Feb. 17, 1942. H. ANGEL 2,273,083

TELEGRAPH STORAGE TRANSMITTER

Filed Aug. 17, 1940 2 Sheets-Sheet 1

FIG. 1

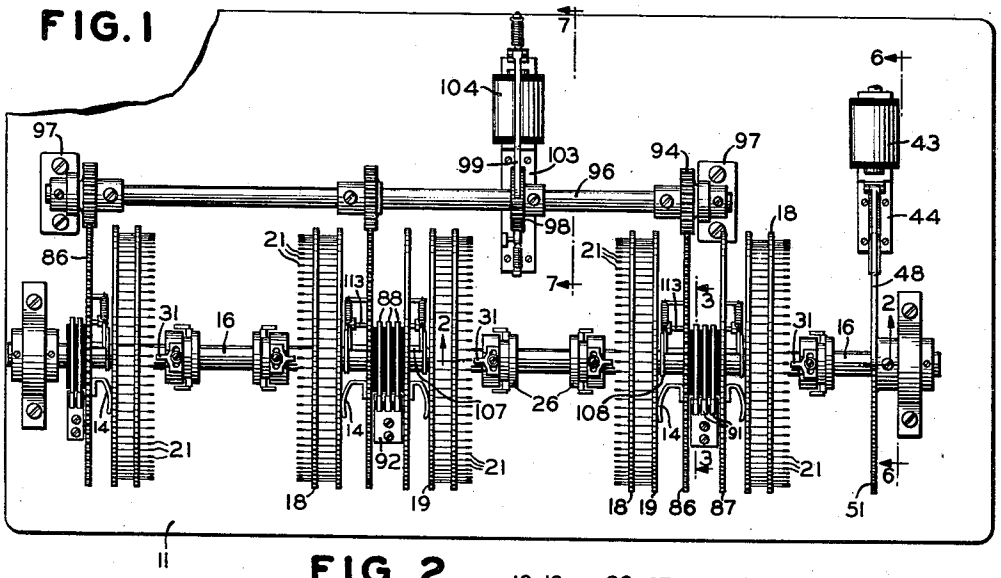


FIG. 2

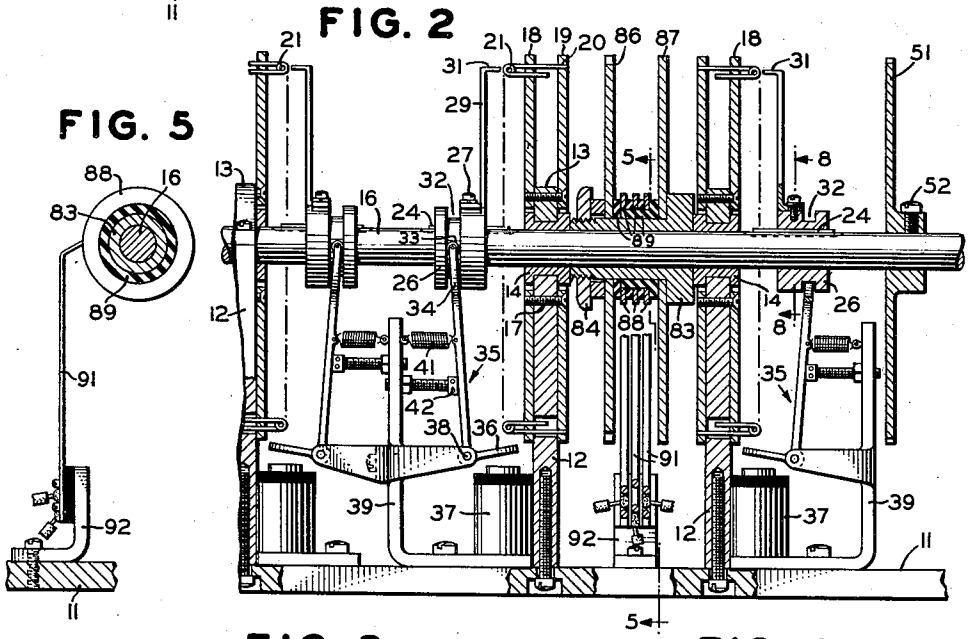


FIG. 5

FIG. 3

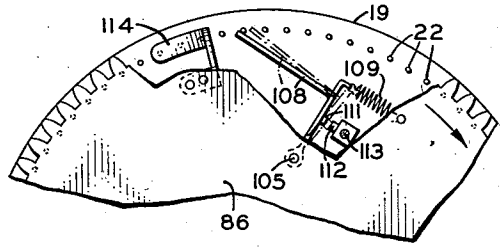
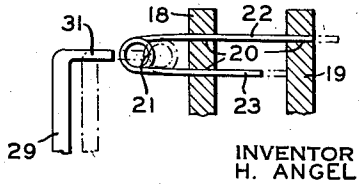


FIG. 4



INVENTOR
H. ANGEL

BY M. R. Marsh

ATTORNEY

Feb. 17, 1942. H. ANGEL 2,273,083

TELEGRAPH STORAGE TRANSMITTER

Filed Aug. 17, 1940 2 Sheets-Sheet 2

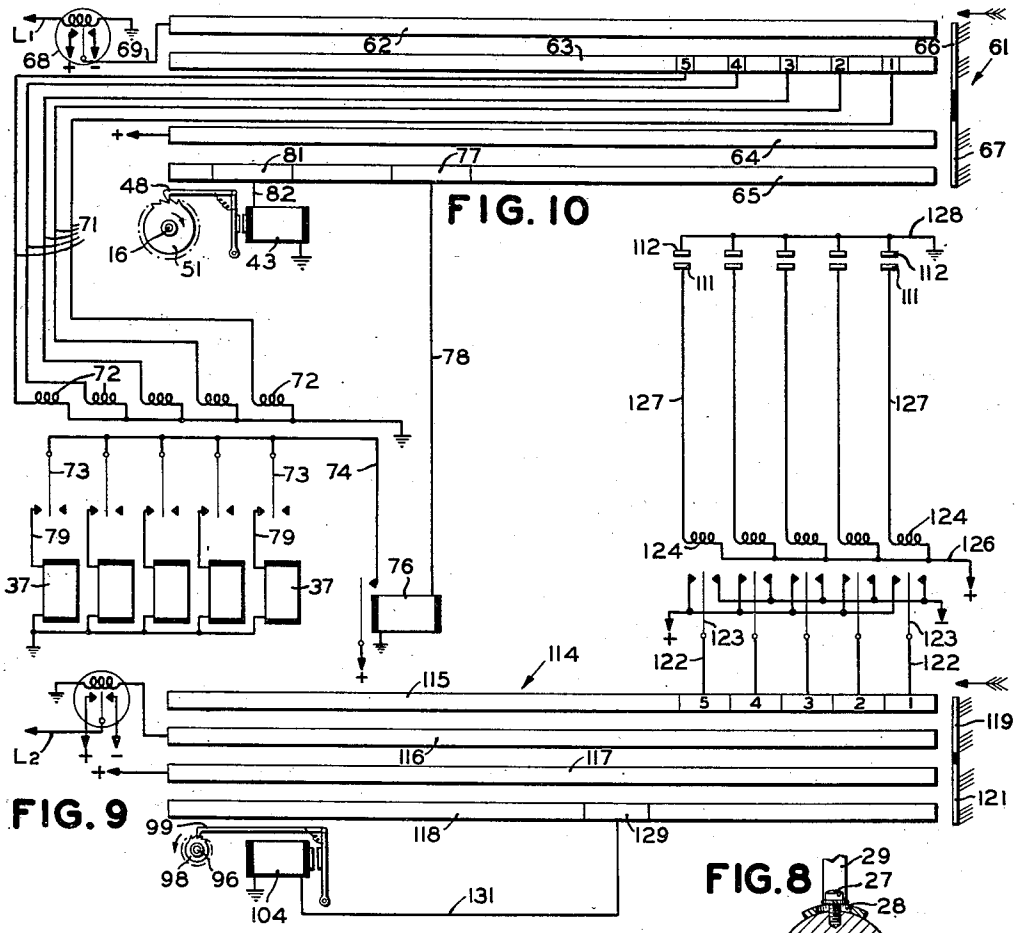


FIG. 10

FIG. 9

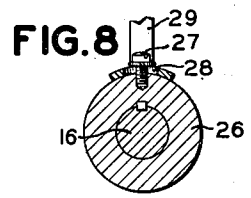


FIG. 8

FIG. 6

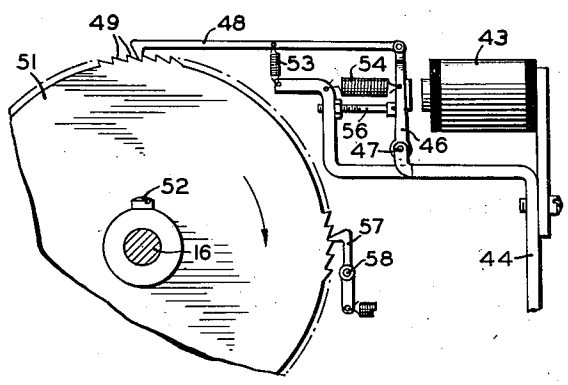
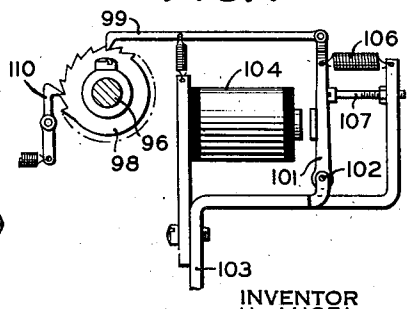


FIG. 7



INVENTOR
H. ANGEL

BY M.R. Marsh

ATTORNEY

Patented Feb. 17, 1942

2,273,083

UNITED STATES PATENT OFFICE

2,273,083

TELEGRAPH STORAGE TRANSMITTER

Herbert Angel, Brooklyn, N. Y., assignor to The Western Union Telegraph Company, New York, N. Y., a corporation of New York

Application August 17, 1940, Serial No. 353,011

10 Claims. (Cl. 178—17.5)

This invention relates primarily to apparatus for storing and retransmitting telegraph signals and more particularly to apparatus for positioning groups of small movable mechanical elements in permuted settings in accordance with received code groups of signals and subsequently retransmitting signals representing the settings of the mechanical elements, the mechanical elements being arranged for use over and over again.

In many types of telegraph services it is often desirable to store received signals for a time and subsequently transmit them to an outgoing circuit. An example of the above is where signals are received over one channel of communication, such as over a simplex tie line, at no definite speed to be subsequently retransmitted over a multiplex channel. As the simplex tie line is usually associated with a single patron or branch office and is of such short length that lost line time is of small importance relative to lost time on a multiplex channel which may be of considerable length, it is often desirable to store the signals received over the simplex tie line so that subsequent transmission thereof over the multiplex circuit may be effected at a much higher rate of speed or at the maximum speed of the multiplex circuit. With such an arrangement the multiplex channel will not necessarily be tied up during the receipt and storage of signals over the simplex line, it being free to be used for the transmission of other signals during such time, and when the stored signals are eventually transmitted over the multiplex channel it may be done at the maximum capacity thereof.

Heretofore storage of the signals in such instances was generally accomplished by the use of tape which was perforated in accordance with received signals and subsequently run through a transmitter to control and send the signals over the multiplex channel. However, such an arrangement has disadvantages in that it requires extensive and expensive equipment, such as a reperforator for perforating the tape in accordance with the received signals, a tape transmitter, and a tape which may be used but once. to overcome these disadvantages it has been proposed heretofore to employ mechanical storage transmitters wherein mechanical elements were positioned in accordance with received signals and subsequently employed to control the transmission of corresponding signals. These storage units, while eliminating some of the disadvantages of tape storage, were extremely complicated, expensive to manufacture and maintain, noisy in operation and had limited storage capacity.

In view of the above, it is one of the primary objects of the present invention to provide a mechanical or metallic storage transmitter that is easily and cheaply manufactured and maintained, has few and easily effected adjustments, reliable and quiet in operation and has a reasonable storage capacity.

Another object of the invention resides in the ease with which it is adapted to store signal groups comprising different numbers of signaling impulses, such as five or six unit code groups.

In general the invention comprises sets of stationary discs through which extends a rotatable shaft with independently movable setting members thereon for selectively positioning small mechanical elements or selecting pins carried adjacent the peripheries of the discs. The mechanical elements are slidable in a direction parallel to the axis thereof and a mechanical element in each disc is selectively positioned to represent an impulse of each code group. If the signaling code has five units or signaling impulses there will be five groups or sets of mechanical elements with an element of each group being positioned to represent corresponding ones of the signaling impulses. A transmitting mechanism operating independently of the selectively positioning or setting up of the mechanical elements controls the transmission of signals representing the positions of the mechanical elements. In this manner the mechanical elements are positioned to represent received code signals and subsequently control the transmission of corresponding signals, and following the transmission of a group of signals the mechanical elements are reset and capable of being positioned to represent another signal.

A more thorough and complete understanding of the operation and scope of the invention may be had from the following detailed description when taken in conjunction with the accompanying drawings, in the latter of which:

Fig. 1 is a plan view showing the principles of the invention and the arrangement of the various units thereof;

Fig. 2 is a fragmentary sectional view taken substantially on line 2—2 of Fig. 1, showing principally the mechanism for selectively setting the mechanical elements or selecting pins;

Fig. 3 is a fragmentary sectional view taken substantially on line 3—3 of Fig. 1, showing one of the transmitting elements as controlled by the mechanical elements;

Fig. 4 is an enlarged fragmentary sectional view showing the arrangement of one of the mechanical elements and the positioning member therefor;

Fig. 5 is a fragmentary sectional view taken substantially on line 5—5 of Fig. 2;

Fig. 6 is a fragmentary sectional view taken substantially on line 6—6 of Fig. 1, showing the setting up stepping mechanism;

Fig. 7 is a fragmentary sectional view taken substantially on line 7—7 of Fig. 1, showing the stepping apparatus for the transmitting mechanism;

Fig. 8 is a fragmentary sectional view taken substantially on line 8—8 of Fig. 2;

Fig. 9 is a schematic diagram of the transmitting circuits and associated elements; and

Fig. 10 is a schematic diagram showing the elements and circuits for the setting up apparatus.

Referring first to Fig. 1, a plan view of the invention is shown adapted to operate for use in storing signals having five variable impulses. In the arrangement shown there are two double storage units and one single storage unit, a unit as hereinafter pointed out comprising a set of mechanical elements or selecting pins with mechanisms for moving the same from normal to operated positions in accordance with a signaling impulse and for subsequently controlling the transmission of a representative impulse of one line condition or another in accordance with the position of the mechanical element. In the invention all the storage units are substantially similar and comprise similar parts, and in the following description where the operation and arrangement of the elements of a single storage unit is described, the description thereof applies equally well to all of the storage units. The storage units are so controlled, as hereinafter pointed out in detail, that one unit, such as the first, stores all the first signaling impulses of the code groups, the second storage unit all the second signaling impulses of the code groups, etc., for the five storage units. As shown and described in the following paragraphs, the invention is arranged to store signal groups composed of five units or impulses and as will be obvious, by changing the number of storage units, such as increasing the number to six, six unit code groups could be stored.

In the drawings, and particularly in Figs. 1 and 2, reference numeral 11 indicates a base plate upon which the various elements of the invention are located. Fixed to the base 11 are bearing posts 12 which, together with bushing clamping members 13, support and clamp a plurality of bushings such as 14 in fixed position. The bushings 14 have a shaft 16 journaled therein, adapted to rotate in a manner hereinafter pointed out. Fixed to opposite sides of each bearing post 12 and clamping member 13 by screws, such as 17, are two circular discs 18 and 19, and arranged around the discs 18 and 19 adjacent the periphery thereof are rings of holes 20. The disc 19 has one ring of holes therein at a fixed radius, and the disc 18 has two rings of holes therein. Extending through the holes in the discs 18 and 19 are the movable mechanical elements or selecting pins 21 which are positioned as hereinafter described into one of the other of two positions to represent receive signals. The selecting pins 21 are preferably constructed of spring wire and have one or more complete turns adjacent the center with the free ends extending substantially parallel, such as the construction of a safety pin. In fact, it has been found that safety pins with the head and point removed or cut off work very satisfactorily as the selecting pins. Referring to Fig. 4, which shows a selecting pin 21 at an enlarged scale, it will be noted that the two arms 22 and 23 thereof are of different length. The arms of the selecting pins 21 extending through the holes in the discs 18 and 19 form a ring with the arms substantially parallel with the shaft 16. The longer arm 22 of the selecting pins 21 extends through both discs 18 and 19, whereas the shorter arm 23 extends only through the disc 18. The tendency of the arms 22 and 23 of the selecting pins 21 to open or spread apart prevents free movement thereof in the discs 18 and 19 and provides the biasing effect for retaining them in either one or the other of their two positions. In Fig. 4 the selecting pin 21 is shown in its normal unselected position by the full lines thereof, and in its selected position by the dot-dash outline. The manner of selectively operating or moving a selecting pin from its normal to its selected position and the resetting thereof back to its normal position will be pointed out hereinafter.

Mounted on the shaft 16 for rotation therewith by means of keys 24 are collars 26. The collars 26 are movable along the axis of the shaft within predetermined limits, as pointed out hereinafter, but by means of the keys 24 invariably rotate with the shaft 16. Adjustably attached to the collars 26 by screws 27, Fig. 8, extending through slots such as 28 are arms 29. The arms 29, hereinafter referred to as the setting-up arms, extend radially from the collars 26 and have projections 31, Figs. 1, 2 and 4, at the free ends thereof which extend axially of the shaft 16. The projections 31 are in operative relation with the left hand end, as shown in Fig. 4, of an associated set of selecting pins 21 and serve to move the pins from their normal to their selected or operated position in accordance with representative signaling impulses. Formed in the collars 26 are circular grooves 32, and rollers 33 carried in the upper ends of forked or bifurcated arms 34 of bell cranks 35 engage radial surfaces of the grooves 32 to move the collars 26 back and forth along the shaft 16. The bell cranks 35 of which the arms 34 form a part have horizontally extending arms 36 which serve as armatures for associated selecting magnets 37 in operative relation therewith. The bell cranks 35 are pivotally mounted on pins such as 38 supported by brackets 39 attached to the base 11. Springs 41, attached to the arms 34 of the bell cranks 35 and to the brackets 39, normally hold the bell cranks 35 in their retracted position against associated stops 42. With the bell cranks 35 in their retracted position the projections 31 at the ends of the setting-up arms 29 are clear or a little to the left, as shown in Fig. 4, of associated sets of selecting pins 21.

The setting-up arms 29 are adjusted by means of the screws 27 relative to the collars 26 so that with the shaft 16 at rest in a normal stop position each of the projections 31 are in alignment with a selecting pin 21 in an associated storage unit. Therefore, when the selecting magnets 37 are selectively operated in accordance with a received code group, operating impulses being distributed thereto by a distributor hereinafter described, the energized ones of the magnets 37 cause associated collars 26 to move toward as-

sociated discs 18, and in so doing the projections 31 on the setting-up arms 29 slide associated selecting pins 21 to operated positions. The ends of the arms 23 of the selecting pins 21 coming into engagement with the discs 19 limit the movement thereof to an operated position, and in such an operated position the ends of the arms 22 extend an appreciable amount beyond the outside face of the discs 19. Thus, a set of selecting pins 21, one in each of the storage units, are set in operated positions or remain in their normal positions in accordance with a received code group. The selecting pins 21, associated with the selecting magnets 37, that are not energized obviously remain in their normal unoperated positions.

After setting a set of selecting pins 21, one in each storage unit, in accordance with one received code group of impulses, the shaft 16 is stepped to bring the projections 31 opposite the next set of selecting pins. The stepping of the shaft 16 is performed preferably by a stepping magnet 43, Fig. 6, horizontally mounted from a bracket 44 extending from the base 11. The magnet 43 has associated therewith an armature lever 46 pivotally mounted on a pin 47 in the bracket 44 which carries on its upper end an operating pawl 48. The pawl 48 cooperates with teeth 49 on a ratchet wheel or disc 51 which is attached by a set screw 52 to the shaft 16 for rotation therewith. A spring 53 holds the pawl 48 in engagement with the teeth 49, while another spring 54 moves the armature lever 46 and pawl 48 to their normal retracted positions on the deenergization of the magnet 43. An adjustable stop screw 56 determines the retracted position of the armature lever 46 and its attached pawl 48. A spring biased retaining pawl 57 pivoted at 58 also cooperates with the teeth 49 of the disc 51 to prevent rotation of the disc and shaft 16 in a reverse direction as the pawl 48 moves to pick up another tooth. The movement of the armature lever 46 is limited by the back stop 56 so that on the energization of the magnet 43 the disc 51 will be rotated an amount equal to the distance between two consecutive teeth on the periphery thereof. As the teeth 49 on the disc 51 are equal in number to the number of selecting pins in the holes in the discs 18 and 19, each time the disc 51 is stepped one tooth the setting-up arms 29 move into operative relation with or opposite the next selecting pin 21. The magnet 43 is energized as hereinafter pointed out in conjunction with each operation of the magnets 37, and accordingly the setting-up arms 29 are successively moved into operative relation with successive ones of the selecting pins 21. Thus, the selecting pins 21 of each storage unit are operated from their normal to their operated positions or remain in their normal positions in accordance with received groups of code impulses and consecutive selecting pins or elements in a storage unit represent, according to their position, corresponding impulses of succeeding code groups.

The manner in which the position of the selecting pins 21 control the transmission of representative groups of impulses and the distributing of operating impulses to the magnets 37 and 43 will hereinafter be described.

In distributing the operating impulses to the selecting pin operating magnets 37 and timing the operation of the shaft stepping magnet 43 a distributor of the type known in the art as a multiplex distributor is employed. Although the invention is shown and hereinafter described as operating in conjunction with multiplex signals, it will be obvious that by changes apparent to those skilled in the art the invention could readily be employed to operate in response to start-stop or simplex type signals and when operating in response to these simplex type signals the start and rest impulses would not necessarily have a storage unit as these impulses are of uniform character for each code group. In Fig. 10 the multiplex distributor is indicated in general by reference numeral 61 and comprises four rings 62 to 65 with a set of two brushes 66 and 67. The direction of movement of the brushes 66 and 67 is from right to left as indicated by the arrow, and the brush 66 bridges the solid ring 62 with the segmented ring 63 while the brush 67 bridges the solid ring 64 with the segmented ring 65. Code groups of signals received over the line L1 operate the tongue of a line relay 68 in accordance therewith and apply over a conductor 69 corresponding positive and negative impulses to the solid ring 62. The brushes 66 and 67 rotate in timed relation with the received code groups and the brush 66 contacts the segments numbered 1 to 5 of ring 63 while potential in accordance with the successive impulses of each code group is applied to the solid ring 62. The segments numbered 1 to 5 of the ring 63 are connected by individual conductors such as 71 to one side of the coils of individual relays such as 72, the other sides of which are grounded. Each of the relays 72 has a tongue 73, and all the tongues are connected in parallel by a conductor 74 to the make stop of a relay 76. Depending upon the polarity of the potential on the solid ring 62 at the time the brush contacts the segments numbered 1 to 5 of the ring 63, the tongues 73 of the relays 72 are operated to either their left or right hand stops and accordingly the positions of the tongues 73 to one stop or the other represent a received code group of impulses. Following the operation of the relays 72 the brush 67 contacts a segment 77 of the ring 65 and applies potential from the solid ring 64 over a conductor 78 to operate the relay 76. A tongue of the relay 76 has potential applied thereto and engagement thereof with its front stop applies potential over the conductor 74 to the tongues 73 of relays 72. The left hand stops associated with the tongues 73 of relays 72 are connected by individual conductors such as 79 through the coils of the selecting magnets 37 to ground. Accordingly, the magnets 37 associated with the tongues 73 on their left hand stops will be energized when the relay 76 is operated to apply potential to the tongues 73. The magnets 37 associated with the tongues 73 on their right hand stops will obviously not be operated on the energization of relay 76, as the circuits thereto are open at the tongues 73. Accordingly, the magnets 37 are operated in a combination representative of the received code group.

Shortly after the brush 67 passes from segment 77, it contacts a segment 81 of the ring 65 to apply potential over a conductor 82 to the grounded stepping magnet 43. This causes operation of the magnet 43 and, as hereinbefore pointed out, the stepping or movement of the setting up arms 29 into operative relation with the next set of selecting pins 21. Thus, the setting up arms 29 are positioned opposite a new or succeeding set of selecting pins 21 to be operated in accordance with the next received code group of impulses.

A cutout arrangement such as those well-

known in the art may be employed to open the circuit supplying potential to the solid ring 64 or the magnet 43 and relay 76 when no intelligence signals are being received over the line L1 to prevent the stepping of the setting up arms 29 during idle periods of the line L1. Such cutout arrangements are well-known in the art, and as they form no part of the present invention the addition of circuits disclosing this feature would unnecessarily complicate the drawings, and they are therefore omitted.

The manner in which a signal group of impulses representing the position or setting of a set of the selecting pins 21 is transmitted to a sending line and the elements for accomplishing this will now be described. In the double storage unit shown in section in Fig. 2 a sleeve member 83 is loosely mounted on the shaft 16 with the ends thereof in abutting relation with the bushings 14. The sleeve 83 being loosely mounted on the shaft 16 permits the shaft and the sleeve to rotate independently of each other. The sleeve has adjacent its right hand end a flange, and clamped against the flange by a nut 84 in threaded engagement with the threaded left hand end of the sleeve are two discs 86 and 87, together with three slip rings 88. The slip rings 88 are insulatively supported from one another, the discs 86 and 87 and the sleeve 83 by insulating elements or rings 89. Associated with each of the slip rings 88 are individual brushes such as 91, Fig. 5, supported from the base 11 by a bracket member 92.

The disc 86 has formed in the periphery thereof teeth adapted to engage the teeth on a gear 94, Fig. 1, fixed for rotation therewith to a shaft 96. The shaft 96 is journaled in brackets such as 97 supported from the base 11. Also fixed to the shaft 96 is a ratchet wheel 98, and cooperating with the teeth of the ratchet wheel 98 is an operating pawl 99, Fig. 7. The operating pawl 99 is pivotally carried at the upper end of an armature 101 which is pivoted at its lower end on a pin 102 carried in a bracket member 103 supported from the base 11. Associated with the armature lever 101 is a magnet 104 which upon energization thereof operates the pawl 99 to step the ratchet wheel 98 a distance of one tooth. Upon deenergization of the magnet 104 a retractile spring 106 returns the armature lever 101 and pawl 99 to their retracted positions as limited by an adjustable stop 107. A spring biased retaining pawl 110 cooperates with the teeth of the ratchet wheel 98 to prevent rotation thereof in a reverse direction on the back stroke of the pawl 99 or during rotation of the shaft 16. The number of the teeth on the ratchet wheel 98 and the size of the gear 94 meshing with teeth on the disc 96, Fig. 1, are such that the sleeve 83 on the shaft 16 with its attached elements is rotated or stepped an amount equal to the distance between two successive selecting pins 21 in the associated storage units on each operation of the stepping magnet 104. The magnet 104 is energized in conjunction with the transmission of each code group in a manner hereinafter pointed out, and other gears similar to 94 fixed to the shaft 96 engage discs such as 86 associated with the other double storage unit and the single storage unit to rotate associated transmitting equipment one step in conjunction with each energization of the magnet 104. Thus, the transmitting elements of each storage unit rotate in synchronism with one another.

Extending axially from the disc 86, Fig. 3, is a pin 105 upon which is pivoted a lever 108. A spring 109 fixed to the lever 108 tends to pivot the same in a clockwise direction to bring an insulatively supported contact 111 thereon into engagement with a fixed contacting element 112 insulatively supported on a pin 113 extending axially from the disc 86. The free end of the lever 108 cooperates with the ends of the arms 22 of the selecting pins 21 to hold the contacting elements 111 and 112 apart when one of the pins is in its operated position, as with a pin 21 in its operated position the end of the arm 22 thereof extends beyond the side of the disc 19 and is engageable with the free end of the arm 108. With the end of the lever 108 opposite the end of the arm 22 of a selecting pin 21 in its normal unoperated position the spring 109 is allowed to pivot the lever 108 so as to close the contacting elements 111 and 112. The position of the lever 108 when prevented from pivoting to close the contact elements is shown by the full outline thereof in Fig. 3 and in the dotted outline thereof in the position it assumes when not cooperating with the end of a selecting pin 21.

When the sleeve 83 is stepped the disc 86 is rotated to bring the end of the lever 108 into operative relation with the next selecting pin 21, and depending upon the position of this particular pin at this time the contacting elements 111 and 112 will be closed or opened. As the disc steps from one position to the other the end of the lever 108 moves out of operative relation with one selecting pin and into operative relation with the other. Thus, for each position of the disc 86 the contacting elements 111 and 112 asume an opened or closed position in accordance with the position of the selecting pins 21. A resetting arm 114 fixed to and rotating with the disc 86 cooperates with the ends of the selecting pins 21 at some point following the lever 108, preferably one or two pins following, to force the selected pins back into their normal unoperated positions where they are again ready to be operated by the setting-up arm 29 in accordance with another received code impulse when the setting-up arm is opposite the same. The disc 87 on the sleeve 83 has a lever similar to the lever 108 together with associated contacting elements, such as 111 and 112, which are positioned in either closed or opened condition in accordance with the positions of the pins 21 in the right hand storage unit of Fig. 2. Each of the other storage units also have contacting elements, such as 111 and 112, which are positioned in accordance with the operated or non-operated condition of the associated selecting pins, and accordingly the five sets of contacting elements are positioned in open or closed positions in accordance with the operated or unoperated positions, respectively, of a selecting pin in each of the storage units.

One of the three brushes 91 of a double storage unit, such as the one shown in Fig. 2, is connected through one of the slip rings 88 to both of the stationary contacting elements, such as 112, while the other two brushes 91 are individually connected to the movable contacting elements 111, and by means of the slip rings 88 and brushes 91 circuits from the contacts are conducted to a transmitting distributor.

In Fig. 9 the transmitting distributor is indicated in general by reference numeral 114 and comprises rings 115 to 118. A brush 119 is adapted to travel from right to left and cooperates with

the rings 115 and 116 to bridge the same, while a similar brush 121 rotating therewith bridges the rings 117 and 118. The ring 116 is connected to a sending line L2, while segments numbered 1 to 5 of the associated ring 115 are connected by individual conductors 122 to the tongues 123 of individual relays 124. One side of each of the coils of the relays 124 is connected in parallel by a conductor 126 to battery, while the other sides of the coils are connected by individual conductors 127 to one of the contacting elements of a set such as 111 on the levers 108. Cooperating contacting elements 112 are connected in parallel by a conductor 128 to ground.

The selective operation of the sets of contacting elements 111 and 112 completes circuits through associated coils of relays 124 whence the same operate to move the associated tongues 123 in accordance therewith. The relays 124 are neutral, and when energized the tongues 123 move from one stop to the other, and when deenergized the tongues return to their neutral or normal position. The left and right hand stops associated with the tongues 123 are connected to positive and negative potential, respectively, and in accordance with the operation of the tongues 123 positive and negative potential is applied to the segments of the ring 115. Accordingly, as the brush 119 subsequently and successively contacts the segments numbered 1 to 5 of ring 115 and bridges the same with the solid ring 116 a code group of impulses comprising positive and negative impulses is transmitted to the sending line L2. Following the transmission of a code group of impulses the brush 121 bridges the solid ring 117 with a segment 129 of ring 118 to apply potential over a conductor 131 to the transmitting unit stepping magnet 104. This impulse causes the operation of the magnet 104 to step the ratchet wheel 98 and cause the ends of the levers 108 to move into operative relation the next set of selecting pins 21. The selecting pins in turn control the contacting elements 111 and 112 in accordance with the position thereof and control the transmission of a representative code group of impulses in the manner described in connection with the preceding revolution of the brushes 119 and 121. Thus, the positions of the selecting pins are transferred to representative impulses and distributed to a sending line L2.

Provision may be made in any one of a number of well-known ways to prevent the levers 108 from approaching too close to the setting up arms 29, such as by opening the circuit to the stepping magnet 104 when the number of pins between the setting up arms 29 and the levers 108 decreases to less than a predetermined number.

It is obvious, of course, that various modifications of the invention may be made without departing from the spirit or essential attributes thereof, and it is desired, therefore, that only such limitations be placed thereon as are imposed by the prior art or are specifically set forth in the appended claims.

What is claimed is:

1. In a signal storage telegraph device, a rotatable shaft, a plurality of arms rotatable with said shaft and movable along the axis thereof, a plurality of sets of mechanical elements arranged in rings around said shaft and having normal and operated positions, means responsive to a received signal group for selectively moving said arms in accordance therewith to move said mechanical elements in the direction of the axis of said shaft whereby groups of elements, one from each ring, are positioned into operated and normal positions to represent according to a predetermined arrangement received signal groups.

2. In a signal storage telegraph device, a rotatable shaft, a plurality of arms rotatable with said shaft and movable along the axis thereof, a plurality of mechanical elements each having normal and selected positions arranged in a plurality of rings around said shaft, an individual arm being associated with each of said rings of elements, individual electromagnetic means for moving said arms along the axis of said shaft, means for selectively operating said last mentioned means in accordance with received signal groups to selectively move said mechanical elements in the direction of the axis of said shaft from normal to operated positions in accordance with said signals, and means for rotating said shaft concomitantly with the operation of said electromagnetic means to successively bring said arms into operative relation with successive ones of said mechanical elements in a ring whereby the positions of said elements in normal and operated positions represent consecutively received signal groups.

3. In a signal storage telegraph device, a series of movable storage elements, means for longitudinally moving said storage elements in combinations of settings into one or the other of two positions to represent received signals, each of said elements comprising a piece of spring material bent back upon itself with the ends thereof of different lengths and means employing one of said ends for limiting the movement of said elements in one of said positions.

4. In a signal storage device, a series of stationary storage carrying members each with individually movable storage elements having normal and selected positions arranged in a ring therein, a rotatable shaft extending through said storage carrying members, a series of independently movable collars on said shaft with arms successively associable one at a time with the storage elements in associated rings, means for moving selected ones of said collars axially along said shaft in accordance with received signals to move storage elements associated with the arms thereof axially of said shaft to selected positions and means for rotating said shaft concomitantly with the axial movement of said collars to bring the arms thereon into operative relation with the next succeeding one of said storage elements.

5. In a signal storage device, a series of stationary storage carrying members each with individually movable storage elements having normal and selected positions arranged in a ring therein, a rotatable shaft extending through said storage carrying members, a series of independently axially movable collars on said shaft with arms successively associable one at a time with the storage elements in associated rings, means for moving selected ones of said collars axially along said shaft in accordance with received signals to move storage elements associated with the arms thereof axially of said shaft to selected positions, means for rotating said shaft concomitantly with the axial movement of said collars to bring the arms thereon into operative relation with the next succeeding one of said storage elements, signal transmitting means and means controlled by the selected positions of said storage elements in said storage members for controlling said transmitting means to transmit signals representative of said received signals.

6. In a signal storage device, a series of stationary storage carrying members each with individually movable storage elements having normal and selected positions arranged in a ring therein, a rotatable shaft extending through said storage carrying members, a series of independently axially movable collars on said shaft with arms successively associable one at a time with the storage elements in associated rings, means for moving selected ones of said collars axially along said shaft in accordance with received signals to move storage elements associated with the arms thereof axially of said shaft to selected positions, means for rotating said shaft concomitantly with the axial movement of said collars to bring the arms thereon into operative relation with the next succeeding one of said storage elements, signal transmitting means, means controlled by the selected positions of said storage elements in said storage members for controlling said transmitting means to transmit signals representative of said received signals and means operative following the transmission of a signal group representative of the selected positions of a set of storage elements one from each of said storage carrying members for restoring selectively positioned ones of said elements to normal position.

7. In a signal storage device, a series of stationary storage carrying members each with individually movable storage elements having normal and selected positions arranged in a ring therein, a rotatable shaft extending through said storage carrying members, means for selectively moving said elements axially of said shaft in combinations to represent received signals, a plurality of circuit controlling members one associated with each of said storage carrying members and movable relative thereto to be successively brought into operative relation with succeeding ones of said storage elements, means including said storage elements in normal and selected positions for operating said circuit controlling members into opened and closed positions in accordance therewith and means controlled by said circuit controlling members for transmitting signals representative of the settings of said storage elements.

8. In a signal storage telegraph device, a rotatable shaft, a plurality of sets of individual elongated mechanical elements arranged in rings around said shaft with the elements extending in the direction of the axis of said shaft, a plurality of arms, one for each ring of said mechanical elements on said shaft and rotatable therewith to be successively brought into alignment with successive elements of associated rings, and means responsive to received groups of signal impulses for selectively moving said arms axially of said shaft to engage and move said elements from normal to selected positions whereby sets of elements, one from each ring, represent in accordance with their normal and selected positions received groups of impulses.

9. In a storage transmitter responsive to received groups of code impulses of two line conditions, a rotatable shaft, a plurality of sets of individual selecting elements arranged in rings about said shaft, one ring of elements for each code impulse of said groups, said elements being movable in the direction of the axis of said shaft, a set of arms, one for each ring of selecting elements on and rotatable with said shaft to be successively brought into alignment with successive elements of associated rings, individual electromagnetic means for moving said arms axially of said shaft to shift one element at a time of associated rings from normal to operated positions, means for distributing operating impulses to said electromagnetic means in accordance with received impulses whereby they are operated in accordance with respective line conditions of each code group, and means controlled by said selecting elements in operated and normal positions for effecting the transmission of signals representative of the setting thereof.

10. In a storage transmitter responsive to rereceived groups of code impulses of two line conditions, a rotatable shaft, a plurality of sets of individual selecting elements arranged in rings about said shaft, one ring of elements for each code impulse of said groups, said elements being movable in the direction of the axis of said shaft, a set of arms, one for each ring of selecting elements on and rotatable with said shaft to be successively brought into alignment with successive elements of associated rings, individual electromagnetic means for independently moving said arms axially of said shaft to shift one element at a time of associated rings from normal to operated positions, means for distributing operating impulses to said electromagnetic means in accordance with received impulses whereby they are operated in accordance with respective line conditions of each code group, means successively associable wtih sets of selectively operated selecting elements, a set of elements comprising one from each ring, a transmitting mechanism and means controlled by said last mentioned means for effecting the transmission of code groups of impulses representative of the setting of the sets of elements with which said means is successively associated.

HERBERT ANGEL.