provide means for indicating to an operator the establishing of the respective periods for transmission of the different kinds of information.

A further object is the provision of means for effectively supervising the continuity and condition of the transmission line and for providing an indication if failure of said line should occur.

Another feature of the invention resides in the provision of novel receiving means, including novel apparatus for recording the types of information transmitted. Included in this phase of the invention are novel provisions for driving a recording chart in either of opposite directions, for maintaining appropriate tension on the chart for bringing fresh portions of a chart into record-receiving position, and for effecting orientation of charts at different receiving stations.

More specific features of the invention comprise novel provisions whereby changes in the average prices of a group of stocks, bonds, or other commodities, may be automatically reproduced graphically in response to the setting up at a transmitting station, of values corresponding to changes in the prices of individual commodities of the group. The invention provides a continuous record throughout each trading period of the average prices of the group of commodities, and also includes provisions for recording indications of volumes of sales of commodities in juxtaposition to the recorded

averages, so that an observer may be apprised continuously of the trend of the market.

A further feature of the invention resides in novel and efficient means for correlating the transmission of averages and volumes, enabling each to be transmitted at given times over the transmitting line without interference with the other. Novel means for transmitting impulses to the average recorder upon the accumulation of a predetermined change in average, while excluding changes below a predetermined amount, are also provided.

Further features of the invention will be described in the specification and pointed out in the appended claims.

In the accompanying drawings:

Fig. 1 is a wiring diagram showing connections at the central transmitting station for sending signals in accordance with our invention.

Fig. 2 is a wiring diagram showing connections at a receiving station adapted to respond to signals from the transmitting station.

Fig. 3 is a plan view, with parts broken away, of an embodiment of our invention for the transmission of averages.

Fig. 4 is a longitudinal vertical section taken on line 4—4 of Fig. 3.

Fig. 5 is a transverse vertical section on an enlarged scale taken on line 5—5 of Fig. 3. In this view the push button 13 of the stock counter is shown depressed.

Fig. 6 is a horizontal sectional detail view on line 6—6 of Fig. 5.

Fig. 7 is a detail view showing the push button of Figure 5 released and in normal position.

Fig. 8 is a detail view showing the interlocking magnet and associated parts of Fig. 5 viewed from the bottom.

Fig. 9 is a longitudinal sectional detail view on an enlarged scale taken on line 9—9 of Figure 3, showing the parts for transmitting average impulses.

Fig. 10 is a view in side elevation, partly in section, taken on line 10—10 of Figure 9.

Fig. 11 is a longitudinal sectional detail view of an enlarged scale, taken on line 11—11 of Fig. 3, showing the parts for operating the polarity switch at the average transmitter.

Fig. 12 is a view in side elevation, taken on line 12—12 of Fig. 11.

Fig. 13 is a bottom plan view, taken on line 13—13 of Fig. 11.

Fig. 14 is a diagrammatic view illustrating a plurality of receiver units in circuit with the transmission line.

Fig. 15 is a diagram showing the application of alternating current to a receiving station.

Fig. 16 is a front elevation partly in section of recorder apparatus, embodying our invention.

Fig. 16' is a view of a detail pertaining to the control of the volume tape.

Fig. 17 is a rear elevation partly in section of said apparatus.

Fig. 18 is a left side elevation of the recorder apparatus.

Fig. 19 is a right side elevation of the recorder apparatus.

Fig. 20 is a top plan view of the pen carriage.

Fig. 21 is a bottom plan view of the pen carriage.

Fig. 22 is a side elevation of the upper portion of the carriage mechanism.

Fig. 23 is a diagrammatic view showing the average tape and associated parts.

Fig. 24 is a side elevation partly in section of the average motor.

Fig. 25 is a side elevation partly in section of the volume motor.

Fig. 26 is a rear elevation of the carriage mechanism.

Fig. 27 is a rear elevation of the average motor with driving pawl 182 shown in section.

Fig. 28 is a horizontal sectional view on line 28—28 of Fig. 27.

Fig. 29 is a horizontal sectional view on line 29—29 of Fig. 16.

Fig. 30 is a view in horizontal section, on line 30—30 of Fig. 16, through mechanism driven by the volume motor and through mechanism driven by the time motor.

Fig. 31 is a view in elevation, showing the volume motor looking from the right side of Figure 25.

Fig. 31A is a horizontal section on lines 31a—31a of Fig. 31.

Fig. 32 is a perspective view showing the recorder cabinet with parts of the casing broken away.

Fig. 33 is a plan view of the volume transmitter with parts in section.

Fig. 34 is a vertical sectional view on lines 34—34 of Fig. 33.

Fig. 35 is a vertical sectional view on lines 35—35 of Fig. 34.

Fig. 36 is a vertical sectional view on lines 36—36 of Fig. 34.

The average transmitter

The average transmitter 10 (Figures 3-13) comprises a given number of counters 11 each of which may be of the well known Veeder type, and each serving to indicate the present value of one of a selected group of stocks. The lowest indication on each counter may conveniently be chosen as $\frac{1}{8}$ of a dollar.

Each of the stock counters 11 is provided with a gear 12 and a push button 13. Depression of the button 13 engages an intermediate gear 14, associated with the particular counter, with the gear 12 of said counter. This may be conveniently accomplished as follows:

The intermediate gear 14 of each counter is mounted on a shaft 15 (Figures 3 and 5) slidably supported in a bracket 16. A spring 17, positioned between one end of said bracket and a collar 18 on said shaft 15 normally maintains the shaft 15 retracted, with the gear 14 out of mesh with the associated gear 12 of the counter. At its end opposite the gear 14, shaft 15 is adapted to be engaged by a stud 19 on a bail 20 piv-

oted at 21 to a suitable bracket 22. Normally, under the action of the spring 17, the shaft 15 and bail 20 occupy the positions shown in Fig. 7. The bail 20 is suitably connected with the push button 13, as by a pin 23, so that when said push button is depressed, said bail is rocked from the position shown in Figure 7 to that shown in Figure 5, with consequent pushing of the shaft 15 by stud 19 into the Figure 5 position, wherein gear 14 is brought into mesh with the counter gear 12. A collar 24 on shaft 15 may be provided to limit the extent of movement of said shaft 15 by engagement with bracket 16, as shown in Figure 5. Upon release of push button 13 by the operator, the compressed spring 17 restores the shaft 15, bail 20, and gear 14 to their normal positions, with gear 14 disengaged from gear 12. A spring 12' which bears against gear 12 prevents the latter from over-running or being turned accidentally.

Extending across the transmitter 10 and transversely to the counters 11 is a main operating shaft 25, to which is attached a disk 26 having a handle 26', outside the transmitter casing 27. The main operating shaft 25 is shown as having secured thereto a plurality of bevel pinions 28, each of which meshes with a corresponding bevel pinion 29 pinned to a corresponding shaft 30. Each shaft 30, as shown in Fig. 5, is mounted in a suitable bracket 31 and has secured thereto a pinion 31', which meshes with a gear 32 secured to a shaft 33. Each shaft 33 extends longitudinally of the transmitter casing and cooperates with a plurality of stock counters. Thus, as shown in Figure 3, the shaft 33 nearest the handle 26 has fastened thereto a pinion 34 which is in constant mesh with the gears 14 of the pair of counters 11 revealed by the broken away top plate of the transmitter nearest the shaft 25. If now the button 13 associated with either of these counters is depressed, the corresponding gear 14 is shifted, as above described, into engagement with gear 12 of said counter, while remaining in mesh with the gear 34 of the shaft 33, as shown in connection with the counter bearing the reading 124.00 in Fig. 3. Then, upon turning the handle 26 in either direction through a given extent, the aforesaid counter gear 12 is rotated through a corresponding extent and direction, correspondingly operating said counter. The shaft 33 is also provided with similar gears 34 Fig. 3 for similarly operating the pairs of counters shown to the left of the counters nearest the shaft 25. Since the construction employed in conjunction with shaft 33 and the others of said counters is the same as that above described, it need not be here repeated. The second shaft 33, adjacent the shaft 33 specifically described above, is likewise provided with gears 34 for operating associated pairs of counters in the same manner as hereinbefore described. The third shaft 33 is shown cooperating with a single set of counters instead of with pairs of counters on opposite sides of said shaft, but, as will be apparent, the operation of the counters from the gears 34 on said third shaft 33 is accomplished in the same manner as described above, i. e., by simply depressing the push button 13 associated with the appropriate counter and turning the handle 26 in the desired direction and through the desired extent.

In the embodiment of the invention here specifically described it is assumed that twenty-five individual stock counters 11 are present, only fifteen, however, being actually shown in Fig. 3.

As there shown, three longitudinal rows of counters 11 are shown, five counters in each row. Two other longitudinal rows of five counters in each row are present but not shown, between the lines designating broken away portions of the transmitter. Of course, it is obvious that any desired number of stock counters may be utilized and that the invention is not restricted to any particular number of such counters.

A Veeder type counter 36 (Fig. 3) is operated by the main shaft 25 to exhibit the average of the indications appearing at any one time on the group of stock counters 11. This average indicating counter may be operated in any suitable manner from shaft 25 for example, as follows:

A shaft 37 connected by a suitable coupling 38 to the shaft of counter 36 has fast thereto a pinion 39 which meshes with a pinion 40 meshing in turn with a gear 32 rotatable with the bevel pinion 29 which meshes with the bevel pinion 28 on the end of shaft 25 opposite from the end which carries the handle 26. Pinion 40 may conveniently be mounted on a shaft 41 slidable in a bracket 42 so that when desired the pinion 40 may be moved out of mesh with gear 32 and pinion 39, and the counter 36 operated manually to any desired setting. Normally, however, the pinion 40 is in mesh with pinion 39 and gear 32, as shown in Fig. 3. A spring 43 normally maintains shaft 41 and pinion 40 in said operative position.

The ratio of the gearing 39, 40, 32 is so chosen that, assuming twenty-five stock counters 11, one complete rotation of handle 26 and operating shaft 25 will rotate shaft 37, together with the shaft of counter 36, through one-half a revolution. One complete rotation of shaft 25 changes the reading on the selected individual stock counter 11 by $\frac{1}{2}$ of a dollar. A change of $\frac{1}{2}$ of a dollar in any one of the individual stock counters 11 changes the average of the group of 25 stocks by .125 divided by 25, or .005 dollar, or, in other words, by one half cent. The lowest order wheel of each counter 11 turns through eight steps to complete a revolution, and in completing the revolution, turns its next higher order wheel through $\frac{1}{8}$ of a revolution, said next higher order wheel in completing a revolution also turning its adjacent higher order wheel through $\frac{1}{8}$ of a revolution, as is well known in the art. The counter 36, however, operates entirely on the decimal system, its reading exhibiting dollars and decimal fractions thereof. With the gearing above referred to, turning of shaft 25 through one complete rotation in either direction, corresponding to a change of $\frac{1}{2}$ in the reading of any one stock, turns the shaft 37 and the lowest order wheel of counter 36 through one-half a revolution, said lowest order wheel of counter 36 indicating mills. It will thus be evident that counter 36, upon any operation of shaft 25 in accordance with change of reading in any one stock, is operating to show the average of the group of 25 stocks resulting from said change.

An impulse is sent from the average transmitter to the average recorder whenever the average of the group of stocks changes a predetermined amount. In the present embodiment the impulse is sent whenever the group average changes by two cents. For transmitting such impulse the main shaft 25 drives pinion 31' (Fig. 9) on the middle shaft 30. Pinion 31' meshes with gear 32 secured to an extension 33' of the middle shaft 33, which extension also has secured there-

to an arm 47. Bracket 47' supports the end of said extension. Journalled for rotation on the shaft 33' is a disk 48 having a pin 49 adapted to be contacted by the aforesaid arm 47. Disk 48 is provided with a notch 50. Contacts 51, 52 are carried by leaf springs 54, 53, respectively, and are normally held separated through the engagement of stud 55 of leaf 54 with the periphery of disk 48. Disk 48 is made from insulating material. When, however, notch 50 of disk 48 comes opposite the stud 55, the spring 54 is released and brings contact 51 into engagement with contact 52 with resultant closing of a circuit whereby an impulse is sent to the average recorder.

In the present embodiment the gearing between main shaft 25 and shaft 33 is in a ratio of four to one; four rotations of shaft 25 being required for one rotation of shaft 33. Thus, for each complete rotation of shaft 25 arm 41 moves through 90°. Assuming that a given rotation of shaft 25 has operated the disk 48 through a step wherein contacts 51 and 52 are closed to send an impulse, no further closing of contacts 51 and 52 will take place until during the fourth revolution of shaft 25 in the same direction or the fourth revolution of said shaft in the opposite direction. It may be observed, at this point, that in each of the four positions of the disk 48, corresponding to normal or home position of shaft 25, the contacts 51, 52 are separated, these contacts being closed only momentarily during the travel of disk 48 from one of its four positions to the next, i. e., during the passage of the notch 50 past the stud 55.

If it be now assumed that the notch 50 of disk 48 passes by the stud 55 with consequent sending of an impulse from contacts 51, 52, during the turning of shaft 25 through a given revolution, at the end of said revolution of shaft 25 said notch 50 has passed completely by the stud 55. By way of a specific example, assume that disk 48 has turned in a clockwise direction into the position shown in Fig. 10. During the rotation of shaft 25, in which said disk 48 was turned clockwise into the Fig. 10 position, the notch 50 has passed over the stud 55 with consequent sending of an impulse through contacts 51 and 52. The arm 47 is now in engagement with one side of the pin 49 on disk 48. Another impulse will not be sent from contacts 51 and 52 until the arm 47 turns through the last 90° step of a complete revolution clockwise, or through the last 90° step of a complete revolution counter-clockwise. If, with the parts in Fig. 10 position above noted, the arm 47 turns counterclockwise, it will not move disk 48 until it engages the opposite side of the pin 49. This it will do when it has completed its third step of 90° rotation, so that during its fourth 90° step counter-clockwise it will, through the pin 49, turn the disk 48 to bring the notch 50 from the position shown in Fig. 10 counter-clockwise to a position 90° from that shown in Fig. 10, during which movement the notch 50 has passed over the stud 55 and another impulse has been sent. If, with the parts in the position shown in Fig. 10, the arm 47 is moved clockwise, it remains in engagement with the pin 49, carrying the disk 48 with it, and during the fourth 90° step of clockwise movement from the Fig. 10 position, the notch 50 of said disk is passed over the stud 55 and an impulse is sent. It will be seen that it is in the final 90° step of rotation of arm 47 to complete a revolution in either direction that the next impulse is sent. Movement of said arm through a less amount in either direction will not

bring the notch 50 over the stud 55. Thus, for changes in the group average of less than two cents in the embodiment here shown, the contacts 51, 52 remain separated, and will not be engaged to send an impulse until a change in the group average amounting to two cents is accumulated. Upon the accumulation of a change in the group average amounting to two cents, the aforesaid contacts close momentarily during the rotation of disk 48 to send an impulse. The arm 47 is of sufficient width as indicated in Figure 10 that, in moving from one side to the other of the pin 49, said arm will pass through three steps. In other words, if arm 47 is in engagement with one side of pin 49 and is moved in a direction away from said side of the pin, said arm will engage the opposite side of the pin at the end of the third 90° step of movement of said arm, and will, in its fourth step of movement in said direction, move the disk 48 through 90°. A spring arm 48' bears continually against the periphery of disk 48 to insure holding the latter in the position to which it has been set.

Means are provided for controlling the polarity of the impulse sent by closure of contacts 51, 52 depending upon the direction of rotation of the shaft 25. For this purpose, there is provided a polarity switch 56 of any suitable or conventional construction, such as a double-pole double-throw switch as shown diagrammatically in Fig. 1. When in the position shown in Fig. 1, switch 56 determines that the impulse shall be positive, and when in its other position, said switch determines that said impulse shall be negative. For controlling the operation of said switch in accordance with the direction of rotation of shaft 25, said shaft has fixed thereto a pair of cams 57, 58 (Figs. 11, 12, and 13). The switch 56 has pivotally connected thereto two arms 60 and 61. One arm 60 has a finger 60' adapted to be engaged by the shoulder 58' of cam 58. The opposite arm 61 has a finger 61' for engagement with a shoulder 57' of cam 57. The cam shoulders 57', 58' face in opposite directions. Assuming now that shaft 25 is turned counter-clockwise, as viewed in Figure 11, the shoulder of cam 58 will act upon finger 60' of arm 60 to thereby throw the switch 56 into a reversed polarity position. Continued counter-clockwise rotation of shaft 25 will not affect the setting of the switch 56, since the latter has been thrown by cam 58 to a position out of the range of action of said cam.

The arms 60, 61 rest upon fingers 62, 63, respectively of a leaf spring 64. The hub 59, which carries the cams 57, 58 and is pinned to shaft 25, limits the upward movement of arms 60, 61 in the different positions of switch 56. In this connection, arm 60, which is shorter than arm 61, is shown provided with an extension 60'' riveted to said arm and adapted to bear against the bottom of said hub. The throwing of switch 56 to its reversed polarity position by cam 58, as above described, brings finger 61' of said bail into position for operation by shoulder 57' of cam 57 when the shaft is turned clockwise. However, continued counter-clockwise rotation of shaft 25 and cam 57 will have no effect upon the switch 56, since the cam shoulder 57' is then not rotating in such direction as to actuate the finger 61'. Should the shaft 25 thereafter be rotated clockwise, the cam shoulder 57' will act through finger 61' to throw the switch 56 back to its position shown in Fig. 11, wherein the polarity corresponding to clockwise rotation of shaft 25 is established. Finger 61' is now out of the range of action of cam 57, but

finger 60' is brought into position for operation by cam shoulder 58' upon counter-clockwise rotation of shaft 25.

The proportions of cams 57, 58 and width of the notch 50 are so selected, that the operation of the cams is completed before the notch 50 is engaged by the stud 55. This is done for the purpose of sending the impulse only after proper polarity is established.

The main shaft 25 is normally locked against rotation when in its normal or home position by means of a pivoted latch 64' engaging a notch 65 in a disk 66 secured on said shaft as shown on Figs. 5 and 8. Latch 64' is carried by the pivoted armature 67 of electromagnet 68. The latter is normally energized but under certain conditions, described later on, may be de-energized by depressing any of the individual stock counter push buttons 13. As noted in Figure 5, each push button 13 is adapted upon depression to engage a stud 69 made of insulation material, of a leaf spring 70 carrying a contact 71 normally engaged by the contact 72. Upon depression of any push button 13 the latter engages stud 69 and separates contact 71 from contact 72, as shown in Figure 5, thereby under certain conditions, described later on, breaking the circuit through the magnet 68, whereupon a contact spring 606 connected to the armature 67, retracts the latter and withdraws latch 64' from engagement with notch 65.

Magnet 68 is also energized, despite the depression of any push button 13, during the periods in which volumes are being transmitted to the recorder, as will be hereinafter described.

The volume transmitter

For transmitting volume indications, means such as shown in Figures 33-36 may be employed. This apparatus is mounted in a suitable case 75 and comprises a main operating shaft 76 having secured thereto outside the case a disk 77 carrying a handle 78. Shaft 76 may conveniently be mounted in brackets 79, 80 secured to the bottom of the casing 75.

Said shaft has secured thereto a worm 81 which meshes with a worm wheel 82 secured to a shaft 83 rotatably mounted in brackets 84, 85. Shaft 83 also has secured thereto a gear wheel 86 and has loosely mounted thereon a gear wheel 87 provided with a hub 88 to which is secured a disk 630 made of insulating material and carrying a pair of teeth 631 (see Figs. 1 and 34) and a series of teeth 632 spaced from said teeth 631.

Pivotally mounted at 89 on a stationary arm 90 secured to the bracket 85 is a frame 91 to which is pivotally connected a stem 92 of insulating material carrying a push button 622. Push button 622 projects through an opening in the top plate of casing 75. At its lower end stem 92 extends through a bracket 93. A spring 94 positioned between said bracket 93 and a collar 95 on stem 92 normally maintains said stem and push button projected upwardly into the position shown in Figures 34 and 36. When push button 622 is depressed, the frame 91 is rocked downwardly and brings a pinion 96, carried by said frame, into mesh with the previously mentioned gears 86 and 87. Upon then rotating the handle 78 the shafts 76 and 83, together with the gear wheel 86 are rotated, and, through pinion 96, this rotation is transmitted to gear 87 and disk 630. Disk 630 is secured by screws 97 to a disk 98 fixed to a shaft 99 which is rotatably mounted in a plate 100 secured to a bracket 101. A torsion

spring 102 is secured at one end to said shaft 99 and at its other end to said plate 100, and is wound during the turning of said shaft and disk 98 with disk 630. Disk 98 has secured to its periphery a drum 103 bearing numerals visible through an opening 75' shown in the top plate of the casing 75 (Fig. 34). Having depressed the push button 622 aforesaid, the operator turns the handle 78 clockwise until the numeral on disk 103, which corresponds to the volume which it is desired to transmit, appears through the opening 75' in the top of the casing. Thereupon the operator ceases turning the handle 78 and releases the push button 622. Spring 94 thereupon returns push button 622 to its normal position, raising the frame 91 and disengaging pinion 96 from gears 86, 87. Spring 102 now returns shaft 99, disk 98, drum 103, and disk 630 to the normal or zero position of the latter. Push button 622, when depressed, engages a contact 623 with a contact 624 and also engages a contact 632 with a contact 633, the purpose of which will be later described. Depression of said push button 622 and lowering of frame 91 also moves downwardly the pair of contacts 628, 629 carried by said frame, so that contact 629 is brought into position for operation by the teeth 631, 632 on the disk 630, whereby, in the rotation of said disk, said contact 629 is engaged with contact 628 each time that a tooth on said disk operates said contact 629. A spring 104 carried by frame 91 is in constant engagement with pinion 96 and maintains the teeth of said pinion aligned with those of the gear wheels 86, 87.

Having transmitted the desired volume, the operator completes a rotation of handle 78 into the normal position of said handle and shaft 76, at which time a notch 105 in a disk secured to said shaft is engaged by a roller 106 and an arm 107 pivotally mounted in casing 75 (Fig. 36) and urged by a spring 108 into engagement with said notch. At the time when roller 106 engages notch 105, a notch 109 in a disk 627 secured to the opposite end of shaft 76 is engaged by a pin 110 on an arm 626 integral with the armature of a magnet 625 in the casing 75. Said armature and arm 626 are normally spring urged into the position shown in Figure 35, wherein said pin 110 engages said notch 109 to thereby lock the shaft 76 in its normal position. To unlock the shaft 76, magnet 625 must be energized, which is accomplished by depression of push button 622 at certain times, as will be hereinafter described. A light 618 in casing 75 is illuminated whenever magnet 625 is energized, and is visible through an opening in the top plate of said casing, indicating that the volume transmitter is unlocked.

The receiving apparatus

The apparatus which receives the impulses from the average and volume transmitters and which records averages and volumes is shown in Figures 16-32, inclusive. This apparatus includes a chart 150 which is threaded from a supply roller 151 over a driving roller 152 (see Figures 16, 17, and 23) thence upwardly over a roller 153 and downwardly over the face of the receiving apparatus around roller 154, thence upwardly around driving roller 155 and downwardly to the storage roller 156.

The supply roller 151 is suitably mounted between sides 157, 158 of a suitable frame work. As shown, said roller is supported at one end by a pin 159 projecting from a screw 160 and entering into an opening in the end of said roller.

At its other end, said roller has a projection 161 which receives an end of a shaft 162 mounted in side piece 158. Projection 161 is slotted to receive a pin 163 on said shaft 162, so that turning of shaft 162 will correspondingly turn the roller 151. Storage roller 156 is mounted in the same way as the supply roller 151. Roller 152 is provided with teeth 164 at its opposite ends, which teeth engage perforations in the edges of chart 150 for driving the latter. Said roller 152 is mounted securely on a shaft 165 of a gear 166, which shaft passes through the frame 158. At its opposite end roller 152 is mounted in frame 157. Roller 155 is mounted in the same way as roller 152 and is likewise provided with teeth at its opposite ends for engaging said perforations at the edges of the chart 150. A gear 167 is secured to a shaft 168 on which roller 155 is mounted securely. If desired, one of the end or tooth-carrying portions of 164' of each of the rollers 152, 155, may be mounted for slight axial movement with respect to the body portions of said rollers. Thus, as illustrated in Figure 16, in connection with roller 155, one end portion may be separated from the body portion of the roller and slidable with respect thereto along shaft 168. A screw 155' is threaded into the end 155'' of the body portion of roller 155, and also extends through the end portion 164' of said roller, said end portion being slidable on the body of said screw between the head and the threaded end thereof. Compensation is thereby made for varying widths of the chart under different humidity conditions. Roller 154 is mounted in any convenient way between frame pieces 157, 158, as, for example, through extensions 168 (Fig. 26) of screws 169 mounted in said frame pieces. The mounting for roller 153, Figure 16, may conveniently comprise a hood or shell 170 (Figs. 16 and 18), the cylindrical ends of which are rotatably mounted in the aforesaid side frame pieces 157, 158. Projections 171' from screws 171 passing through the ends of said hood 170 extend into opposite ends of the roller 153. Between said ends the hood is open or cut away so that it extends only around a portion of the circumference of the roller and permits the chart to be readily passed around the roller 153. Preferably, the projections 171' on which roller 153 is rotatably mounted, are off-set from the centers of the end pieces of the hood 170. Each of said end pieces has secured thereto a weighted arm 172 (Figs. 18 and 19), whereby said end pieces through said pins 171' and roller 153 maintain the chart 150 under the desired tension at all times.

It will be seen that when rollers 152, 155 are turned in the directions of the arrows shown diagrammatically in Fig. 23, the chart 150 is fed from the roller 151 under roller 152 over roller 153 downwardly over the face of the receiving apparatus, thence over roller 154, over roller 155, and down onto roller 156. If said rollers 152, 155 are rotated respectively in the opposite directions from those indicated by the arrows in Fig. 23, chart 150 will be fed from roller 156 upwardly across the face of the receiving apparatus and on to roller 151. In this connection means are provided for maintaining constant tensioning of the chart in both directions. While tensioning means, such as springs or any other suitable or known construction may be employed, we have shown for this purpose a cord 173 (Figs. 17 and 23) which is secured at one end to a spool 174, secured to the shaft 162

which rotates with roller 151. Said cord extends downwardly and is attached at its other end to spool 175 which is secured to rotate with roller 156. A wheel 176 (Figs. 32 and 23) is mounted in the loop provided by cord 173 between spools 174, and 175, said wheel being suitably weighted by weight 177 carried by arms 178 pivotally carried by said wheel 176. With this arrangement it will be seen that owing to the weight 177 the cord 173 tends constantly to rotate spool 174 and roller 151 clockwise, as shown in Fig. 23, and constantly tends to turn spool 175 and roller 156 also clockwise. If now rollers 152 and 155 are rotated to move the chart downwardly between rollers 153, 154, the chart will be drawn off roller 151, rotating said roller against the downward pull of string 173. At the same time the weight 177 acts to turn the spool 175 and roll 156 clockwise, as viewed in Figure 23, to wind tightly thereon the amount of chart fed off from the roller 151. Similarly, if rollers 152, 155 are rotated in such direction as to feed the chart upwardly from roller 154 to roller 153, the chart is removed from roller 156, rotating said roller against the action of weight 177, while at the same time said weight, through cord 173, tends to rotate spool 174 and roller 151 clockwise (Fig. 23) to feed on to roller 151 the amount of chart which is fed off from roller 156. The length of cord 173, should, of course, be so chosen that the weight 177 is free at all times to exert the above described tensioning effect throughout the operation with the length of tape employed.

For driving the rollers 152, 153 to shift the chart 150 in either direction the following means may be provided: Referring to Figures 17, 24, and 27 reference numeral 463 designates a magnet forming part of the average motor and which is adapted through suitable connections to cause the actuation of the rollers above described. Said magnet may conveniently be fastened on an extension 193' of an intermediate frame piece 193, which, together with a similar frame piece 194, is secured to upper and lower brackets 330, 331, mounted on back frame piece 332 of the receiver apparatus. Said back piece extends from frame member 157 to member 158, and also from bottom frame piece 333 to upper frame piece 334. Magnet 463 is adapted to receive impulses from the contacts 51, 52 of the average transmitter to cause the chart 150 to be stepped through distances corresponding to the number of impulses from said contacts. In Figure 24 the parts associated with magnet 463 are shown in the position which they assume when said magnet is de-energized. Armature 179 of said magnet is pivoted at 180 to stationary frame piece 180', said armature forming part of a vertically extending arm 181 which, at its upper end, pivotally carries a pawl 182. A spring 183 connects said pawl with an extension 184 of said arm 181. Arm 181 and armature 179 are normally maintained in the position shown in Figure 24 by spring 185 connected at one end to said arm, and at the other to arm 186 secured by a screw 186' to extension 180' of frame piece 193. A tail 186'' of arm 186 bears against the pivot pin 180 of armature 179. Through slot 186''' the arm 186 may be adjusted on the extension 180' retained in its adjusted position by screw 186'. If, now, magnet 463 is energized, armature 179 is attracted to magnet 463 and the arm 181 is thrown to the right in Fig. 24, storing energy in spring 185. Pawl 182 is thereby carried to the right suffi-

ciently to engage the teeth of ratchet wheel 187 immediately to the right of the tooth shown engaged by said pawl in Fig. 24. Now, when the impulse through magnet 463 terminates, spring 185 restores arm 181 and armature 179 into the position shown in Fig. 24, and pawl 182 moves to the left, rotating ratchet wheel 187 through one step. At the end of this movement pawl 182 engages a stationary block 188 locking the ratchet wheel against rotation beyond said step. A spring detent 189 engages the teeth of ratchet wheel 187 to prevent reverse rotation of the latter. Ratchet wheel 187 is secured to gears 190, 191 which are fastened to hub 192 rotatably mounted between intermediate frame members 193, 194 (Fig. 27). Thus, the gears 190 and 191 rotate with the ratchet wheel 187. Gear 190 normally meshes with pinion 195 fixed on shaft 196 and mounted in said frame pieces 193, 194. Pinion 195 is in constant engagement with a gear 196 secured to shaft 197 rotatable in frame piece 193 and connected by a suitable joint 198 with a shaft 199 mounted in frame piece 158 and having secured to its end beyond said frame a gear 200 (Figs. 17 and 19). The latter meshes with an intermediate gear 201 which in turn meshes with both of the gears 166, 167 previously described as secured to the respective rollers 152, 155. It will thus be seen that with the parts as shown in Figure 27, upon each operation of the ratchet wheel 187 following an impulse through magnet 463, motion will be transmitted in one direction to the gear 201 by way of gear 190, pinion 195, gear 196, shafts 197 and 199, and gear 200. Gears 166 and 167 and rollers 152, 155 are thereby turned in such direction as to feed the chart 150 downwardly across the face of the receiving apparatus. The average recording pen 202 (Figs. 16, 18, and 19) is moved at a constant rate from left to right (Fig. 16) by a constant speed motor, as will be later described, but does not move vertically. Downward movement of the chart 150 with respect to said pen corresponds to an increase in the average and results in a vertical mark on the chart corresponding in extent with the change in average which in turn corresponds to the number of impulses received from transmitter contacts 51, 52. To indicate a decrease in the average, the chart 150 is moved upwardly with respect to pen 202. For this purpose, when the polarity switch 56 of the transmitter is in a position corresponding to rotation of shaft 25 in a direction corresponding to a decreased value, an impulse from transmitter contacts 51, 52 energizes magnets 463 and 469, through connections which will be later described. Magnet 469 is shown mounted on a frame piece 193'' secured to frame piece 193. When magnet 463 (Figures 17, 24 and 27) is energized it attracts its armature 179 pivoted at 180. At the same time, magnet 469 attracts the armature 203. Said armature carries an arm 205 which at its lower end bears against one end of shaft 196', the latter being slidably mounted in the frames 193, 194, and having secured thereto the pinion 195 previously described. Pinion 195 is shifted by operation of armature 203 and arm 205 to bring pinion 195 out of engagement with gear 190 and into engagement with a pinion 206, rotatably mounted on frame 194 and constantly meshing with gear 191. Now, upon cessation of said transmitter impulse from contacts 51, 52, ratchet wheel 187 is turned as above described, but pinion 195 is now turned in the reverse direction from that previously described,

since it receives motion from the ratchet wheel through gear 191 and intermediate pinion 206. Thereby, gear 196, shafts 197, 199 and gears 200 and 201 are rotated reversely from their previous direction, turning gears 166, 167 (Fig. 19) and rollers 152 and 155 in such direction as to shift the chart 150 upwardly with respect to pen 202. When magnet 469 is de-energized, a spring 207 (Fig. 27) which acts upon pivotally mounted arm 208 bearing against the opposite end of shaft 196' restores said shaft into the position shown in Figure 27, with pinion 195 out of mesh with pinion 206 and again engaged with gear 190.

The chart 150 (Fig. 16) is provided with heavy lines 209 corresponding to dollar indications and with intermediate lines 210 representing ten-cent values. Numerals indicating the values represented by the lines 210 may be provided as indicated in Fig. 16. A series of counters 211, 212 and 213 are mounted on the framework at one side of the chart. These counters are set to indicate values one dollar apart. Counter 212 is preferably initially set to the nearest dollar value represented by the average of the group of stocks at the end of the previous trading period, while counter 211 is set to show one dollar less than counter 212, and counter 213 one dollar more than said counter 212. For example, if the average of the group of stocks at the end of a previous trading period is \$51.50, counter 212 is set to show \$51, counter 211, \$50, and counter 213, \$52. The chart 150 is stepped to bring a dollar line 209 opposite counter 212, and is then stepped further downwardly to bring a line 210 designating 50 cents opposite pen 202. The end of pen arm 202 which carries the stylus for marking on chart 150 is directly opposite counter 212. Thus, the values of the record on chart 150 can be readily determined from the counters and the indications at the chart edges. Counters 211 and 213 may be eliminated if desired, though their presence adds to convenience of reading.

Counters 211, 212, and 213 are normally operated by ratchet wheel 187 (Fig. 27) whenever the latter is turned in response to an average impulse from the transmitter. For this purpose, pinion 195 meshes with a gear 214 on a shaft 215 mounted in frame piece 194 and connected by point 216 with a shaft 217. The latter is mounted in frame 157 and has secured thereto beyond said frame a sprocket 218 (Fig. 18). Sprockets 219, 220, 221 are secured to the shafts of counters 213, 212, and 211 respectively. A chain 222 engaging said sprockets 218—221 drives the counters 211, 212, and 213 from sprocket 218. Said counters are of the conventional Veeder type and their lowest order indications are units of dollars.

A spring detent 214' (Fig. 28) may be employed for engagement with gears 214 and 195, to maintain said gears aligned to facilitate engagement of pinion 195 therewith.

Suitable means for maintaining the chain 222 tightened to the desired extent may be provided, that shown comprising a pivoted arm 223, weighted at one end and carrying at its other end a sprocket 224 engaging said chain.

At the end of a trading period it is desirable to shift the tape 150 to bring a fresh portion thereof opposite the pen 202. For this purpose a sufficient number of impulses are sent through magnets 463 and 491, as will be explained later on, to shift the desired amount of tape downwardly. At this time the pen 202 is adjacent the extreme right hand edge of the tape. When magnet 491 is energized, it attracts its armature

225, which, through its extension 208, shifts shaft 196 to the left (Fig. 27), disengaging pinion 195 from gear 214. Said pinion remains disengaged from said gear as long as magnet 491 is operating and maintains the counters 211, 212, and 213 disconnected from ratchet wheel 187, so that said counters are not moved. The tape is shifted downwardly to bring the new portion opposite pen 202, while magnet 491 is energized continuously, impulses being sent through magnet 463 from a source hereinafter described.

Magnet 491 may be mounted, as shown in Fig. 27, on a frame piece 194' secured to frame piece 194.

As will later be described more in detail, provision is made for orienting the average chart at each receiver at the end of the trading period to insure that the average pen 202 at each receiver will be on the same dollar line on the charts if by any reason average indications are a few cents off. It suffices to observe at this time that for this purpose impulses are sent through the average motor to step the average chart into such position that a dollar line is opposite the pen 202. In this position of the chart, moreover, the counters 211, 212, and 213 are opposite dollar lines on said chart. When a dollar line on the chart is opposite pen 202, an arm 226 (Fig. 19) of insulating material secured to gear 201 is engaged with a roller 227 on a projection extending from a leaf spring 484' which leaf spring carries a contact 484 adapted to engage a contact 485 on an adjacent leaf spring 485'. When arm 226 engages roller 227 it separates contact 484 from contact 485, preventing the sending of any further orienting impulses through the average motor. The orienting impulses aforesaid are sent from a source other than the average transmitter, as will be later explained, and it may be observed at this point that the contacts 484, 485 are not in circuit with the average transmitter contacts 51, 52, so that the presence of a dollar line on the average chart opposite the pen 202, during the transmission of impulses from contacts 51, 52, will not break the circuit through the average motor, and the latter can continue to operate in response to impulses sent from the contacts 51, 52 of the average transmitter. The contacts 484, 485, when engaged, enable orienting impulses to be sent through the average motor 463, and when separated, break the circuit for said orienting impulses.

The receiver apparatus also includes a volume chart 230 (Fig. 16) which extends across the face of said apparatus below the average chart 150. Said volume chart is perforated at its edges and extends around a pair of vertical rollers 231, 232, which are provided with teeth 233 at their opposite ends for engagement with the perforations in said chart. The volume chart is stationary during each trading period, but at the end of such period the rollers 231, 232 are operated to bring a fresh portion of the chart opposite the volume pen 234.

Both the volume pen 234 and the average pen 202 are mounted on a carriage 235 (Fig. 16) which is moved continuously at a constant rate of speed from left to right during each trading period. This carriage comprises upper and lower rollers 236 positioned to engage opposite sides of a stationary tubular track 237 mounted in the frame work of the receiver. The carriage also comprises an upwardly extending portion 238 to which the average pen 202 is secured. A horizontal extension 238' of carriage portion 238 also

has mounted thereon, as shown in Figures 22 and 26, a pair of rollers 236' which engage opposite sides of an upper stationary track member 237' mounted in the receiver frame work. Said upwardly extending carriage portion 238 also has an extension 239 on which is pivotally mounted at 240 a drive switch arm 241. The latter is maintained in either of opposite tilted positions by a spring 242 engaging a roller 243 on an extension 244 of said arm 241. A flange 245 on arm 241 is adapted to engage one or the other of a pair of oppositely rotating worm shafts 246, 247 rotatably mounted in the receiver frame. Fastened on one end of shaft 247 is a gear 248 (Fig. 19) which meshes with a pinion 249 integral with or fastened to a gear wheel 250 secured on shaft 246. Gear 250 meshes with gears 251, 252, the latter being mounted on the shaft of a constant speed motor (517, Fig. 17), which is continuously in operation during the trading period. Thus the worm shafts 246, 247 are rotated continuously in opposite directions. Normally, i. e., during the trading period, the switch arm 241 (Figs. 22 and 26) is tilted so that its flange 245 engages the worm shaft 247, its flange at that time being out of engagement with worm 246. As long as flange 245 engages worm 247 the carriage 235 is driven continuously from left to right. Shortly after the trading period has ended the carriage 235 has been carried so far to the right (left in Figure 26, which is a rear view) that a pin 253 on a collar 254 secured to shaft 247 engages said flange 245 and, during continued rotation of said shaft, acts upon said flange to rock the switch arm 241 out of engagement with worm shaft 247 and into engagement with worm 246. The arm 241 is now in the position shown in Fig. 22. The rotation of shaft 246, in cooperation with arm 241, now shifts the carriage from its right hand position along the track 237 to the extreme left hand position of the carriage. When the carriage arrives in its extreme left hand position (right in Figure 26), a pin 255 on a collar 256 secured to shaft 246 acts upon flange 245 during continued rotation of said shaft and rocks switch arm 241 into the position the reverse of that shown in Fig. 22, said flange then engaging worm 247 and being out of engagement with worm 246.

The constant speed motor (numbered 517 in Figs. 2 and 17) on the shaft of which the gear 252 is secured continues rotating, now shifting the carriage 235 slightly to the right from its extreme left hand position. During the last portion of the movement of the carriage from the right into its extreme left hand position, a one-way trip pawl 257 (Figs. 18 and 26) pivotally mounted on said carriage passed freely over a lug 258 extending upwardly from a leaf spring 530' which carries a contact 530 normally in engagement with a contact 531 carried by an adjacent leaf spring 531'. The foregoing contacts are in the circuit of the motor 517. Now, when the carriage shifts a short distance to the right from its extreme left position, said pawl 257, which bears against a stop pin 259, depresses the lug 258 and separates contact 530 from contact 531. The constant speed motor circuit is now broken and the carriage is stopped in this position, ready for resumption for operation at the next trading period. It may, at this time, be observed that when the carriage arrived in its extreme right hand position on arm 260 on said carriage strikes a contact 518 and engages the latter with a contact 519 to close a circuit through a relay 522 (Fig. 2), the purpose of which will be hereinafter

described. It may be noted that gear 249 is of less diameter than gear 248 so that the carriage will travel more rapidly to the left than to the right.

The rollers 231, 232 (Figs. 18 and 19) are mounted for rotation with shafts 263, 264 journaled in suitable brackets 265, 266 (Fig. 16). Roller 232 is fastened to shaft 264, while roller 231 is connected to shaft 263 through a spring 285, as hereinafter noted. Said shafts have secured thereto sprockets 267, 268 which engage a chain 269. The latter also engages a sprocket 270 mounted in a bracket 271 on the carriage 235. Sprocket 270 is secured to a shaft 272 which has also secured thereto a ratchet 273 (Fig. 21). A spring pressed pawl 274 engages ratchet 273 and prevents rotation thereof in one direction while permitting rotation in the opposite direction. During the travel of the carriage from left to right, the ratchet 273 is free to rotate under the action of the chain 269 on sprocket 270. The pawl 274, however, prevents rotation of ratchet 273 and sprocket 270 when the carriage moves from right to left, and as a result, since the chain 269 cannot now rotate said sprocket, the carriage, in moving to the left, carries the chain 269 with it, thereby driving the rollers 231, 232 throughout the left hand travel of said carriage to bring a fresh portion of the volume chart into position for cooperating with the volume pen 234. It will be understood that the sprocket 270 engages only one side of the chain 269, i. e., the front side of said chain. A suitable strap 275 secured to bracket 271 on the carriage extends downwardly in front of the chain 269 to insure that said chain is maintained in engagement with sprocket 270. Preferably the rollers 231, 232 are rotated at such a rate as to feed the chart slightly faster than the travel of the carriage, so that a margin is provided between the portion of the chart employed for the previous trading period and the portion employed for the next trading period. The volume chart is fed from a storage roll 277 (Figs. 17 and 19) mounted in suitable brackets on the receiver framework, a slight distance behind the roller 231. From the roller 232 the chart passes on to a storage roll 278 mounted on a bracket on the receiver framework a slight distance behind said roller 232 (Figs. 17 and 18). During the feeding of the chart from the supply roll 277 by the rollers 231, 232, the storage roll 278 is turned correspondingly. For this purpose a pulley 279 (Fig. 18) secured to roller shaft 264, drives a spring belt 280 which passes around a pulley 281 secured to shaft 282 to which the storage roll 278 is fastened. Due to the tension in the spring belt slippage is provided between said belt and the storage roll 278 so that as the diameter of the roll and accumulated chart thereon increases with respect to the diameter of the supply roll and chart thereon, the chart is constantly kept free from slack.

Secured to the upper end of the shaft 264 above the bracket 265 (Figs. 16 and 16') is a ratchet 283 engaged by a spring pressed pawl 284 which prevents reverse rotation of roller 232. A torsion spring 285 is secured at one end to collar 286 pinned to shaft 263 and at its other end to roller 231, which is rotatably mounted on shaft 263 (Fig. 16—right). Spring 285 constantly tends to rotate roller 231 in the direction opposite to that in which shaft 263 is turned under the action of chain 269. Roller 231 is thus turned from chain 269 through shaft 263 and spring 285, the action of said spring constantly maintaining the chart

under the desired tension between rollers 231 and 232.

The volume pen 234 which carries at its upper end a suitable stylus point for marking volume records on the volume chart, is mounted for vertical movement in a channel in the pen carriage 235. As shown in Figures 16, 22 and 26, the pen 234 is engaged between pairs of rollers 288 mounted on the carriage. On the rear of the pen 234 is secured a rack 289 which meshes with a broad pinion 290 the ends 291 of which are journaled for rotation in ball bearings in the side frame pieces of the receiver apparatus. Pinion 290 is of sufficient width to be engaged by rack 289 throughout the movement of the carriage 235 during a trading period. Secured to pinion 290 is a gear 292 (Figs. 18 and 26) which meshes with a gear 293, the latter in turn meshing with a gear 294 secured to a shaft 295 (Figs. 18 and 17). The latter is journaled for rotation in ball bearings in the side frame piece 151 and is connected by a joint 296 with a shaft 297 journaled in intermediate frame pieces 298, 299, fastened to upper and lower brackets 335 and 336 on frame member 332. Shaft 297 has secured thereto a gear 300.

Gear 300 (Figs. 17 and 31) meshes with a pinion 301 secured to a shaft 302 rotatably mounted in frames 298, 299. A pinion 303 rotatably mounted in frames 299 and 298 meshes with pinion 301, as well as with a gear 304. Gear 304 forms part of a unit comprising said gear, a hub 305, a gear 306, and a ratchet 307, secured to a shaft 308 rotatable in said frames. The magnet 500 (Fig. 25) of the volume motor has an armature integral with arm 309, pivoted at 310 to a stationary bracket 311. Said arm 309 carries at one end a pawl 312 biased by a spring 313 into engagement with ratchet 307. A spring 314, connected at one end to arm 309 and at its other to stationary arm 315, normally holds arm 309 in the position shown in Fig. 25. Arm 315 is adjustably secured to bracket 311 through slot 315' and screw 316. A tail 315'' of said arm 315 bearing against pivot pin 310.

It will now be seen that when the volume magnet 500 is energized, arm 309 is swung to the left in Fig. 25 to engage the next tooth on ratchet 307, and that when the energizing impulse ceases said arm is returned to the right, by spring 314, turning ratchet 307 one step. A stop 317 is engaged by pawl 312 at the end of said step of rotation of said ratchet and prevents overrunning of the latter. A spring similar to spring 189 in Figure 24 previously described in connection with ratchet 187 of the average motor may be provided for preventing reverse rotation of ratchet 307 of the volume motor.

Each impulse received by the volume magnet 500, in other words, shifts pawl 312 to take up a new tooth on ratchet 307, and upon the cessation of said impulse the pawl turns said ratchet one step. As long as pinion 301 (Fig. 31) is engaged with pinion 303, the turning of ratchet 307 will, through gears 300, 294, 293, 292, 290, and rack 289, move the volume pen 234 upwardly. The extent of upward motion of said pen corresponds to the number of impulses received by the magnet 500 from the volume transmitter, so that the vertical extent of the line drawn by said pen indicates the volume transmitted. As hereinafter more particularly described, volumes are transmitted to the pen 234 at regular intervals. Since the average pen 202 is carried transversely of the receiving apparatus at the same rate as the transverse travel of the volume pen, the

volume indication at the end of any period shows the volume of the stocks traded at the average indication shown on the average chart for that period. As shown in Figures 16 and 32, the volume chart is directly below the average chart so that the markings on said charts are clearly correlated and the relation volume and average price are readily apparent to an observer.

After the proper number of impulses have been received by the volume motor and the latter has thereby stepped pen 234 upwardly to record the corresponding volume, connections are established, as hereinafter described, for operating a magnet 510 (Fig. 31). The latter, when energized, attracts its armature 318, shifting arm 318' of said armature to the left in Figure 31. Said arm 318' thereby shifts shaft 302 and pinion 301 to the left, said shaft being mounted for sliding movement, disengaging pinion 301 from pinion 303 and engaging pinion 301 with gear 306. Now, when magnet 500 is vibrated as will be described later on and ratchet 307 rotated, the pinion 301 will be rotated in the reverse direction from that in which it turned when engaged with pinion 303, and the pen 234 will be moved downwardly. While magnet 510 is energized, current is passed through magnet 500 from a source other than the volume transmitter, this current being repeatedly interrupted and reestablished by contacts 511, 512 in circuit with said magnet, as more particularly described hereinafter. It may be noted in this connection that when magnet 500 is deenergized, contacts 511, 512 are engaged, and that when said magnet is energized a stud 319 of insulating material on arm 309 engages the leaf spring which carries contact 512 and separates the latter from contact 511, the resultant deenergization of said magnet permitting said contacts to reengage. Thus, impulses continue throughout the magnet 500, with one step of downward movement of volume pen 234 following each impulse, until said pen reaches its lowermost position. At this time an arm 320 (Fig. 18) of insulating material secured to gear 293 engages a roller on a stud 321 fastened to contact carrying leaf springs 507, 515, removing the latter from engagement with contact carrying leaf springs 506, 514, respectively. The circuits through both magnets 500 and 510 are thereby broken. The volume pen has been restored to its lowest position preparatory to further transmission of volumes.

Upon de-energization of magnet 510, a spring 324, Figs. 25, 31 and 31a, which engages one end of shaft 302, restores said shaft into its right hand position shown in Figure 31. Pinion 301 is thereby disengaged from gear 306 and is re-engaged with pinion 303.

To insure against upward movement of the volume pen 234 beyond the volume chart a pair of contacts 495, 496 carried by leaf springs 495', 496', which contacts are in circuit with the volume magnet 500 and are normally engaged, are disengaged from each other by contact of arm 320 with a roller on a leaf spring 495' when the stylus of the pen reaches the upper limit of the volume chart.

The pen 234 may be counterbalanced in a suitable way as by a weight 321 carried by a cord 322 attached to pulley 323 secured to shaft 295 (Fig. 30).

The flat front face of an upwardly extending portion 238 of the carriage provides a backing for the volume chart during the marking of the volume lines thereon by the pen. A backing for

the average chart is provided by plate 325, which is mounted on a bracket 326 secured to frame piece 158 (Fig. 16). At its other end said backing plate 325 may be conveniently mounted on the counter 212 by means of a spring 327 as shown in Figure 29.

Between the volume and average charts there is provided a time scale comprising a plate 328 (Fig. 16) fastened at its opposite ends to the frame pieces 157, 158. This time scale may include long indication lines 329 designating hours and intermediate shorter lines designating suitable fractions of hours. The vertically extending portion 238 of the pen carriage extends behind the plate 328, as shown in Figure 22, and is provided with a horizontal extension 238' which extends through a slide 328' in the time scale. The average pen 202 is secured to a vertical extension 238'' of horizontal extension 238'.

As shown in Figure 32, the receiver apparatus may be mounted in a suitable cabinet 340. Mounted in said cabinet on a suitable bracket is the "minor switch" which comprises the contact arms 443, 448 (Fig. 2) previously referred to. This switch is of a known standard construction and need not be here described in detail. It may be noted, in passing, that the arms 443, 448 are mounted to rotate with a ratchet wheel about pivot 341. In Fig. 32 only the arm 443 is shown, but it will be understood that the arm 448 is immediately behind said arm 443, and that the ratchet wheel referred to is immediately behind said arm 448, both of said arms being secured to said ratchet wheel to rotate therewith about pivot 341. Said switch also comprises a pair of magnets 441, 475, shown diagrammatically in Fig. 2. The armature 342 of magnet 441 is pivoted at 343 and has pivoted thereto at its other end a pawl 344 which engages the ratchet wheel aforesaid and, upon energization of magnet 441, rotates said pawl, together with arms 443, 448, through one step. Arms 443, 448 engage sets of contacts, the arm 443 being engageable with contacts 444, 455, 456, and 452 (Fig. 2) which contacts are insulated from each other. These contacts are also shown in Fig. 32. Arm 448 engages contacts 449, 457, 458, and 453, shown in Fig. 2, which contacts are mounted behind the first mentioned group of contacts and are insulated therefrom, as well as from each other. The contact arms 443, 448 are also insulated from each other. The pivoted armature 345 of magnet 475 carries at its upper end a detent tooth which normally engages the aforesaid ratchet wheel and retains it in the position to which it is set by pawl 344. Upon energization of magnet 475, the tooth of its armature is disengaged from said ratchet wheel, whereupon a spring returns said ratchet, together with contact arms 443, 448 into the lowermost position of said arms, wherein the latter are out of engagement with any of their associated contacts. This will be hereinafter referred to as the normal or zero position of said arms.

When said arms are in said normal or zero position, shown in Fig. 32, an arm 346, movable therewith, engages a spring contact 432, whereby the latter is forced into engagement with a contact 431. These contacts are also shown in Fig. 2. Whenever arms 443 and 448 are out of their normal or zero position, the arm 346 releases a contact 432 which thereupon springs out of engagement with contact 431. The minor switch here referred to is, as above noted, of a standard type, such as manufactured by the

Automatic Electric Co. of Chicago, Ill., under number RA-70 to 76, in catalog numbered 4071.

Circuit connections at the receiver apparatus

Referring to Figure 2, which shows the average and volume recorder circuits, 400, 401 designate poles of a local source of suitable direct current supply at the receiving apparatus. Lines 402, 403 are connected to a suitable source of direct current at the control panel through various relays and switches as explained later on. Normally, a small flow of current termed the "supervisory current" is present in the lines 402, 403. This "supervisory current" is sufficient in amount to energize relay 404 termed the "supervisory relay," but is not sufficient to operate either of relays 421, 422, in circuit with wires 402, 403, and hereinafter mentioned. When relay 404 is energized, its contact 405 is engaged with contact 406 and its contact 407 is engaged with contact 408. Current now flows from pole 400 through wire 409, contacts 408 and 407, relay 410, and wire 411 to pole 401, thereby energizing relay 410. Contact 412 of relay 410 is now engaged with contact 413, and contact 414 of said relay with contact 415. As a result, wire 416 is connected to pole 400, and wire 417 to pole 401.

Contact 405 having been engaged with contact 406 as above noted, current now flows from wire 416 through relay 418 to wire 417, energizing said relay 418, and disengaging contact 419 of said relay from contact 420.

With the aforesaid relays in the condition above described, at the beginning of the market period, or prior to the transmission of any averages or volume, the dial 420 of the control panel (Fig. 1) at the central transmitting station, is operated to send an impulse over the wires 402, 403, as it will be explained later on. This impulse is of greater strength than the supervisory current aforesaid, and will operate one or the other of the relays 421, 422, depending upon the polarity of said impulse, said polarity being determined by the polarity switch 56 of the transmitter. It will be noted that a rectifier 423 is interposed between relay 421 and wire 403, so that only impulses of a given polarity will pass through said relay 421. Another rectifier 424 is interposed between relay 422 and wire 403 so that only impulses of the reverse polarity will pass through relay 422.

Assuming that the first impulse above referred to is of such polarity as to operate relay 421, contact 425 of said relay is engaged with contact 426, and contact 427 of said relay with contact 428. It should be noted that upon the closing of contacts 412 and 414 by energization of relay 410 a relay 429 is energized by the passage of current from wire 416 through wire 430, contacts 431, 432, wire 433, relay 429, and wire 434 to wire 417. Energization of relay 429 engages its contact 435 with contact 436. Relay 421 having been energized as above described by the first impulse aforesaid, current now flows from wire 416 through wire 437, contacts 426, 425, wire 438, contacts 435, 436, wires 439 and 440, magnet 441, and wire 442 back to wire 417. Magnet 441 steps contact arm 443 through one space for each energization of said magnet, and in response to the first impulse aforesaid, said arm 443 is stepped into engagement with contact 444.

The same action takes place if the aforesaid first impulse is of such polarity as to energize relay 422. In this event contact 445 of relay 422 is engaged with contact 446, closing the circuit

through magnet 441 by way of said contacts 445 and 446.

Energization of magnet 441 operates not only the arm 443 above mentioned, but also an arm 448, said arms 443 and 448 being operated in unison by said magnet 441. Hence at the same time that arm 443 is stepped into engagement with contact 444, arm 448 is stepped into engagement with contact 449. In parallel with relay 429 are a condenser 450 and a resistance 451. As long as arms 443 and 448 are in their normal or home positions shown in Figure 2, the contacts 431 and 432 are engaged with each other maintaining the circuit closed through relay 429, but whenever arms 443, 448 are stepped out of their home position aforesaid, contacts 431 and 432 are disengaged, breaking said circuit. Due to the condenser 450 the relay 429 is maintained energized for an appreciable interval following the cessation of the impulse above referred to. This interval may conveniently be two seconds, though it of course may be varied as desired. The provision of the condenser 450 enables relay 429 to remain energized despite the opening of contacts 431, 432 throughout a series of successive impulses sufficient to cause magnet 441 to step the arms 443 and 448 through four spaces into engagement with contacts 452 and 453 respectively. Arm 443 is also adapted to engage with either of two intermediate contacts 455, 456 and arm 448 with two intermediate contacts 457, 458, depending upon the number of impulses imparted to the magnet 441.

If the first impulse above referred to, sent from the dial 420 of the control panel is not followed by another impulse and operation of relay 421 or 422 within the prescribed interval (two seconds, for example), the relay 429 becomes de-energized and its contact 435 is disengaged from contact 436 and is engaged with a contact 459. Arms 443 and 448, as above noted, are in engagement with contacts 444 and 449, respectively. If now an impulse is sent over wires 402, 403 from the average transmitter, one or the other of the relays 421, 422 will be operated depending upon the polarity of said impulse. Assuming that relay 421 is operated by said impulse, contacts 425, 426 are engaged, as are likewise contacts 427, 428. Current now flows from line 416 through wire 437, contacts 426, 425, wire 438, contacts 435, 459, wire 460, wire 461, arm 448 and contact 449, and wire 462 through the average motor 463, and thence through wire 464 to wire 417. The pawl which acts upon the ratchet wheel of the average motor is thus actuated to engage the next tooth on said ratchet wheel, and, upon the termination of said impulse, said pawl, under the action of its spring, returns to its normal position, turning said ratchet wheel one step, and thereby moving the average recording chart downwardly one step, corresponding to an increase of two cents in the group average. Upon the cessation of the impulse from the average transmitter relay 421 is de-energized.

Relay 421 being now de-energized, contact 425 is disengaged from contact 426, breaking the circuit through the average motor. Upon the next transmitter impulse through relay 421, contacts 425, 426 are again closed and another current impulse flows through the average motor 463, moving the average chart downwardly another step. This operation is repeated for each transmitter impulse through the relay 421.

A transmitter impulse of such polarity as to operate relay 422, assuming the arms 443 and 448 to be in engagement with contacts 444 and 449 as

aforesaid, will cause the average motor to shift the average chart upwardly an extent corresponding to a two cent change in the group average. This is accomplished as follows:

Operation of relay 422 by said transmitter impulse closes contacts 445, 446, and also contacts 466, 467. Current now flows from line 416 through wire 437, contacts 446, 445, wire 438, contacts 435, 459, wire 460, wire 461, arm 448, contact 449, wire 462, through the average motor as before. Current also flows from wire 460 through arm 443, contact 444, wire 468, contacts 467, 466, through magnet 469 and thence to wire 464 and wire 417. Energization of magnet 469 operates the reversing gearing hereinbefore described in connection with the average recorder, and energization of the average motor shifts the pawl thereof to take up a new tooth on its ratchet wheel, so that, upon termination of the impulse aforesaid, said pawl returns to normal position and shifts the ratchet wheel one step. The magnet 469 remains energized, under the action of its condenser 469¹, a sufficient time to maintain the reversing gearing in mesh during the return of said pawl to its normal position, and thus said pawl, through its ratchet wheel and the aforesaid reversing gearing, shifts the chart upwardly through a two cent space. Upon the cessation of the aforesaid transmitter impulse through relay 422, the latter is promptly deenergized and contacts 445, 466 are separated from contacts 446, 467. Succeeding transmitter impulses through relay 422 will repeat the energization of motor 463 and magnet 469 to shift the average chart upwardly through successive steps as above described.

While one recorder unit has been specifically considered in the foregoing description it will be apparent that a plurality of recorder units or receiving stations may be connected in series in the lines 402, 403. Thus, in Fig. 14, three receiving stations R₁, R₂, and R₃, each comprising the relays 404, 421, 422, and associated parts described in connection with Fig. 2, are shown connected to said lines.

Means are provided for orienting or synchronizing the recorders at all of the receiving stations at any desired time as, for example, at the end of each trading period, in order to insure that the average pen at each receiver will be on the same dollar line on the chart, if for any reason a chart may have become out of step with the other charts. For this purpose a switch 472 at the transmitting station is opened for a sufficient time to effect the de-energization of the relay 418. The opening of switch 472 breaks the circuit through relays 404 at all receivers, which relays are promptly de-energized with consequent disengagement of their contacts 405 from contacts 406 and breaking of the circuits from wires 416 through relays 418. The condenser 473 in parallel with relay 418 in each receiver maintains relay 418 energized for an appreciable interval (about one second, for example), after which interval the relay 418 is de-energized. Contact 419 of relay 418 in each receiver is now in engagement with contact 420 so that current flows from wire 416 through wire 474, magnet 475, and wire 442 to wire 417. At this point it may be observed that, although the de-energization of relay 404 has separated contact 407 from contact 408, relay 410 is maintained energized by condenser 477 for a sufficient period after relay 418 is de-energized to enable magnet 475 to be energized from lines 416, 417, and to restore arms 443, 448 to their

normal positions, shown in Figure 2. When magnet 475 is energized it retracts a retaining pawl from engagement with a ratchet connected to arms 443, 448 as previously described in connection with the recorder, whereupon a spring restores said ratchet and arms to normal position. Also, if desired, a condenser 481 may be inserted as shown between wire 416 and magnet 475, so that when only a small current is available, as with rectified alternating current, the magnet 475 may be energized for an instant without drawing an undue proportion of current from other parts of the apparatus. This condenser 481 may be eliminated when the original source is direct current, as distinguished from rectified alternating current. A resistance 482 is shown in parallel with the condenser 481 to enable the condenser to discharge within a given time prior to the next energization of the magnet 475.

The arms 443 and 448 being now in their normal or home positions, shown in Fig. 2, the switch 472 (Fig. 1) is now closed with resultant energization of relays 404 and 412. Dial 420 is now operated to send an impulse through either relay 421 or 422. Contact 435 is now engaged with contact 436. Magnet 429 is now energized, since contacts 431 and 432 are engaged as aforesaid whenever arms 443 and 448 are in their home position. Now, upon operating dial 420 to send an impulse as aforesaid, the magnet 441 is energized to step the arms 443 and 448 into engagement with contacts 444 and 449, respectively. After the lapse of a sufficient time (two seconds, for example) to permit relay 429 to be de-energized and contact 435 re-engaged with contact 459 further impulses are sent from the dial 420 through relay 422. The milliammeter 736 (Fig. 1) in series with wires 502, 503 shows the polarity of the current in said wires, and if such current is not of the proper polarity for energizing relay 422 the operator turns handle 26 of the average transmitter through a short distance to reverse the setting of the polarity switch 58. The impulses through relay 422 repeatedly engage relay contact 445 with contact 446 and send current impulses through the average motor 463 and reversing magnet 469 in the same manner as previously described in connection with impulses through relay 421. The average motor 463 thus steps the average chart upwardly. The impulses aforesaid are sufficient in number to step the chart upwardly to bring the fifty cent line next below the nearest dollar line below the pen into coincidence with the pen of each chart the reading of which is correct. In other words, the number of impulses which should be sent equals half the proper cents indication of the final average reading plus twenty-five. Thus, if, for example, the correct final average reading is \$61.24, thirty-seven impulses (half of twenty-four plus twenty-five) are sent. The fifty cent line next below the nearest dollar line below each pen which indicates the correct average is now in coincidence with said pen. Switch 472 may now be opened, restoring the contact arms 443, 448 to zero or home position, and after again closing said switch, dial 420 is operated to send four impulses through either relay 421 or 422, thus stepping contact arms 443, 448 into engagement with contacts 452 and 453 respectively. After lapse of sufficient time to permit relay 429 to be de-energized and contact 435 to again engage contact 459, further impulses are sent from dial 420, this time through

relay 421, the polarity switch 56 being previously set into its appropriate position for the transmission of impulses of such polarity. The impulses through relay 421 repeatedly engage relay contact 425 with contact 426 and send current impulses through the average motor 463 by way of contact arm 448, contact 453, contacts 484, 485, wire 486, contact 458, and wire 462. The average motor thus steps the average chart downwardly. These impulses are sufficient in number to insure that each receiver chart is shifted downwardly until the dollar line next above the pen is brought into coincidence with said pen. Whenever an average chart is so positioned that a dollar line thereon is coincident with its pen, contacts 484, 485 connected to contact 453 are separated through means previously described and hence when this condition is attained with contact arm 448 in engagement with contact 453, no further impulses from dial 420 will be received by the average motor 463 associated with said chart. Further impulses will, however, continue to be effective upon the average motor of any other receiver which has not yet been restored to a position wherein a dollar line thereon is opposite the associated pen. In the embodiment here illustrated, wherein each impulse through the average motor steps the average chart a space corresponding to two cents, it will be seen that fifty impulses, with arms 443, 448 on contacts 452, 453 are the maximum number required for insuring that a dollar line on each average chart is brought into coincidence with the pen of that chart.

After the recorder charts have been oriented or synchronized, as above described, contacts 443, 448 are returned to normal or home position by breaking the switch 472 for a sufficient time to permit relay 418 to become deenergized and contact arms 443, 448 to return to home position. In order to install a fresh portion of the chart for average transmission, switch 472 is closed and the dial 420 is operated to send three impulses through magnet 441 and thereby to step the arms 443, 448 from home position into engagement with contacts 456, 458, respectively. Impulses are then sent from dial 420 through relay 421, after the lapse of sufficient time for relay 429 to de-energize, and since contact 435 is now in engagement with contact 459, impulses will be sent from wire 416 through the average motor by way of wire 437, contacts 425, 426, wire 438, contacts 435, 459, wires 460, 461, contact 448, contact 458, and wire 462. At the same time, current impulses will flow from wire 460 through contact arm 443, contact 456, contacts 427, 428, and wire 490 through magnet 491 and wire 492 to wire 464 and wire 417. Magnet 491, when energized, disconnects the counters 211, 212, and 213 from the average motor, so that said counters will not be operated. The average motor will now shift the average chart downwardly to bring a fresh portion of the chart into position for cooperation with the average pen, the extent of downward movement of the chart depending upon the number of impulses aforesaid. Due to condenser 493 the magnet 491 remains energized during the period between the termination of one impulse and the commencement of the following impulse, so that said magnet remains steadily energized throughout the series of impulses, and thus maintains the counters out of conditions for operation by the average motor. At the expiration of a predetermined time, half a second, for example,

after said series of impulses, said magnet 491 is de-energized.

As previously noted, when arms 443, 448 are in engagement with contacts 444, 449, respectively, impulses from the average transmitter act upon the average motor to step the average chart appropriately.

If it should now be desired to transmit the volume of sales of the stocks in the group at any desired time, the contact arms 443, 448 are restored to their home position by breaking the circuit through relay 404. Two impulses are then sent through magnet 441 to step said arms into engagement with contacts 455, 457, respectively. The two impulses above referred to are sent from the volume transmitter previously described. Now, when relay 429 is de-energized following the separation of contacts 431, 432, impulses from the volume transmitter are sent through either of relays 421, 422 as the result of which, in each of said impulses, current flows from wire 416, through wire 437, contacts 426, 425 or 446, 445, wire 438, contacts 435, 459, wires 460 and 461, arm 448, contact 457, wire 494, contacts 495, 496, wires 497, 498, and 499 through the volume motor 500, and thence through wire 464 to wire 417. Each impulse through the volume motor shifts the volume pen through one step, as was previously described, the total number of steps through which the pen is shifted by any series of impulses corresponding to the number of said impulses received from the volume transmitter. After the appropriate number of impulses are sent from the volume transmitter, the relay 404 is de-energized, as will be explained later on, at which time a contact 501 is engaged with a contact 502, and current flows from wire 416 through said contacts, wire 505, contacts 506, 507, wires 508, and 509, through reversing magnet 510 to wire 464 and wire 417. Magnet 510 thereupon operates reversing gearing between volume motor 500 and the volume pen so that operation of said volume motor will then lower said pen. Shortly thereafter, depending upon the period of discharge of the condenser 473, the relay 418 is de-energized engaging contact 503 with contact 504, upon which current flows from wire 416 through said contacts, wire 513, contacts 514, 515, wire 516 and normally closed contacts 511, 512 through the volume motor 500, wire 464, and wire 417. Energization of the volume motor 500 withdraws contact 512 from contact 511 breaking said circuit through the volume motor, whereupon contact 512 is returned by a suitable spring into engagement with contact 511 again energizing said volume motor. This action is rapidly repeated, with downward movement of the volume pen for each energization of the volume motor until the volume pen is restored to its lowermost position. At this time arm 320 previously referred to in connection with the volume recorder, disengages contacts 515 and 507, from their respective contacts 514, 506, breaking the circuits through wires 513 and 505 and de-energizing the volume motor 500 and reversing magnet 510.

As a safety precaution, means are provided for breaking the circuit through the volume motor whenever the volume pen reaches its uppermost position. For this purpose, arm 320, previously described, separates contact 495 from contact 496 when the volume pen reaches its uppermost position.

The slight delay in engagement of contact 503

with contact 504 following the engagement of contact 501 with contact 502 establishes the previously mentioned reversing gearing before the volume motor is energized.

The condenser 477 connected across relay 410 maintains the latter energized for a sufficient time after de-energization of relays 404 and 418 to insure the return of the volume pen into its lowermost position. In practice the lowering of the volume pen from its uppermost position to its lowermost position takes place speedily, since contacts 511, 512 rapidly engage and disengage.

The motor 517 is connected, as shown, across the lines 416, 417. This motor operates the carriage on which the volume and average pens are mounted. This motor operates continually in the same direction. Normally, it drives the pen carriage from left to right. Upon the arrival of the pen carriage in its extreme right hand position an arm on said carriage strikes contact 518 and engages the latter with contact 519. A circuit is now closed from wire 416 through wire 430, wire 520, contacts 518, 519, wire 521, relay 522, and wire 434, to wire 417. Relay 522 when thus energized, engages its contact 523 with contact 524 and also engages its contact 525 with contact 526. A circuit is now maintained closed through relay 410, this circuit being as follows: From wire 416 through wire 527, contacts 525, 526, wire 528, relay 410, wire 411.

Upon the arrival of the pen carriage in its extreme right hand position, the reversing gearing previously described is established between motor 517 and the carriage, whereupon the carriage is moved to the left. Contacts 518 and 519 are now opened, but relay 522 remains energized by way of wires 416, 430, 520, 529, contacts 530, 531, wires 532 and 533, and contacts 523 and 524. The power can now be shut off from the circuit 402, 403, without releasing relay 410 and stopping the motor 517. Now, when the pen carriage is returned into its extreme left hand position, it re-establishes the gear connections for driving said carriage to the right, and upon moving slightly to the right said carriage engages contact 530 and separates the latter from contact 531, de-energizing the relay 522. The parts are now ready for resumption of operation. It will be noted that with the foregoing provisions the pen carriage, after reaching its extreme right hand position, is automatically restored to the left into position for resuming operation at the next market period, without requiring attention on the part of the operator. At the same time, the aforesaid de-energization of relay 522 de-energizes the relay 410 and cuts off power from the lines 416, 417, and also stops the motor 517.

The motor 517 may be of any suitable constant speed type.

Circuit connections at the central transmitting station

Referring now to Figure 1, the operator's control panel designated 550 is located at the central transmitting station, as are also the average transmitter 10 and the volume transmitter 75. The wires 551, 552 are connected to a suitable source of direct current. A motor 553 is connected across the lines 551, 552 by a suitable switch 554. This motor 553 is of any suitable or standard type of constant speed motor. A disk 555, of insulating material, driven by motor 553 controls contacts in circuit with the average

and volume transmitters. As long as contact arm 556 is in engagement with the periphery of disk 555, said contact arm engages contact 557, whereby a circuit is closed as follows: From wire 552 through wire 558, contacts 556, 557, wire 559, contacts 560 and 561, wires 562, 563, and 564; relay 565, wires 566, 567, and 568 and wire 569 to wire 551. A circuit is also closed through wire 558, contacts 556, 557, wire 570, and signal light 571 on the control panel. Illumination of light 571 indicates that the contacts 556, 557 are closed and that the average-transmitting period of the cycle is established. Current also flows from wire 564 through signal light 572 on the average transmitter, indicating to the operator that the average transmitter is in condition for operation.

In the meantime, prior to energization of relay 565, current is flowing from wire 552 through wires 573, 574, 575, 576, 577, contacts 578, and 579, and wires 580, 581 and 582 through the interlocking magnet 68 previously described in connection with the average transmitter, said magnet maintaining the locking arm 64 in engagement with notch 65 of disk 66 on the main shaft 25 of said transmitter. At the same time current can flow through said magnet 68, whether or not relay 565 is energized, by way of wire 576, wire 587, and the contacts 71, 72 controlled by the push buttons 13 of the individual stock counters. The contacts 71, 72 of each stock counter are connected in series with those of all of the other stock counters, and hence breaking of any pair of contacts 71, 72 by depression of the appropriate push button 13 breaks the path of current from wire 587, to wire 582.

With the polarity switch 56 in the position shown in Figure 1, a supervisory current flows through the wires 402, 403 to the receiving station as follows: From wire 552 through wire 559, relay 591, wire 592, blade 56' of switch 56, contact 593, wire 594, contact 602, to wire 403. From wire 403 current flows through the relays 421, 422 and 404 to wire 402, as shown on Fig. 2. As previously described, this supervisory current is not sufficiently strong to operate either of the relays 421, 422, but is strong enough to operate the relay 404. From wire 402 the current flows through wire 595, contact 595', blade 56'' of switch 56, wire 596, wire 597, contacts 598, 599, wire 597', switch 472, and contact 472' and wire 600 to wire 551. The switch 472 is manually operable and is in closed position during the transmission of averages and volumes. If the position of switch 56 is reversed from that shown in Figure 1, the blades 56', 56'' engage contacts 601, 602, respectively. The supervisory current referred to now flows in the reverse direction from that previously described through wires 402, 403, but this does not change the conditions above described in the circuit 402, 403, relays 421 and 422 remaining inoperative, and relay 404 being operated. Specifically, when switch 56 is reversed, as aforesaid, current flows from wire 552 through relay 591, wire 592, blade 56', contact 601, wire 595 to wire 402, thence to wire 403 through the relays aforesaid and thence through contact 602, blade 56'' and wire 596 to wire 551.

When relay 565 is energized, as above described, its contact 578 is disengaged from contact 579, whereupon current to the magnet 68 can flow only through the circuit of push button contacts 71, 72. Now, if any of said push buttons be depressed, current ceases to flow through magnet 75

68 and the locking arm 64 drops out of engagement with disk 66, freeing the transmitter for operation. The operator now turns the operating disk 26 in one direction or the other for a number of revolutions corresponding to the change in the value of the stock selected by depression of the push button. As previously described, when a predetermined change in the average of the group of stocks has taken place (two cents in the embodiment here described) notch 50 of disk 48 releases contact 51 for engagement with contact 52.

It may be noted at this point that when relay 565 is energized, a relay 640 is energized by way of contacts 648, 649 of said relay 565, for purposes to be hereinafter noted. For the present it suffices to note that relay 640 is energized when relay 565 is energized and that contact 598 of relay 640 is disengaged from contact 599. This, however, will not interrupt the supervisory current, described, previously, because the path of this current will now be through contacts 654, 655 of relay 565.

Now, upon the engagement of contacts 51 and 52 in the operation of the average transmitter with a push button 13 depressed as aforesaid, relay 591 is shorted between wires 573 and 592 and current of increased strength flows in one direction or the other through the wires 402, 403, the direction of said current depending upon the position of the polarity switch 56. Assuming said switch to stand in the position shown in Figure 1, the closing of contacts 51, 52 results in current flow as follows: From wire 552 through wires 573, 574 and 575 through wire 603, contacts 52, 51, switch blade 56', contact 593, wire 594, wire 403, the relays previously mentioned between wires 403 and 402, wires 402 and 595, contact 595', blade 56'', wire 596, wires 652, 652', and 653, contacts 654 and 655 of relay 565, wires 656, 656' and 657, contact 599, and wire 597' to wire 551.

This flow of current from wire 403 to wire 402 with relay 491 shorted, is sufficiently strong to operate the relay 421 (Fig. 2). Due to the polarity of the rectifier 424 the current flow through relay 422 is cut down so that that relay will not be operated. The effect of this impulse upon the average recorder has been previously described in connection with Figure 2.

If, at the time contacts 51 and 52 are closed, switch 56 is in its reversed position with its blades engaging contacts 601 and 602 respectively, relay 591 will be short circuited as aforesaid and the current flows from wire 552 through wires 573, 574, and 575, wire 603, contacts 52, 51, blade 56', contact 601, wire 595 to wire 402, and thence through the relays aforesaid to wire 403 back through contact 602 and blade 56'', through wires 596, 652, 652', 653, contacts 654 and 655 of relay 565, wires 656, 656', and 657, contact 599, and wire 597' to wire 551. In this reversed flow of current the relay 422 is operated but due to polarity of rectifier 423 insufficient current flows through relay 421 to operate the latter. The effect of the operation of relay 422 has been previously described in connection with Figure 2.

When the interlocking relay 68 is energized, contacts 604, 605 of said relay are disengaged from contacts 606, 607. When, however, said magnet 68 is de-energized, unlocking the transmitter from operation, contacts 604, 605 are engaged with contacts 606, 607. Current now flows through wires 573, 574, and 575 through contacts 604 and 606, and thence through signal

light 608 and wires 609, 566, 567, 568 and 569 to wire 551. The illumination of light 608 indicates that the average transmitter is unlocked. Current also flows through wires 573, 574, and 575, through contacts 605 and 607, and contacts 641, 642, and thence through relay 565, whereby said relay 565 is maintained energized as long as relay 68 is de-energized, regardless of whether contacts 556 and 557 are engaged.

During the continued rotation of disk 555 by motor 553, a notch 610 in said disk comes opposite the contact arm 556, whereupon contact 556 is disengaged from contact 557 and engages contact 611. Light 571 is now extinguished and a light 612 is illuminated, indicating that the cyclical period for the transmission of volumes is established.

As soon as the depressed push button 13 at the average transmitter is released, relay 68 is energized and the contact 605 is separated from contact 607, so that current cannot flow from wire 575 to relay 565. If now contacts 556, 557 are separated as above described, and no push button 13 is depressed, relay 565 is de-energized, separating contact 648 from contact 649 and breaking the circuit through relay 640. The latter remains energized for a brief period (two seconds for example) depending upon the capacity of its condenser 660, and during this period of energization of relay 640 its contact 598 remains disengaged from contact 599. During said period between the release of relay 565 and release of relay 640, no current flows through the transmitting wires 402, 403. Hence, contact 419 (Fig. 2) at the receiver engages contact 420 and magnet 475 is energized to release the arms 443 and 448, which thereupon return to their home position.

Upon the de-energization of relay 640, the contact 615 engages contact 614, and current now flows from wire 558 through contacts 556, 611, wire 613, contacts 614, 615, wires 616 and 617, through light 618 and thence through wires 619, 620 and 621 to wire 551. Illumination of light 618 indicates to the operator that he can now press button 622 to unlock the volume transmitter. Depression of button 622 engages contacts 623 and 624, whereby current can flow through wires 613 and 616 through relay 625 and thence through said contacts 623, 624 to wire 619. Energization of relay 625 withdraws latch 626 from engagement with a notch in disk 627 of the volume transmitter, thereby freeing the volume transmitter for operation. The depression of button 622 also moves contacts 628 and contact 629 toward disk 630, bringing said contacts into position for operation by said disk. To transmit volumes the disk 630 is now rotated by means of handle 630'. In the meantime, since relay 625 is energized, relay 640 becomes energized through wires 552, 573, 574, 633, 662, 663, 665, contacts 666, 667 and wires 668, 670, 671, 651, and 651'. Relay 661 is also energized upon energization of relay 625, through wires 663, contacts 672 and 673, and wires 674, 675, 676. The supervisory current now flows through relay 591, wire 592, arm contact 56', contact 593, wires 594, 403, relays 404, 421, 422, wires 402, 595, contacts 595', 56'', wires 596 and 552, contacts 689, 690, wires 597' and 600, to wire 551. A parallel holding circuit through relay 661 is also established to through wires 677, and contacts 678, 679, 680, 681. Disk 630 is provided with a pair of teeth 631 and with a series of teeth 632 spaced from the teeth 631. Upon now rotating the disk 630 the teeth 631 successively en-

gage contact 629, producing two engagements of said contact with contact 628.

Each engagement of contact 629 with contact 628 short circuits the relay 591 between wires 573 and 592 and produces an increased current flow through wires 402, 403 and their associated relays. The direction of flow of the impulses through contacts 628, 629 in wires 402, 403 is not material, since, as previously described, in the operation of the volume transmitter, energization of either relay 421 or 422 will produce the same effect upon magnet 441 (Fig. 2). Assuming that the position of the switch 56 is as indicated on Figure 1, upon the first engagement of contact 629 with contact 628 current flows from wire 552 through wires 573, 574, 633, contacts 629 and 628, wires 634, 635 and 636 through switch blade 56', contact 593, wire 594, wire 403, the relays between wires 403 and 402, and wire 402, back through wire 595, blade 56'', wires 596 and 552, contacts 689 and 690 and wire 597' to wire 551. If the blades 56', 56'' of the polarity switch are engaged with contacts 601, 602, respectively, current will flow from wire 636 through blade 56', contact 601, wire 595 to wire 402 and thence to wire 403, contact 602 and blade 56'' to wire 596. There will thus be a flow of current through wires 402, 403 upon each engagement of contact 629 with contact 628. The two impulses produced by engagement of teeth 631 with contact 629 step the switch arms 443 and 448 (Fig. 2) into engagement with contacts 455 and 457 as previously described, whereby the volume recorder is selected for operation. Actuation of contact 629 by teeth 632 with consequent impulses through wires 402, 403 cause impulses through the volume motor to shift the pen to the proper volume position, as described hereinbefore. The space between teeth 631 and 632 on disk 630 is provided to enable relay 429 to de-energize and engage contact 435 to engage contact 459 before the first tooth 632 engages contact 629.

If the operator maintains a push button 13 of the average transmitter depressed at the time when notch 611 of disk 555 comes opposite contact 556, current does not flow to the volume transmitter relay 625, because, as previously noted, relay 640 was energized by energization of said relay 565 and has withdrawn contact 615 from engagement with contact 614. As previously noted, as long as contact 556 was in engagement with contact 557 relay 565 was energized, and its contact 641 is in engagement with contact 642. Now, when notch 610 comes opposite contact 556 and the latter separates from contact 557, assuming that a push button 13 is maintained depressed so that contact 605 remains in engagement with contact 607 of relay 68, relay 565 continues to be energized because the current can now flow from wire 552 through wires 573, 574, and 575, and thence through contacts 605, 607, wire 644, contacts 641 and 642 and thence through a relay 565 and wires 566—569, to wire 551. At the same time, current can flow from wires 573, 574 and 575 through contacts 605 and 607, contacts 641 and 642, through wires 564, 563, 562, contacts 560 and 561, wire 559, wire 559', wires 645, 646 and 647, contacts 648 and 649 of relay 565, wires 650, 651, and 651' through relay 640 and wire 569 to wire 551. Relay 640 thus is maintained energized, and its contact 598 remains out of engagement with contact 599. Supervisory current cannot now flow between contacts 598 and 599, though it can flow by way of wire 596 through wires

652, 652' and 653 through the closed contacts 654, 655 of relay 565, thence through wires 656 and 657 to contact 599, and thence through closed switch 472 to wire 551. If the operator now releases the depressed push button 13, however, while notch 610 is still over contact 556 the resultant energization of magnet 68 will disengage contact 605 from contact 607 and break the circuit through relay 565 with consequent disengagement of contacts 654 and 655, thus disrupting entirely any flow of supervisory current. The switch arms 443 and 448 (Fig. 2) thus now drop back to their normal or home position. The de-energization of relay 565 also breaks contacts 648, 649 disrupting the previously described circuit through relay 640 and at the end of a predetermined time (two seconds, for example) depending upon the capacity of condenser 660, the relay 640 de-energizes, whereupon contact 615, which was disengaged from contact 614, upon energization of relay 640, now returns into engagement with contact 614, permitting current to flow to the volume transmitter. The push button 622 being depressed, volumes may now be transmitted as long as the notch 610 remains over the contact 556, or, as will be seen later, as long as the operator maintains said push button 622 depressed.

It will be seen that during the time that relay 640 remains energized following release of the depressed push button 13, with contacts 556, 557 separated, no current flow can take place through wires 402, 403. This is because the release of push button 13 re-energizes magnet 68 separating contacts 604, 605 from the respective contacts 606, 607 and breaking the circuit through relay 565. Contacts 654, 655 are now separated, wherefore no current can flow from wire 596 to wire 597' by way of contacts 654, 655. Nor can current flow from wire 596 to wire 597' through contact 598, since, as above noted, relay 640 remains energized for a brief period. Current also cannot flow from wire 596 to wire 597' by way of the contacts controlled by relay 625, since at this time relay 625 is de-energized due to the separation of contact 615 of relay 640 from contact 614. Thus all possible paths of current through wires 402, 403 are cut off. Now, when relay 640 de-energizes, contact 598 reengages contact 599 and contact 615 is re-engaged with contact 614. Current can now flow through relay 625 of the volume transmitter provided notch 610 is still opposite contact 556, and push button 622 is depressed. The reengagement of contacts 598, 599 re-establishes the flow of supervisory current through wires 402, 403 by way of wire 590, relay 591, the polarity switch contacts, wires 596, 597, contacts 598, 599 and wire 597'.

It will be seen from the foregoing description that if an operator is holding a push button 13 depressed, and is operating the average transmitter in accordance with the new value of a stock, a change in the average may nevertheless be transmitted over wires 402, 403 despite the separation of contacts 556, 557. The average transmitter remains in control as long as said push button is held depressed, and thus the change in the average will be transmitted. Upon then releasing the depressed push button 13 the volume transmitter assumes control by the depression of push button 622 since relay 525 is then energized as above noted. In the meantime, the temporary interruption (for about 2 seconds) of current flow in wires 402, 403 between release of push button 13 and de-energiza-

tion of relay 640 has caused relay 475 (Fig. 2) to be energized and contact arms 443, 448 to return to their home positions. Now, when the operator, with push button 622 held down, turns the volume transmitter disk 630, impulses will be sent from the volume transmitter through wires 402, 403.

At this point, it may be noted that when relay 625 is energized, relays 640 and 661 are energized. Relay 640 is energized as follows: From wire 552 through wires 573, 574, 633, 662, 663, contact 664 of relay 625, wire 665, contacts 666, 667 of relay 625, wire 668, contact 669, wires 670, 671, 651, 651', relay 640, and wire 569 to wire 551. At the same time, relay 661 is energized from wire 663 through contacts 672, 673, wires 674, 675, and 676, through said relay 661 to wire 569. When relays 640 and 661 are energized they close a holding circuit through relay 661 as follows: From wire 552 through wire 677, contacts 678 and 679 of relay 640 and contacts 680, 681 of relay 661.

Now, upon turning disk 630, two impulses are sent over wires 402, 403 as the result of closing contacts 628, 629 by the two teeth 631 on said disk, with resultant stepping of arms 443, 448 into engagement with contacts 455, 457, Fig. 2. Upon further turning of disk 630 to engage the proper number of teeth 632 with contact 629 the number of impulses corresponding to the volume in question are transmitted over wires 402, 403, and the volume motor 500, Fig. 2, steps the volume pen upwardly to indicate the transmitted volume.

If, while the operator holds button 622 depressed, and is operating the volume transmitter disk 630, the notch 610 passes by contact 556 and disk 558 re-engages said contact with contact 557, the transmission of the volume can nevertheless proceed without interference. Since relay 661 is energized it will be seen that contact 561 of said relay is disengaged from contact 560, so that the average transmitter relay 565 cannot be energized even though contacts 556, 557 are engaged. The average transmitter is thus kept out of action. Relay 625 remains energized despite the opening of contacts 556, 611, since the depression of button 622 has engaged contacts 682, 683, and the initial energization of relay 625 has engaged a contact 584 with contact 685, so that current can flow from wire 552 through wires 573, 574, 633, contacts 682, 683, wires 686, 687, contacts 684, 685, wire 688, relay 625, contacts 623, 624, wires 619, 620, and wire 569 to wire 551. At the same time light 618 in parallel with relay 625 remains illuminated. Also, the volume light 612 on the control panel remains illuminated through the following circuit: from wire 552, through wires 573, 574, 633, 662, 663, contact 664 of relay 625, wires 665, contacts 666 and 667 of relay 625, wire 668, contacts 669 and 727 of relay 625, wires 728 and 729, contact 614, and wire 612, through light 612 to wire 551.

After the desired volume has been transmitted the operator releases push button 622, breaking the circuit through relay 625, which promptly de-energizes. Since contact 666 is not separated from contact 667 the circuit through relay 640 is broken. Upon the de-energization of relay 625 no supervisory current can flow through wires 402, 403, until relay 640 is de-energized, which, as above noted, will take place about two seconds after the circuit through relay 640 is broken. When relay 625 is de-energized and relay 640 remains energized, all possible paths of current

flow through wires 402, 403 are broken since contact 598 is separated from contact 599 and contacts 689 and 690 of relay 625 are separated. At the same time, of course, contacts 664 and 655 of relay 565 are separated since relay 565 is not energized. Now when relay 640 is de-energized contact 598 engages contact 599, re-establishing the flow of supervisory current in wires 402, 403. When the flow of supervisory current is interrupted as above described, the magnet 475 (Fig. 2) is energized and arms 443 and 448 return to their home position. The de-energization of relay 640 separates contact 680 from contact 678 but relay 661 remains energized (for about a second, for example) due to its condenser 691. Deenergization of relay 640 also reengages a contact 692 with contact 693 in wire 558 and since relay 661 temporarily remains energized its contact 694 remains engaged with contact 695. A current impulse thus now flows from wire 552 through wire 558, contacts 693, 692, contacts 695, 694, wire 635, one of the blades of the polarity switch 56, wires 403, 402, and thence through the other blade of the polarity switch through wires 596, 597 and 597' to wire 551. This current impulse energizes one or the other of the relays 421, 422 (Fig. 2) and causes an impulse to flow through magnet 441 (Fig. 2), stepping arms 443, 448 from their home position into engagement with contacts 444, 449. Now, when relay 661 de-energizes, its contact 694 is separated from contact 695 and its contact 561 re-engages contact 560 so that current can now flow through contacts 556, 557 through relay 565 of the average transmitter. The system is now conditioned for the transmission of averages. If the operator completed volume transmission and released volume push button 622 before contact 611 is disengaged from contact 556, the circuit through relay 640 will be broken at contacts 666, 667; relay 640, however, remains energized for a brief period (two seconds, for example) during which the supervisory current described above will be interrupted at contacts 690, 689. After relay 640 becomes deenergized, the holding circuit through relay 661 is broken at 678, 679.

However relay 661 remains energized for a brief interval (a second for example) during which an impulse of increased current (by short-circuiting of relay 591) is sent through the wires 402, 403 as follows: Wires 552, 558, contacts 693, 692, 695, 694, wires 635, 636, arm contact 56', wires 594, 403, 402, 595, contacts 595', 56'', wires 596, 597, contacts 598, 599 and wires 597', 600 and 551.

The interruption of current and subsequent one impulse of increased current through wires 402, 403, release arms 443, 448 to their home position and install them in engagement with contacts 444 and 449.

The disk 555 in the embodiment here described makes one complete revolution in two minutes, and the notch 610 is of such extent as to pass over the contact 556 in ten seconds, so that during the last ten seconds of each cycle of rotation of disk 555 contact 556 is in engagement with contact 611 for the transmission of volumes. The period of rotation of disk 555 and the extent of notch 610 may of course be varied as desired.

A light 700 on the control panel is connected in parallel with light 572 on the average transmitter and is energized as long as the average transmitter is conditioned for transmitting averages. Likewise, a light 701 on the control panel

is in parallel with light 618 and is energized whenever the volume transmitter is conditioned for transmitting volumes. While light 571 is normally de-energized when contacts 556, 557 are separated, lights 571, 700 and 572 remain energized despite the separation of said contacts, as long as the operator maintains a push button 13 depressed. Likewise, while light 612 is normally extinguished upon separation of contacts 556, 611, lights 612, 701 and 618 remain illuminated despite the separation of said contacts, as long as push button 622 is held depressed. When contacts 611, 556 are disengaged but the push button 622 is still depressed, relays 625, 640 and 661 are energized, and current flows from wire 552, wires 573, 574, 633, contacts 682, 683 wires 686, 687, contacts 684, 685; from here, through light 618, and wires 620, 621, to wire 551. Current also flows through wire 616, light 701, and wire 621 to wire 551.

Also current flows from wire 552, wires 573, 574, 633, 662, 663, 664, contacts 666, 667, 669, 727, wires 728, 729, contact 614, through light 612, to wire 551.

When contacts 556, 557 are disengaged, but the push button 13 is still depressed, relay 640 and 565 are energized, and current flows as previously noted through lights 572, 700 and also through contacts 560-561 through light 571.

A single stroke bell 703 is connected in parallel with light 701 and provides an audible signal which comes into action when the transmission of volume is in order. It should be noted that neither bell 703 nor lights 701, 618 will be energized, even though contacts 556, 611 are engaged, until any depressed push button 13 at the average transmitter is released. Likewise, lights 700 and 572 will not be illuminated, even though contact 556 engages contact 557, until the push button 622 at the volume transmitter is released.

Means are provided for giving a signal whenever the supervisory current circuit is broken, or relay 591 is shorted, for more than a predetermined time (three seconds, for example), or whenever less than a predetermined amount of supervisory current flows through wires 402, 403, for more than said predetermined time. For this purpose, relay 591 is provided with a contact 705 which, when said relay is shorted or de-energized, is disengaged from contact 706. As long as current of a predetermined value flows through relay 591 contact 705 engages contact 706 and a relay 707 is energized withdrawing its contact 708 from engagement with contact 709 and engaging its contact 710 with contact 711. Now, if relay 591 is shorted or de-energized, or the current therethrough is less than a predetermined amount, contact 705 disengages contact 706, and breaks the circuit through relay 707. The latter, however, remains energized through condenser 712 for a predetermined (three seconds, for example), and if contacts 705, 706 remain separated beyond said time, relay 707 is de-energized with resultant engagement of its contact 708 with contact 709. A double pole double throw switch 713 is normally in the position shown in Fig. 1 connecting a bell 714 between wires 715, 716. Now, when contact 708 engages contact 709 as aforesaid, current flows from wire 552 through said contacts, wire 715, bell 714, and wire 716 to wire 551. The sounding of the bell shows that the line 402, 403 is not in proper condition for operation. The attendant proceeds to remedy the condition of the line 402, 403, and if desired, to avoid continual sounding of the alarm in the mean-

time, the attendant may throw the switch 713 into engagement with contact 717 to connect a light 718 between wire 715 and wire 719, at the same time throwing the bell out of circuit. Switch 713 at this time also engages contact 720 connected to bell 714, but since contacts 710, 711 are separated the bell does not sound. Upon restoration of the proper current conditions in wires 402, 403 and relay 591, the latter reengages contact 705 with contact 706 again energizing relay 707, which thereupon separates contact 708 from contact 709 and engages contact 710 with contact 711. Current now flows from wire 552 through contacts 711, 710, wire 721, switch 713, contact 720, bell 714, and wire 716 back to wire 551, again sounding the bell and showing that proper conditions have been restored. To silence the bell, the attendant restores the switch to its position shown in Figure 1.

A contact 722 connected to a wire 723 is normally disengaged from a contact 724 connected to wire 725. Wires 723 and 725 are connected to wires 574, 635, respectively. As a result, whenever contact 722 engages contact 724 the relay 591 is shorted and increased current flows in the line 402, 403. Contact 722 is engaged with contact 724 by any suitable means, such as the manually operated dial 420 of any suitable or conventional construction. This dial is operated to actuate contact 722 and to send impulses in the wires 402, 403 for the purpose of stepping the switch arms 443 and 448 (Fig. 2) into their third and fourth positions, as well as to orient the average charts at the receiving stations and to bring fresh portions of said charts into position for receiving averages, as previously described in connection with Fig. 2.

A suitable instrument may be included in one of the lines 402, 403 to show the polarity and condition of the current in said lines. This instrument, designated 726, may be a standard form of milliammeter, with zero in the center.

In Figure 15, connections are illustrated for utilizing an alternating current source at a receiver. In this view the alternating current means are designated 730, 731. The carriage driving motor 517, which in this instance may be of alternating synchronous motor, is connected to main 730 by wire 732. Another wire 734 connected to said motor, has a contact 735 adapted to be engaged by contact 736 of relay 410. To contact 736 there is connected a wire 737 which is connected by wire 738 with main 731. A rectifier unit 739 of well known conventional construction is connected by wire 740 to main 730 and by wire 741 to contact 742 cooperating with contact 743 of relay 404, said contact 743 being connected, as shown, with wire 738. It will now be seen that energization of relay 404 engages contact 743 with contact 742, closing a circuit through the rectifier unit 739, which thereupon applies direct current to the wires 416, 417. The energization of relay 404 also has engaged its contacts 405, 407 with contacts 406, 408, respectively, thus energizing relays 410 and 418. Energization of relay 410 engages contact 736 with contact 735, thus closing a circuit through the carriage driving motor 517 from the mains 730, 731. The receiver apparatus is now in condition for operation in the same manner as previously described.

It will, of course, be appreciated that in lieu of condensers for delaying release of relays 410, 418, 429, 469, 491, 640, 661, and 707, the release

of said relays may be accomplished in any other suitable way well known in the art, as by dashpots, for example. It will also be apparent that the relays 421, 422 and rectifiers described in connection therewith may, if desired, be replaced by a polarized relay responsive to the direction of current flow through wires 402, 403.

In the recorder embodiment herein described, it may be observed that gears 190 and 191 may each have fifty teeth (as also may ratchet wheel 187) while pinions 195 and 206 may each have fourteen teeth. It is found that thereby the pinion 195 may be expeditiously and freely moved into engagement with either gear 190 or pinion 206 in any position to which said gear and pinion may be set by operation of ratchet 187.

Summary of operation

By way of a specific illustration of operation of the invention as applied to the transmission and recording of stock averages and volumes, let it be assumed that a fresh portion of the average chart has been brought into position for cooperation with the average pen 202 at the end of the previous trading period. As previously described, the chart 150 at each receiving station was brought, after the end of the trading period, into such position that the proper dollar line thereon is opposite the average pen 202, by sending impulses from dial 420 with the minor switch arms 443, 448 positioned as previously noted. Thereafter, said chart 150 at each receiver was stepped further downwardly to bring a fresh portion into recording position, this being accomplished by sending impulses from dial 420 with the minor switch arms 443, 448 in engagement with contacts 456, 458. Sufficient impulses were sent from said dial 420 with said switch arms on contacts 456, 458 aforesaid to shift the chart downwardly through such number of dollar lines from the position to which it was moved in the orienting operation aforesaid as to bring the desired fresh portion of the chart into average-receiving position, but with a dollar line opposite the pen.

The operator at the central transmitting station now closes switch 472, closing the circuit for the flow of supervisory current over the transmission wires 402, 403, and energizing relay 404 at each receiving station, with resultant operation of relays 410 and 418 as hereinbefore described. Since wires 416, 417 at each receiving station are now connected to current source 400, 401, the carriage motor 517 is now energized.

An impulse is now sent from the central station by operation of dial 420, stepping the minor switch arms 443, 448 from their home or zero positions into engagement with contacts 444, 449. The operator now sends a sufficient number of impulses from dial 420 through relay 421 to shift the chart downwardly from its position in which the dollar line previously mentioned is opposite the pen to a position in which the cents reading of the previous closing average is opposite said pen. The counter 212 opposite the pen indicates the dollar amount of said average reading. Hence at the commencement of the new trading period the average recorder exhibits the previous closing average on the fresh portion of the chart which is to receive the average record throughout the new period. For example, if said closing average was \$61.50, the counter 212 opposite the pen indicates \$61, and the pen, after said chart has been moved downwardly as aforesaid, is on a 50¢ line on the chart, whereby the

reading of \$61.50 is exhibited. Motor 553 has in the meantime been connected by switch 554 with mains 551, 552 at the central station. By way of illustration, disk 555 is assumed to make one complete revolution in two minutes, and notch 610 thereof to be opposite contact 611 for ten seconds in each revolution of said disk.

With the minor switch arms stepped into engagement with contacts 444, 449 as aforesaid the operator at the central station observes the quotations and volume indications on the customary ticker tape. As long as contacts 556, 557 are in engagement, light 571 on the control panel is illuminated, and as long as the relay 565 of the average transmitter is energized, light 700 on the control panel and light 572 on the average transmitter are likewise illuminated. As soon, now, as the ticker tape shows a quotation for any stock in the group in question, which quotation is different from that appearing on the counter 11 for said stock, and assuming that light 572 is illuminated, indicating that transmission of averages is in order, the operator depresses button 13 for said stock, and rotates handle 26 of the average transmitter in a direction corresponding to increase or decrease in said stock value, and for a number of rotations corresponding to the extent of said increase or decrease. For example, if the quotation indicates a decrease of $\frac{3}{8}$ of a dollar, the handle 26 is turned in the proper direction through three complete rotations. Counter 11 for the stock in question now exhibits the new value of the stock. The operator likewise depresses the appropriate push button 13 and operates handle 26 through the appropriate extent and in the proper direction for each change in value of each other stock in the group in the average transmitting period.

As previously described, whenever a change of two cents in the average of the group of stocks is accumulated, contacts 51, 52 of the average transmitter close a circuit over wires 402, 403. The current now sent over said wires is of greater strength than the supervisory current, since the closing of contacts 51, 52 short circuits the relay 590. Also, due to the operation of the polarity switch 56 prior to closing of said contacts 51, 52, said current is of a polarity dependent upon whether the average is increased or decreased. Relay 421 or 422 at each receiving station is thereby operated, and since switch arms 443, 448 are engaged with contacts 444, 449, the average motor 463 is operated to shift the chart 150 upwardly or downwardly in accordance with said two cents change in the average.

As previously noted, if a push button 13 is maintained depressed at the time when notch 610 comes over contact 557, the operation of the average transmitter can be completed without interference, even though contact 557 is now disengaged from contact 556 and is engaged with contact 611. Since relay 640 is energized as long as a push button 13 is depressed, contact 615 is separated from contact 614 and current cannot flow to the volume transmitter. Light 612 is now illuminated, indicating that the cyclical period assigned for the transmission of volumes has been established. Lights 572 and 700 remain illuminated on the average transmitter, as likewise does light 571 as long as push button 13 remains depressed, as also does light 608, which is illuminated whenever a push button 13 is depressed and the locking relay 68 of the av-

erage transmitter de-energized. The operator now releases push button 13 as soon as operation of the average transmitter is completed. Relays 68 and 565 are now deenergized. Relay 640, as previously noted, remains energized for about two seconds, during which time supervisory current is cut off from lines 402, 403, and the minor switch arms 443, 448 return to their home or zero position. In the meantime the total volume of sales of the stocks in the group has been observed from the ticker tape and totaled. As soon as relay 640 is deenergized, light 701 on the control panel is illuminated and bell 703 sounds, emphasizing that volumes should be transmitted.

The operator now proceeds to transmit volumes, depressing push button 622, whereby relay 625 is now energized and the volume transmitter is unlocked. The latter is now operated until the appropriate indication on the volume transmitter dial appears through the opening in the transmitter casing. As previously described, upon operating the volume transmitter, the teeth 631 cause two impulses to be sent over wires 402, 403, stepping the minor switch arms into engagement with contacts 455, 457. Due to the spacing of teeth 632 from teeth 631, sufficient time is allowed for relay 429 to deenergize, and its contact 435 to engage contact 459, following which teeth 632 operate contacts 628, 629 a number of times corresponding with the volume to be transmitted. The volume motor 500 is thereby operated and shifts the volume pen upwardly to draw on the volume chart a line the vertical extent of which indicates said volume.

Should push button 622 be maintained depressed at the time when contact 557 is reengaged with contact 556 the volume transmission may nevertheless be completed, as hereinbefore described, since relay 625 remains energized, and, due to energization of relay 661, contact 561 is disengaged from contact 560, preventing flow of current to the average transmitter. However, as soon as contacts 556 and 557 engage, light 571 on the control panel is illuminated, showing that the period, assigned to transmission of averages is established, the light 612 is not extinguished at that time.

As soon as the volume transmitter has been operated the appropriate extent the operator releases the depressed push button 622, deenergizing the relay 625. Relay 640 remains energized for about two seconds, during which time no current flows in wires 402, 403, the minor switch arms 443, 448 return to normal or zero position, and the volume pen is lowered into its zero position. Relay 640 then deenergizes, but relay 661 remains energized for about a second after the deenergization of relay 640, and during this time an impulse is sent over wires 402, 403, stepping the minor switch arms 443, 448 into engagement with contacts 444, 449. Upon deenergization of relay 661, contact 561 is reengaged with contact 560, so that current can flow through the relay 565 of the average transmitter, whereupon changes in average can be transmitted as previously described. As hereinbefore noted, when relay 565 is energized, light 572 on the average transmitter and light 700 on the control panel are illuminated.

It will be noted that if the operator should depress a push button 13 at a time when relay 565 is not energized, as when contacts 556, 557 are separated or relay 640 is energized, such depression of the push button is ineffective, since

the magnet 68 can not be energized to unlock the average transmitter until relay 565 is energized and a push button is depressed.

Similarly, if the push button 622 of the volume transmitter is depressed either while contacts 556, 611 are disengaged or relay 640 is energized, the volume transmitter cannot be operated since relay 625 cannot be energized at such times.

Throughout the trading period the carriage on which the average and volume pens are mounted is being moved from left to right at a constant rate of speed. Since volumes are transmitted at substantially two minute intervals, the volume indications on the recorder show the rate of sales of the stocks of the group, and also show the amount of sales corresponding to the average indication for each two minute period.

After the trading period has terminated, the readings on the chart may remain in view as long as desired, after which the operator transmits orienting impulses as previously described, insuring that all the charts at the receiver stations are on the proper dollar line, and then sends impulses for shifting the chart downwardly to bring a fresh portion into recording position, but with a dollar line in each chart in coincidence with the pen. The charts are now in position for resumption of operation for the next trading period in accordance with the procedure hereinbefore outlined.

As previously noted, the pen carriage, after moving to its extreme right hand position, effects reversal of the gearing to the drive motor 517, and is thereupon shifted to the left. In its right hand position, the carriage engaged contact 518 with contact 519, closing a circuit through relay 522, which establishes a holding circuit through itself and maintains relay 410 energized until said carriage reaches its extreme left hand position and travels slightly to the right, disengaging contact 530 from contact 531, and breaking the circuit through relay 522. Upon the energization of relay 522, the switch 472 at the central transmitting station may be opened, since relay 522 maintains relay 410 energized and voltage impressed on wires 416, 417 from source 400, 401, despite the release of relay 404, so that the completion of the travel of the carriage to its initial position is insured. Switch 554 at the central station is operated to disconnect motor 555 from lines 551, 552 when the transmission of stock quotations and volumes from the stock exchange is terminated.

The motor 517 preferably moves the pen carriage to the right a distance beyond the position corresponding to the termination of trading, so that marks by the pen on the chart as an incident to orientation and feeding of a fresh chart portion are in a zone distinct from the record of averages.

The terms of expressions which we have employed are used as terms of description and not of limitation, and we have no intention, in the use of such terms and expressions, of excluding any equivalents of the features shown and described or portions thereof, but recognize that various modifications are possible within the scope of the invention claimed.

We claim:

1. In combination, means for transmitting signals corresponding to values of a variable, means for transmitting signals corresponding to values of another variable, means for locking each of said transmitting means against operation, an electromagnet for controlling each of said lock-

ing means, and means comprising a manually operable member for each of said electromagnets and a cyclically operating member common to said electromagnets for operating said electromagnets to unlock the respective transmitting means in different cyclical periods.

2. In combination, a transmission line, means for establishing current flows in said line for transmitting values of a variable, means for establishing current flows in said line for transmitting values of another variable, contact means for controlling the first mentioned transmitting means, contact means for controlling the second mentioned transmitting means, cyclically operable means for successively operating the respective contact means, a relay controlling the first mentioned transmitting means and energized in response to operation of the first mentioned contact means, a relay controlling the second transmitting means and connected with the second mentioned contact means, a relay energized in response to energization of the first mentioned relay, and contacts in circuit with the second relay and separated upon energization of the third relay.

3. In combination, a transmission line, means for establishing current flows in said line for transmitting values of a variable, means for establishing current flows in said line for transmitting values of another variable, contact means for controlling the first mentioned transmitting means, contact means for controlling the second mentioned transmitting means, cyclically operable means for successively operating the respective contact means, a relay controlling the first mentioned transmitting means and energized in response to operation of the first mentioned contact means, a relay controlling the second transmitting means and connected with the second mentioned contact means, a relay energized in response to energization of the second mentioned relay, and contacts in circuit with the first relay and separated upon energization of the third relay.

4. In combination, a transmission line, means for establishing current flows in said line for transmitting values of a variable, means for establishing current flows in said line for transmitting values of another variable, contact means for controlling the first mentioned transmitting means, contact means for controlling the second mentioned transmitting means, cyclically operable means for successively operating the respective contact means, a relay controlling the first mentioned transmitting means and energized in response to operation of the first mentioned contact means, a relay controlling the second transmitting means and connected with the second mentioned contact means, a relay energized in response to energization of either the first or the second relays, contacts in circuit with the first and second relays and separated upon energization of the third relay.

5. In combination, a transmission line, means for establishing current flows in said line for transmitting values of a variable, means for establishing current flows in said line for transmitting values of another variable, contact means for controlling the first mentioned transmitting means, contact means for controlling the second mentioned transmitting means, cyclically operable means for successively operating the respective contact means, a relay controlling the first mentioned transmitting means and energized in response to operation of the first mentioned con-

tact means, a relay controlling the second transmitting means and connected with the second mentioned contact means, a relay energized in response to energization of either the first or the second relays, contacts in circuit with the first and second relays and separated upon energization of the third relay, and means controlled by each of the first and second relays for closing a holding circuit therethrough upon energization thereof.

6. In combination, a transmission line, means for maintaining a flow of supervisory current over said line, means for establishing current flows of increased strength in said line for transmitting values of a variable, means for establishing current flows of increased strength in said line for transmitting values of another variable, contact means for controlling the first mentioned transmitting means, contact means for controlling the second mentioned transmitting means, cyclically operable means for successively operating the respective contact means, a relay controlling the first mentioned transmitting means and energized in response to operation of the first mentioned contact means, a relay controlling the second transmitting means and connected with the second mentioned contact means, a relay energized in response to energization of the first relay, means for delaying de-energization of the third relay following de-energization of the first relay, and means responsive to de-energization of the first relay for interrupting the flow of supervisory current while the third relay remains energized.

7. In combination, a transmission line, means for maintaining a flow of supervisory current over said line, means for establishing current flows of increased strength in said line for transmitting values of a variable, means for establishing current flows of increased strength in said line for transmitting values of another variable, contact means for controlling the first mentioned transmitting means, contact means for controlling the second mentioned transmitting means, cyclically operable means for successively operating the respective contact means, a relay controlling the first mentioned transmitting means and energized in response to operation of the first mentioned contact means, a relay controlling the second transmitting means and connected with the second mentioned contact means, a relay energized in response to energization of the first relay, means for delaying de-energization of the third relay following de-energization of the first relay, and condenser means responsive to de-energization of the first relay for interrupting the flow of supervisory current while the third relay remains energized.

8. In combination, a transmission line, means for maintaining a flow of supervisory current over said line, means for transmitting values of a variable over said line, means for transmitting values of another variable over said line, cyclically operable means controlling the periods within which the respective variables may be transmitted, a relay, contact means operable for closing a circuit through said relay in response to conditioning of either of said transmitting means for operation, means delaying de-energization of said relay following release of the operated contact means, and means controlled by said relay during said delayed de-energization thereof for interrupting current flow in said transmission line.

9. In combination, a transmission line, means

for maintaining a flow of supervisory current over said line, means for transmitting values of a variable over said line, means for transmitting values of another variable over said line, cyclically operable means controlling the periods within which the respective variables may be transmitted, a relay, contact means operable for closing a circuit through said relay in response to conditioning of either of said transmitting means for operation, means delaying de-energization of said relay following release of the operated contact means, and means controlled by said relay during said delayed de-energization thereof for interrupting current flow in said transmission line, a receiver comprising separate means for indicating the respective variables, switch means for selecting the receiver means to be operated by said signals, and means responsive to said current interruption for restoring said switch means into a given position.

10. In combination, a transmission line, means for maintaining a flow of supervisory current over said line, means for transmitting values of a variable over said line, means for transmitting values of another variable over said line, cyclically operable means controlling the periods within which the respective variables may be transmitted, a relay, contact means operable for closing a circuit through said relay in response to conditioning of either of said transmitting means for operation, means delaying de-energization of said relay following release of the operated contact means, means controlled by said relay during said delayed de-energization thereof for interrupting current flow in said transmission line, a receiver comprising separate means for indicating the respective variables, switch means for selecting the receiver means to be operated by said signals, means responsive to said current interruption for restoring said switch means into a given position, and means for thereafter establishing current flow in said line for actuating said switch means to select the receiver portion corresponding to the transmitting means to be operated.

11. Transmitting means comprising a plurality of indicators for different items, means for operating said indicators to exhibit current values of said items, an indicator for exhibiting averages of the values of the group of items, means connecting said average indicator with said operating means, and means controlled by said operating means independently of said average indicator for sending electrical impulses corresponding to changes in said averages.

12. Transmitting means comprising a plurality of indicators for different items, means for operating said indicators to exhibit current values of said items, means controlled by said operating means for sending electrical impulses corresponding to changes in the average values of the group of items, and means operated by said operating means prior to the sending of said impulses for determining the polarity of the latter in accordance with increase or decrease in said average values.

13. Transmitting means as defined by claim 12, including means for delaying the transmission of said impulses until a predetermined amount of change in the average values is attained.

14. In combination, means for transmitting signals corresponding to values of a variable, means for transmitting signals corresponding to values of another variable, cyclically operable means controlling the operation of both said

transmitting means to provide for transmission of the values of the respective variables in different cyclical periods, and means for enabling the completion of the transmission of a value of one variable notwithstanding establishing of the period assigned to transmission of a value of the other variable while the first mentioned value is in course of transmission.

15. In combination, means operable in accordance with changes in price of items of a group, means controlled by the first mentioned means for transmitting electrical impulses corresponding to changes in the average price of said group of items, means for transmitting electrical impulses corresponding to the volumes of sales of said items, and cyclically operating means for controlling both of said transmitting means to compel the transmission of the average price changes in a given cyclical period and the transmission of said volumes in a different cyclical period.

16. In combination, means operable in accordance with changes in price of items of a group, means controlled by the first mentioned means for transmitting electrical impulses corresponding to changes in the average price of said group of items, means for transmitting electrical impulses corresponding to the volumes of sales of said items, and cyclically operating means comprising a substantially constant speed motor and means driven thereby for controlling both of said transmitting means to compel the transmission of the average price changes in a given cyclical period and the transmission of said volumes in a different cyclical period.

17. In combination, means operable in accordance with changes in price of items of a group, means controlled by the first mentioned means for transmitting electrical impulses corresponding to changes in the average price of said group of items, means for transmitting electrical impulses corresponding to the volumes of sales of said items, cyclically operating means for controlling both of said transmitting means to compel the transmission of the average price changes in a given cyclical period and the transmission of said volumes in a different cyclical period, and remote receiving means responsive to both of said transmitting means for recording said average price changes and said volumes in juxtaposition.

18. In combination, a transmission line, means for transmitting values of a variable over said line, means for transmitting values of another variable over said line, cyclically operable means controlling the periods during which the respective variables may be transmitted, a receiver comprising separate means for indicating the respective variables, said receiver comprising means responsive to the termination of the transmitting cycle for one of said variables for conditioning the indicator for the other of said variables for operation from said transmission line, and said receiver also comprising means responsive to the termination of the transmitting cycle for said other of said variables for conditioning the indicator for the first of said variables for operation from said transmission line, and means for enabling transmission of a value of either variable, initiated before termination of the transmitting cycle for said variable, to be completed after termination of said cycle.

19. In combination, a transmission line, means for transmitting values of a variable over said line, means for transmitting values of another variable over said line, cyclically operable means controlling the periods during which the respective variables may be transmitted, a receiver comprising separate means for indicating the respective variables, said receiver comprising means responsive to the termination of the transmitting cycle for one of said variables for conditioning the indicator for the other of said variables for operation from said transmission line, and said receiver also comprising means responsive to the termination of the transmitting cycle for said other of said variables for conditioning the indicator for the first of said variables for operation from said transmission line, means for enabling transmission of a value of either variable, initiated before termination of the transmitting cycle for said variable, to be completed after termination of said cycle, and means responsive to said termination of transmission for conditioning the indicator for the other variable for operation from the transmission line.

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