March 7, 1944. P. HOLCOMB, JR 2,343,297

TELEGRAPH SYSTEM AND APPARATUS

Filed March 7, 1942 2 Sheets-Sheet 1

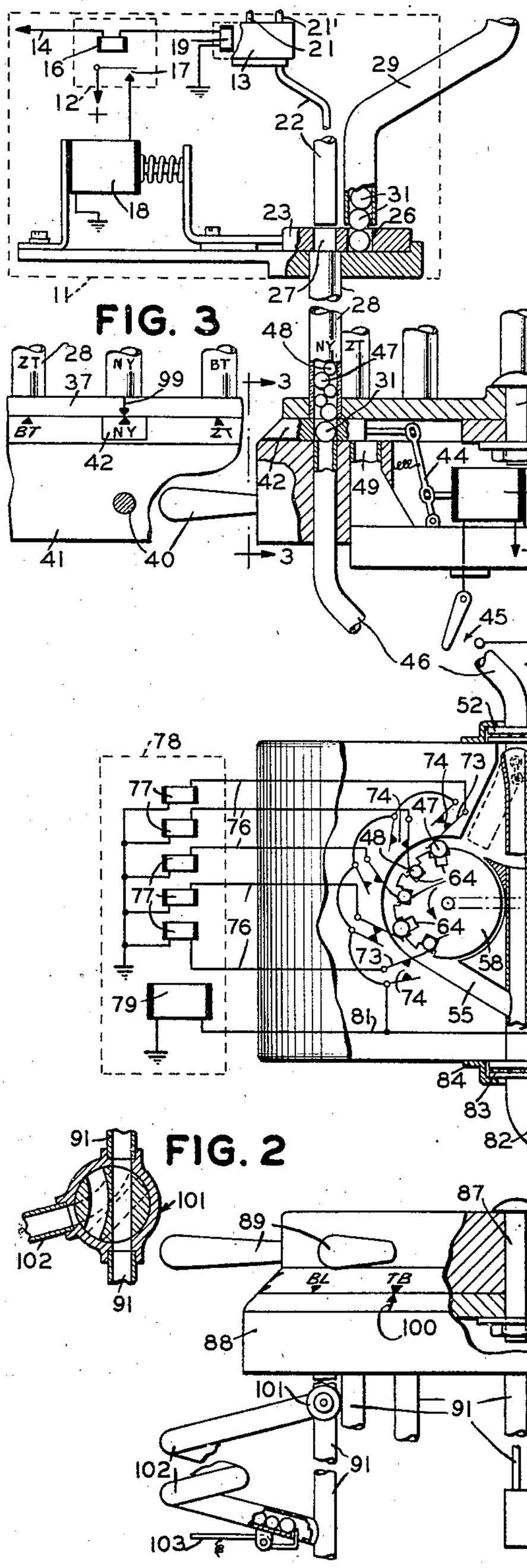

FIG. 1

FIG. 3

FIG. 2

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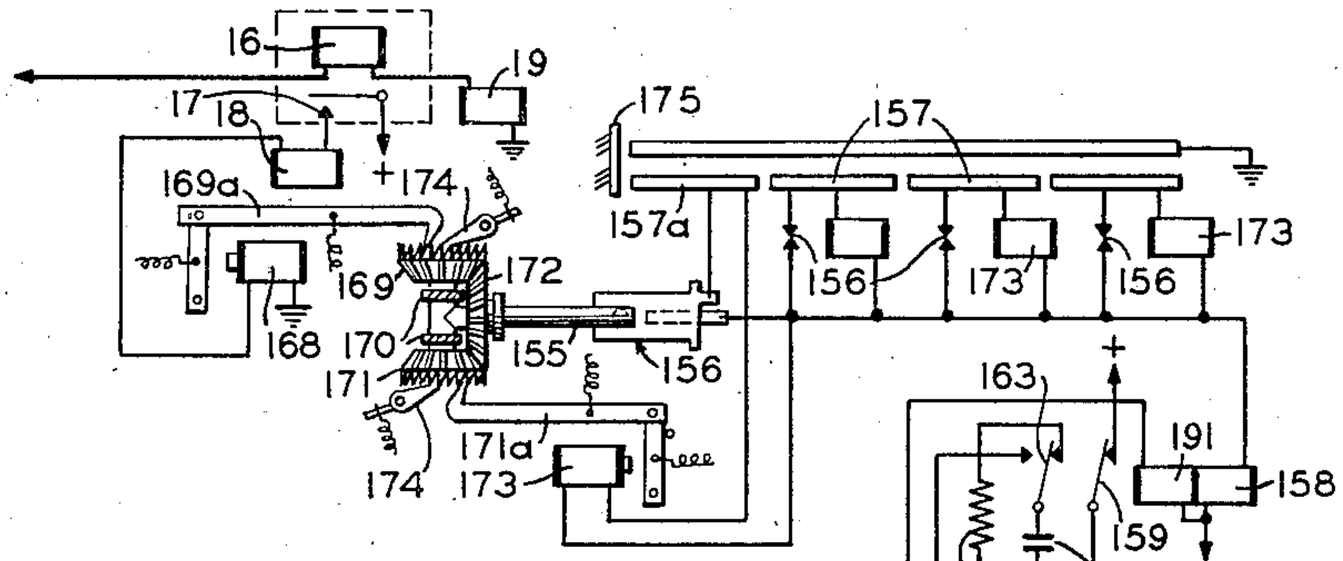


FIG. 4

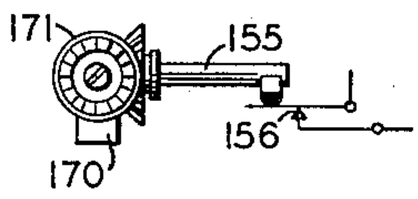
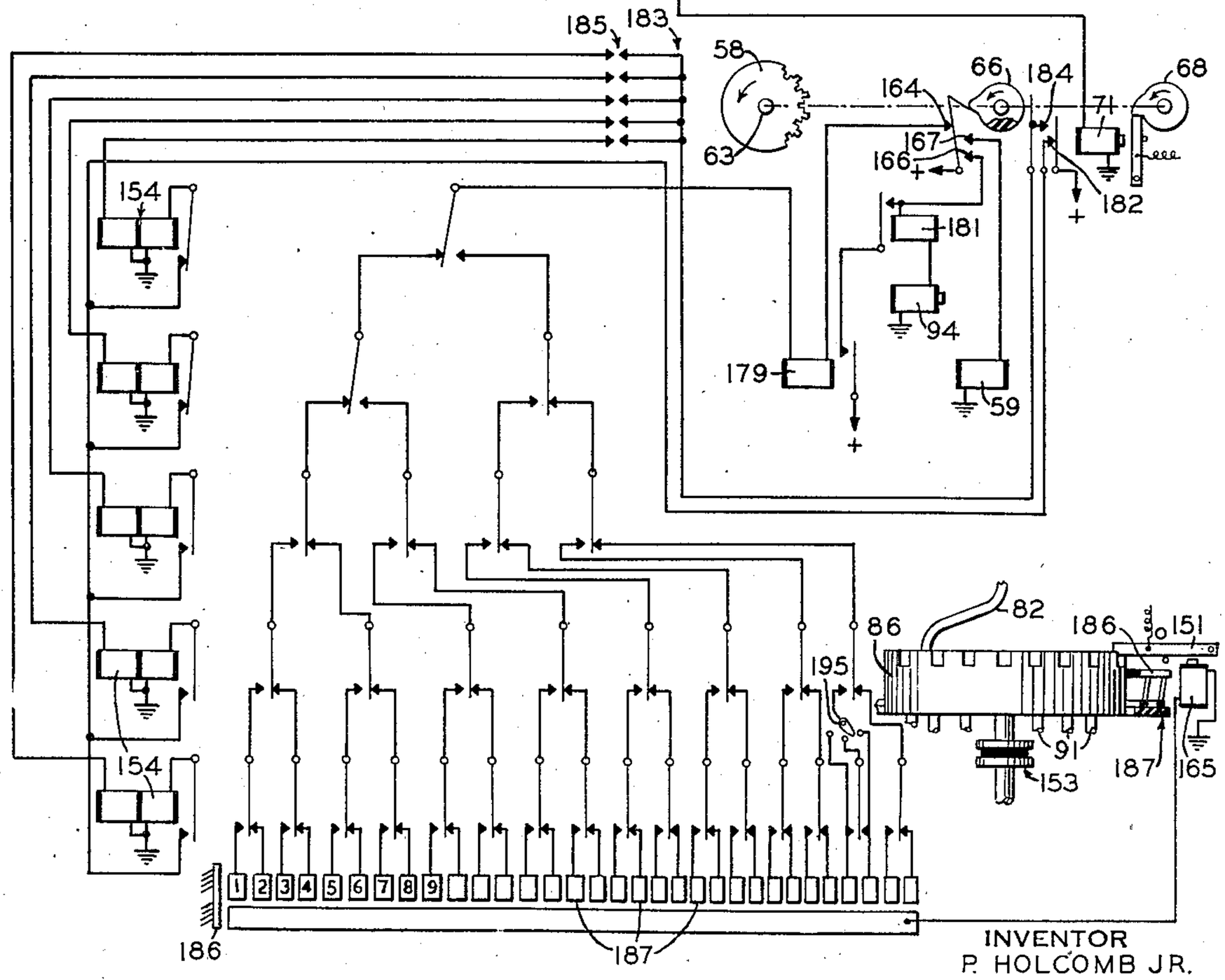


FIG. 5



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UNITED STATES PATENT OFFICE

2,343,297

TELEGRAPH SYSTEM AND APPARATUS

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Application March 7, 1942, Serial No. 433,774

27 Claims. (Cl. 178—17.5)

This invention relates primarily to telegraph systems and apparatus therefor, and more particularly to a system and apparatus which may, for example, be used for relaying signals through a central office wherein the signals may be stored for variable lengths of time.

It is impractical to establish a direct connection between incoming and outgoing channels at a telegraph central office, as the various channels may operate at different speeds or operate on different codes, and such an arrangement would require a large number of facilities which might not be warranted. Accordingly, in telegraph central offices it is necessary to provide means for receiving signals over one channel and store the same before they are routed to and then retransmitted over the proper outgoing channel.

The present invention is a continuation in part of a copending application filed July 8, 1939, Serial No. 283,334, now Patent 2,275,436, of March 10, 1942, and entitled "Telegraph system and apparatus therefor." In the above application apparatus is shown and described whereby received signals operate mechanism to align two different types of mechanical elements, such as two different sizes of balls, in storage tubes whereby the two different sizes of balls represent according to a predetermined plan the received signals. The above-mentioned application also shows means and apparatus whereby the aligned balls of the two different sizes control transmitting means to subsequently transmit to an outgoing line signals representative of the stored balls. The present invention is directed to apparatus which may cooperate with the apparatus of the above-mentioned application whereby the balls arranged in any one of a plurality of tubes may be physically transferred or conveyed to any one of a plurality of other tubes. By this apparatus a message received over any one of a plurality of incoming circuits is stored in a primary storage means or tube and thereafter transferred to a secondary storage tube to control the associated transmitting means associated with any one of a plurality of outgoing circuits.

Accordingly, it is one of the primary objects of the present invention to provide means whereby any one of a plurality of alignments of mechanical elements having different characteristics arranged to represent messages and/or other information may be conveyed to and associated with any one of a plurality of transmitting means.

In connection with the above, it is another object of the present invention to provide one mechanism which may be manually controlled to transfer the arranged mechanical elements and another mechanism which is automatically controlled.

Another object of the present invention is to provide means whereby the two different types of mechanical elements representing one message in a storage tube may be separated from the mechanical elements representing another message.

Another object of the invention is to provide means for determining which one of a plurality of secondary storage tubes a group of balls should be associated with and for depositing the balls in the desired storage tube.

A still further object of the invention is to provide means whereby one group of balls, which for example may represent an urgent message, may be associated with the transmitting means ahead of another group of balls which may represent a less urgent message.

The above and further objects of the invention will be more apparent in the following detailed description thereof when taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a diagrammatic representation of the elements comprising the present invention together with some of the electrical circuits;

Fig. 2 is an enlarged detailed sectional view showing the construction of a valve employed in the apparatus;

Fig. 3 is a sectional view taken on line 3—3 of Fig. 1;

Fig. 4 is a diagrammatic representation of the elements and control circuits of a modification of the invention; and

Fig. 5 is a side view of one of the mechanisms of Fig. 4.

Referring now to the drawings, and particularly to Fig. 1, the rectangle 11 includes the elements of a so-called receiving unit. In the preferred embodiment of the invention the receiving unit 11 includes a line selector 12, which may be of the well-known Gill type, and a ball selector 13, which may be similar to that disclosed in Figs. 5 to 8 of the above-mentioned copending application. The receiving unit is controlled in accordance with received signals which are received over an incoming line circuit 14.

The Gill selector 12 includes a magnet 16 which is connected to the line circuit and a set of contacts 17. The selector operates in response to a predetermined code group or several predetermined code groups to close the contact set 17.

The closing of the contact set 17 is effective to operate a solenoid 18 in the receiving unit, the purpose and function of which will be described hereinafter.

The ball selector 13 includes a control magnet 19 which, as fully described in the above-mentioned application, controls the ball selector in such a manner as to remove the marking and spacing balls from associated supply tubes such as 21 and 25 and deposits the same in the upper end of a storage tube 22 in accordance with the received signals. Thus, the two different sizes of balls in the storage tube 22 represent the signals received over the line circuit 14.

In accordance with the operation of the invention, an end-of-message signal is transmitted following each complete message. The end-of-message signal is effective to operate the selector 12 to close the contacts 17 which energizes the solenoid 18. The energization of the solenoid 18 draws a shuttle 23 to the left. The shuttle 23 rests upon a support 24 and has two vertical holes 26 and 27 therein. The hole 27 is normally in line with the lower end of the storage tube 22 and with the upper end of a so-called primary storage tube 28. The hole 26 in the shuttle 23 is normally positioned in a line with the discharge end of a supply tube 29, which contains therein balls 31 which are different in size from the marking and spacing balls selected by the ball selector 13. The preferred arrangement is to have the balls 31, which may be called end-of-message balls, larger than the marking and spacing balls. The movement of the shuttle 23 to the left deposits the end-of-message ball therein in the primary storage tube 28. As the shuttle 23 is operated only after the receipt of the end-of-message signal, the end-of-message balls 31 will be deposited in the primary storage tube 28 only at the end of a message. Thus, the larger balls 31 separate the message groups of balls in the primary storage tubes 28.

Other receiving units such as 32 and 33, similar to the receiving unit 11, are controlled by signals received over associated incoming circuits 34 and 36, respectively. The receiving units 32 and 33 function in the same manner as the receiving unit 11 to deposit the two different sizes of marking and spacing balls in their associated primary storage tubes 28 with each message group of balls separated by an end-of-message ball such as 31.

The lower ends of all of the primary storage tubes 28 terminate in a horizontal plate section 37 of a frame member 38 with the lower ends of the tubes arranged preferably in a circle on the plate 37. Preferably, the lower ends of the primary storage tubes 28 or the section thereof that terminates in the plate 37 are of glass or some other suitable transparent material. The reason for having the lower ends of the primary storage tubes transparent is so that an attendant may see the presence of the balls in the tube, particularly at the lower ends thereof. The length of the primary tubes 28 is such that a considerable number of balls may be held therein to represent several messages.

Pivotally attached to the underside of the plate 37 by means of a bolt 39 is a disc member 41. The disc member 41 has handles 40, by means of which the disc may be rotated relative to the plate to change the position thereof. In a radially extending groove in the upper side of the disc 41 is a shuttle 42 with a vertical hole therein of sufficient size to permit the passage therethrough of the larger end-of-message balls 31. The movement of the shuttle 42 is controlled by a solenoid 43 through a link 44, the circuit to the solenoid being controlled by a switch 45. With the solenoid 43 in its deenergized condition, the shuttle 42 is to the left, as shown in Fig. 1, with the hole therein directly beneath the lower end of a primary storage tube 28. With the shuttle in this position, the hole is also in alignment with the upper end of a tube 46 fixed to the disc for rotative movement therewith. The size of the tube 46 is such that passage of the larger end-of-message ball 31 therethrough is not permitted, and accordingly, the passage of the balls from a primary storage tube 28 into the tube 46 is prevented when an end-of-message ball 31 reaches the shuttle 42. This indicates that a complete message has passed into the tube 46.

The primary storage tubes 28 are located in a circle on the plate 37 with the bolt 39 at the center of the circle, and by rotating the disc 41 the shuttle 42 and the upper end of the tube 46 may be positioned beneath the lower discharge end of any one of the primary storage tubes at a time. With an end-of-message ball 31 in the shuttle 42 and marking and spacing balls 47 and 48, respectively, located thereabove, the removal of the end-of-message ball permits the marking and spacing balls to enter the tube 46. The end-of-message ball 31 is removed from the shuttle by energizing the solenoid 43, which moves the end-of-message ball toward the center and, when over a tube 49, permits the end-of-message ball to drop therein. The tube 49 leads to a container 51 for catching the end-of-message balls 31. The return of the shuttle 42 to its outer position opens the passageway between the upper primary storage tube 28 to the tube 46. The detailed manner of operating the solenoid 43 to control the passage of balls from the primary storage tubes 28 into the tube 46 will be pointed out hereinafter.

The lower end of the tube 46 terminates in a flange 52 on the upper end of a reading unit indicated in general by reference numeral 53. The reading unit 53 is stationary, and a bearing 54 permits the tube 46 and disc 41 to be rotated relative thereto. The reading unit consists of means whereby an operator may read a part of the message represented by a group of balls to determine its destination. The destination of a message would be indicated preferably by the first few code groups of balls and by reading the same the operator would know where to route the entire message group so that the message group could control the proper transmitting means to transmit over the desired outgoing circuit.

A tube 56 extends through the center of the reading unit 53 and has the upper end thereof positioned directly beneath the lower end of the tube 46. A section 57 of the tube 56 is arranged so that the lower part thereof may be swung a slight amount to the left. This brings the discharge end of the section 57 into operative relation with a disc 58 comprising a part of the reading unit. The upper end of the tube section 57 remains in line with the lower end of the tube 46 at all times, and the pivoting of the tube section 57 is controlled by a magnet 59 through a link 61. A switch 62 controls the energization of the magnet 59. The above-mentioned disc 58 is carried on a shaft 63 suitably journaled in the reading unit and driven through a friction clutch (not shown) from a suitable source of power. When the apparatus embodying the present in-

vention is employed in conjunction with a five-unit signaling code or the well-known Bordeaux code, the disc 58 has five stepped notches 64 in the periphery thereof. The notches 64 are arranged in approximately one-half the periphery of the disc 58 and are of such a size that a smaller spacing ball 48 is permitted to enter to substantially the full depth of a notch, while a larger marking ball 47 is permitted to enter only a part of the depth of the notch. Thus, the larger marking balls protrude an appreciable amount from the notches in the disc, while the smaller spacing balls do not.

Also positioned on the frictionally driven shaft 63 is a cam 66 which has associated therewith a set of contacts 67. A stop disc 68 on the shaft 63 controls the rotation thereof and cooperates with an armature 69 operated by a magnet 71. A switch 72 controls the energization of the magnet 71 and, when the magnet is energized, the armature 69 is operated to disengage the upper end thereof from the stop disc 68, thereby permitting the shaft 63 with its attached elements to rotate. On the deenergization of the magnet 71, the armature 69 is positioned to engage the stop disc 68 and stop the same in its normal stop position, such as that shown in the drawings. The cam 66 on the shaft 63 is arranged to momentarily close the associated contacts 67 just before the shaft reaches its rest position. In the rest position of the shaft 63 the contacts 67 are open.

In operative relation with the disc 58 are a set of five pivot arms 73, the free ends of which are adapted to sense the different sizes or types of balls in the notches 64 in the disc. When the free end of a pivot arm 73 engages a larger marking ball in a notch 64 in the disc, it contacts the ball and effects the closing of an associated set of contacts 74. The free end of an arm 73 engaging a small spacing ball in the disc permits its associated contact set 74 to be open. Each of the contact sets 74 is connected by individual conductors such as 76 to associated magnets 77 in a recording mechanism represented by the dot-dash rectangle 78. The recording mechanism 78 may be of any of the well-known five selecting magnet types and includes a print magnet 79 connected by a conductor 81 to one of the terminals of the contacts 67, the other terminal of which is connected to potential. The closing of the contacts 67 applies potential over the conductor 81 to the print magnet 79 in the recording mechanism 78 and also to one of the terminals of each of the contacts 74. If any of the contacts 74 is held closed by the presence of a marking ball in operative relation with the free end of the associated pivotable arm 73, potential from the contacts 67 is also applied to associated ones of the selecting magnets 77. Thus, the selecting magnets 77 are selectively energized in accordance with the different sizes of the group of five balls in the disc 58, and the operation of the print magnet 79 concomitantly therewith effects recording of a representative character by the recording mechanism. Accordingly, for each group of five balls removed from the tube section 57 by the disc 58, a character representative of the group of balls is recorded by the recording mechanism 78.

Secured to the underside of the reading unit 53 is the upper end of a tube 82 which has a flange 83 carried in a bracket 84. The upper end of the tube 82 is pivotable relative to the reading unit 53, and the lower end thereof terminates in a disc 86 pivotally mounted on a bolt 87 extending from the center of a stationary circular plate 88 secured to the frame 38 and forming a part thereof. The disc 86, which is circular, may be rotated on the plate 88 by means of radially extending handles such as 89.

The lower end of the tube 82 extends through the plate 86 and is flush with the bottom side thereof. Arranged around a circle and extending up through the plate 88 with the upper ends thereof flush with the upper side of the plate are a series of secondary storage tubes 91. The upper ends of the storage tubes 91 are the same radial distance from the center of the plate 88 as is the lower end of the tube 82, and accordingly by rotating the disc 89 which has therein the lower end of the tube 82, the said lower end may be lined up with the upper end of any one of the secondary storage tubes 91. In the preferred embodiment, the secondary storage tubes 91 are of sufficient length to store balls representing several messages. The tube 91 terminates in so-called transmitting devices which are operative to remove the balls stored in the tubes 91 and transmit representative signals. Such transmitting mechanisms are represented by the rectangles 92 and have outgoing circuits such as 93 associated therewith. The transmitting devices 92 may be of the type disclosed in the above-mentioned copending application and shown in Figs. 9 to 15 thereof. Mounted on the plate 86 so as to be rotatable therewith is a magnet 94 which on energization thereof through its armature 96 is effective to insert a pin 97 in the tube 82 adjacent the lower end thereof. With the pin 97 in the tube, the passage of balls from the tube is prevented, and the operation of magnet 94 permits the disc 86 to be rotated to any desired position without depositing balls in the tubes over which it may pass. The energization of the magnet 94 is controlled from a switch 98. The detailed manner in which an operator controls the above-described mechanisms to transfer a group of balls representing a message from a primary storage tube 28 to the desired secondary storage tube 91 will now be described.

Let it be assumed that a message group of balls has passed through the device, and the large end-of-message ball is in the shuttle 42, and that one or more other message groups of balls are in one or more of the other primary storage tubes 28 waiting to be transferred to their proper secondary storage tube 91. The operator is aware of the balls in the primary storage tubes 28, as they may be seen through the transparent lower section thereof. The first operation for the operator is to close the switch 45 which moves the shuttle 42 toward the center of the disc and places a solid section of the shuttle beneath the lower end of the primary storage tube 28 with which it was last associated and deposits the larger end-of-message ball 31 that was in the shuttle in the container 51. With the shuttle 42 in its operated position, none of the primary storage tubes can be connected or a passageway completed from any of the primary storage tubes to the tube 46. The operator then rotates the disc 41 to bring the upper end of the tube 46 beneath the desired primary storage tube 28. Preferably, each primary storage tube has a designation such as BT, NC, ZT, etc. thereon, and similar designations are inscribed on the disc 41. These designations inscribed on the disc 41 are so arranged that, when the upper end of the tube 46 is associated with a particular primary storage tube,

the corresponding designation on the disc 41 will be associated with an indicating mark such as an arrow 99, Fig. 3, on the plate 37. Thus, the operator can tell when the tube 46 is correctly positioned beneath the desired one of the primary storage tubes 28.

The next operation is the closing of the switch 98, which blocks the passage of the lower end of the tube 82 and is followed by the closing of the switch 62, which swings the discharged section of the tube section 57 to the left and into operative relation with the periphery of the disc 58.

The operator then opens the switch 45 which is effective to permit the return of the shuttle 42 to its outer position and thereby establishing a passageway between a primary storage tube 28 and the tube 46 located therebeneath. The balls thereupon enter the tube 46 and pass therethrough to the tube section 57 where the first one encounters the solid portion of the disc 58 and is stopped thereat. The operator then closes the switch 72 to energize the magnet 71 and effect release of the shaft 63, which rotates, and the disc 58 rotating therewith during the first revolution thereof removes the first five balls, or a code group of balls, from the lower end of the tube section 57. While the code group of balls and the disc 58 are in operative relation with associated pivotable members 73, the cam 66 momentarily closes the contacts 67 to apply potential through the print or recording magnet 79 in the printing mechanism and also the ones of the selecting magnets 77 whose associated pivotable arms 73 are associated with the larger marking balls.

The recording mechanism 78 records a character represented by the first group of balls removed from the tube section 57 and continues to record characters represented by other groups of balls removed from the tube section as long as the magnet 71 remains energized to permit rotation of the shaft 63. After a sufficient number of characters have been recorded by the recording mechanism 78 to enable the operator to determine the destination of the accompanying message group of balls, the first few characters being employed to determine the destination of the message, the operator opens the switch 72 to stop the shaft 63 from rotating and, while the disc 58 is making its last revolution, the operator opens the switch 62. During the last revolution of the disc 58, the last group of balls removed from the tube section 57 is deposited in the tube 55 which joins the tube 56 adjacent the lower end thereof. Thus, the groups of balls which were read or associated with the disc 58 are deposited in the tube 56 in the same order in which they are removed from the tube section 57, and before the disc 58 can rotate to remove another group of balls from the tube section 57 the latter is swung to the right and the balls therein will pass down through the tube 56, following the balls deposited therein from the disc 58.

As the switches 62 and 72 must be operated in definite timed relation to one another, an interlocking means which properly times the operation thereof may be employed. The operator reading the destination of the message represented by the group of balls, the first part of which is in the tubes 82, 56 and 46, then rotates the disc 86 to bring the lower end of the tube 82 over the proper secondary storage tube 91. The proper location of the disc 86 is facilitated by the employment of indications such as BL, TB, MR, etc. on the movable disc which cooperate with an indicating mark or arrow 100 on the stationary disc 88. Thus, when the proper indication on the disc 86 is associated with the indicating arrow 100, the lower end of the tube 86 is associated with the upper end of the corresponding secondary storage tube 91. When the disc 86 is properly positioned, the operator opens the switch 98 which controls the magnet 94 to permit the passage of the balls to the proper secondary storage tube 91. Only a single message group of balls is permitted to pass through the mechanism at a time, as the large end-of-message balls 31 placed in the primary storage tube 28 at the end of a message prevent passage of balls representing a second message through the mechanism until after the end-of-message ball has been removed. Thus, a message group of balls from any one of the primary storage tubes 28 may be passed through the mechanism and deposited in any one of the plurality of secondary storage tubes 91, and as the passage of the balls through the mechanism requires but a short interval of time, the mechanism is capable of serving a plurality of primary and secondary storage tubes.

In telegraph practice certain types of messages have preference to a circuit over other types of messages, and the mechanism provides means whereby a group of balls representing a preferred message may be associated with the transmitting device before a group of balls representing a deferred message, even though the group of balls representing the deferred message may be deposited in a storage means such as the primary storage tube 28 ahead of the group of balls representing the preferred message. The reading unit 53 in conjunction with the printing mechanism 78 indicates when the beginning of a deferred message is in the mechanism, and if a deferred message is followed by a preferred message, the operator before opening the switch 98 operates a valve 101, Figs. 1 and 2, to complete a passageway adjacent from the upper end of the secondary storage tube 91 to a deferred tube 102. Accordingly, when the pin 97 is subsequently removed from the lower end of the tube 82, the balls will pass into the deferred storage tube 102 associated with the particular secondary storage tube 91 and be held therein by a stop 103 adjacent the lower end thereof. The stop 103 consists of a pin adapted to enter the deferred secondary storage tube 102 to prevent the passage of the balls therethrough and from re-entering the secondary storage tube 91. When the entire message representing a deferred message is stored in the deferred storage tube 102, the valve 101 is operated to establish a direct passageway between two sections of the secondary storage tube 91 such as shown in Fig. 2. The operation of the mechanism as described above then permits the group of balls representing the preferred message to be associated with the transmitting device such as 92 ahead of the group of balls representing the deferred message in the deferred storage tube 102. A deferred storage tube 102 with its associated elements may be associated with each one of the secondary storage tubes 91 to enable the storage of a deferred message.

As the magnets 43 and 94 are on rotatable elements and the control means therefor preferably stationary, suitable commutator means may be provided, and all the controls of the complete mechanism brought out to a single control panel. Also, the switches may be interlocked to prevent

the improper sequence of operation thereof by any of a number of well-known means.

In the heretofore described arrangement the ball transferring device was manually operated. Without substantially changing the mechanisms, automatic reading and transferring may be employed in the manner hereinafter described. The automatic arrangement shown in Fig. 4 employs differential devices to indicate the number of large end-of-message balls in each primary storage tube 28, together with a contact device which is added to the ejector shuttle to indicate the arrival of end-of-message balls at the distributor. Brush arms 175 and 186 are added to the upper and lower discs, respectively, and their brushes move over fixed outside rings. The developed form of the commutators and brushes is shown in Fig. 4. Notches cut in discs 41 and 86 permit the stop magnet armatures 150 and 151 to arrest rotation at points when tubes 46 and 82 are correctly aligned with the primary and secondary storage tubes 28 and 91. The upper and lower discs are rotated independently of one another by suitable means such as friction clutches indicated generally by reference numerals 152 and 153, respectively. Added contacts are provided for cam 66 and relays 154 with multiple contacts connected in the well-known Tree circuit replace the selecting magnets 77 of the printer 78 in Fig. 1. Three additional relays are added, the function of which will hereinafter be described.

Let it be assumed that the system is clear of traffic and that all primary and secondary storage tubes 28 and 91 respectively are empty. At this time the T bars 155 of the differential storage indicators, of which there is one for each primary storage tube 28, are in the positions shown, and their associated contacts 156 closed. All segments 157 receive direct battery through contacts 156 and the right hand or high current coil of relay 158. Since segments 157 are substantially continuous, contacts 159 of relay 158 remain closed, and battery is applied through said contacts to the upper disc stop magnet 160 and the shuttle magnet 43. The operation of the armature 150 of the stop magnet 160 withdraws it from a notch 150*a* in the upper disc 41 and permits the upper disc to rotate. The operation of the shuttle magnet 43 presents a plane surface to the primary storage tube 28.

With relay 158 energized, a condenser 161 connected to a tongue 163 thereof is in a discharged condition, it being discharged through a resistance 162 and the make stop. Cam 66 and stop arm 68 and reading wheel or disc 58 will be in the position shown in Fig. 2. The armatures of the code relays 154 are locked in the positions of the previous selection, and current passes from cam contact 164 through the Tree circuit of relays 154 through the segment 187 corresponding to the previous setting of tube 82 through the stop magnet 165 to ground. As contacts 166 and 167 are open, the magnet 59 for operating the diversion tube 57, Fig. 1, and the magnet 94 of exit valve pin 97 are deenergized.

Now let it be assumed that the traffic signals begin to appear on one of the circuits, causing the operation of the magnet 19 of its ball selector and magnet 16 of its Gill type selector. Because the Gill type selector does not receive an operating combination in the course of an ordinary message its contacts 17 remain open. Marking and spacing balls, however, are selected and pour into the primary storage tube 28 and collect above the rotating upper disc 41. When the distant operator completes the message, an end-of-message signal is transmitted which causes contacts 17 to close, which in turn control the operation of the magnet 18 to cause a large end-of-message ball to be injected in tube 28, as heretofore described. A magnet 168 is connected in series with the magnet 18 and operates therewith. On the return of the armature of magnet 168 to normal, it causes a gear 169 of the storage indicator to rotate in a counterclockwise direction, as viewed in Fig. 5.

The storage indicator comprises a T-shaped bar 155 rotatable in two fixed bearings 170. Three beveled gears 169, 171 and 172 are loosely mounted on the T bar, as shown, and arranged in the usual manner of differential gear mechanisms. The outer surfaces of gears 169 and 171 have ratchet teeth formed therein, which cooperate with pawls 169*a* and 171*a* operated by the armatures of magnets 168 and 173 so that the gears are rotated or stepped on the back-stroke of the armatures. Holding pawls such as 174 retain the gears in their stepped positions. When there are no big end-of-message balls in the associated primary storage tube 28, the T bar 155 of the differential storage counter is in the position shown in Fig. 5, and its contacts 156 are held closed. On a complete operation of magnet 168, gear 169 is rotated in a counterclockwise direction, as viewed in Fig. 5, and since gear 171 is assumed to be stationary at this moment (although this is not necessary), gear 172 is caused to rotate in such a direction as to raise the T bar 155, which permits the contact 156 to open. When the brush 175 reaches the segment such as 157*a* associated with the open contacts 156, current passes through the now unshunted low current magnet 173 of the storage indicator and moves the ratchet pawl 171*a* into position to engage another ratchet tooth on gear 171. The high resistance winding of magnet 173 reduces the current in the right hand coil of relay 158 to a value that is insufficient to hold the relay operated, and the contacts of the relay are therefore opened. Tongue 159 of relay 158 opens the circuit through magnets 160 and 43 to effect stopping of the upper disc 41 and the shuttle to return to its normal position. The shuttle returning to its normal position establishes a passageway for the balls representing the message stored in the primary storage tube 28 to the tube 46. The tongue of relay 158 contacting its break stop results in the charging of condenser 161 and the subsequent operation of cam stop magnet 71. This releases the shaft 63 for rotation, and during rotation thereof the cam 66 opens the contacts 164 which effects deenergization of relay 179 and stop magnet 165. The deenergization of the stop magnet results in the freeing of the lower disc 86 and the inauguration of its rotational search for the next stopping position. In quick succession battery is applied to contacts 166 and 167, closing a circuit through the magnet 94 and the coil of a relay 181. The energization of magnet 59, as hereinbefore described, diverts balls to the reading disc 58. When the apertures of the reading wheel are in the correct reading position, the code relay locking battery is removed from contact 182 and applied to the code relay operating common contact 183 through cam contact 184. Certain contacts in the group 185 determine that their corresponding unlocked relays are to be operated or held in the operated position when battery is again applied to locking

contact 182 by further rotation of cam 66. Although five balls are shown in Figs. 1 and 2, the reading wheel may have apertures for six or any other number of balls. It is not essential that even multiples of five be employed, as the balls which are not used are sent directly toward the secondary storage by tube 57.

When the cam shaft 63 rotates to its final position, as determined by cam 68, battery is reapplied to the Tree circuit through contact 164 and relay coil 179. Magnet 94 is still locked up, and its pin 97 prevents passage of the balls in the distributor to the secondary storage tubes until brush 186 finds the only segment in ring 187 with completed circuit through the Tree to battery. When this happens, relay 179 is energized, which opens the circuit to the magnet 94 and effects deenergization of the same. A mechanical passageway is thus opened through the distributor from a primary storage tube to the proper secondary storage tube, and this passage is maintained until the end of the message. When the big end-of-message ball finally comes to the shuttle, its greater diameter causes a metal U-shaped spring 188 to expand and complete a circuit through two fixed pin contacts 189 and 190. A circuit is thereby established from ground at the U-shaped spring 188 to battery through the left hand coil of relay 158 to energize the same. Tongues 159 and 163 contacting their make stops effect discharging of condenser 161 in preparation for the next cycle, and operation of the stop magnet armature 150 and shuttle associated with shuttle magnet 43. Thereupon the upper disc 41 begins to rotate, and as its brush 175 leaves segments 157*a*, low current magnet 173 is deenergized and gear 171 is rotated one ratchet tooth in a clockwise direction to cause contacts 156 to close and shunt out low current magnet 173.

If no further messages are completed by ball selector 19 and terminated by big end-of-message balls, contacts 156 will remain closed and brush 175 will pass, but fail to stop, on segment 157*a* in the future. However, if more than one big end-of-message ball had been counted into the differential storage indicator before the first message had been properly discharged from the distributor, the bar 155 of the indicator would have been rotated counterclockwise by increments equal to the number of end-of-message balls in the primary storage tube, and brush 175 would at the end of its next revolution again find contacts 156 in an open condition and would therefore stop on segment 157*a* for the distribution of another complete message.

A manually operable switch 195 may be connected, as shown, with each of the make stops of the tongues of the Tree circuit of the fourth relay of the selecting relays 154. Switches such as 195 could by their position control which one of two segments of each pair on the ring 187 will have battery thereon. If the even numbered segments of the ring 187 are associated with preferred secondary storage tubes, and the odd numbered segments with deferred secondary storage tubes, all the message groups of balls would be deposited in the preferred storage tube with the switch in its left hand position, and in the deferred storage tube with the switch in its right hand position. With the switch 195 in its central position, the last selecting relay 154 would determine into which one of a pair of tubes the message would be deposited.

It is obvious, of course, that various other modifications and arrangements of the apparatus shown and described herein 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 system, a plurality of different types of mechanical elements, a plurality of conveying and storage means for said mechanical elements, a plurality of associated means for arranging said mechanical elements in accordance with received signals in said associated conveying and storage means, a plurality of transmitting means for converting said mechanical elements into respective telegraph signals and means including said conveying and storage means for conveying said mechanical elements from any one of said element arranging means to any one of said transmitting means.

2. In a signal storage telegraph device, a plurality of primary storage means, marking and spacing elements having distinguishing characteristics associated with said primary storage means, said elements being arranged in groups, a plurality of secondary storage means, means for associating any one of said primary storage means with any one of said secondary storage means to permit the movement of said groups of elements from any one of said primary storage means to any one of said secondary storage means, means for removing said elements from said secondary storage means, and means associated with said secondary storage means for changing the sequence in which said groups of elements are removable therefrom relative to the sequence in which they are deposited therein.

3. In a telegraph signal storage device of the type described, a plurality of primary storage means, means for arranging two different sizes of mechanical elements in said storage means in groups in accordance with received message signal groups, a plurality of secondary storage means, and means for conveying a message group of said arranged mechanical elements from any one of said plurality of primary storage means to any one of said plurality of secondary storage means.

4. In a signal storage telegraph system, a plurality of incoming circuits over which message groups of signals are received, a plurality of selecting means, a plurality of primary storage means, means including said selecting means for arranging message groups of marking and spacing members in said storage means in accordance with received signals, a plurality of transmitting means with associated outgoing circuits, a secondary storage means associated with each of said transmitting means, means including said transmitting means for transmitting over associated outgoing circuits signals in accordance with the marking and spacing members in associated secondary storage means, and means for conveying said marking and spacing members from any one of said primary storage means to any one of said secondary storage means.

5. In a signal storage telegraph system, a plurality of primary storage members for storing therein message groups of two different sizes of small marking and spacing mechanical elements with each message group of elements separated by at least one mechanical element of a third size, a plurality of secondary storage members, means for establishing a passageway for said

marking and spacing elements between the exit point of any one of said primary storage members to the entrance of any one of said secondary storage members, and means including the mechanical elements of said third size separating the message groups of elements in said primary storage members for preventing the passage of more than one message group of elements at a time from one of said primary storage members to one of said secondary storage members.

6. In a signal storage telegraph system, a plurality of primary storage members for storing therein message groups of two different sizes of small marking and spacing mechanical elements with each message group of elements separated by at least one mechanical element of a third size, a plurality of secondary storage members, means for establishing a passageway for said marking and spacing elements between the exit point of any one of said primary storage members to the entrance of any one of said secondary storage members, means including the mechanical elements of said third size separating the message groups of elements in said primary storage members for normally preventing the passage of said mechanical elements from said primary storage members, means for selectively removing said third size of mechanical elements from said primary storage members and thereby permit the passage of said other sizes of mechanical elements to selected of said secondary storage members.

7. In a signal storage telegraph system, a source of telegraph signals, said signals being composed of code groups to represent messages with each message separated by code groups of predetermined character, a supply of three different sizes of mechanical elements, a storage means for receiving and retaining said mechanical elements in the order in which they are deposited therein, a mechanical element selecting mechanism, means including said selector mechanism for selecting mechanical elements of two sizes and depositing the same in said storage means in accordance with received message signals, and means controlled by said predetermined code groups separating each message group of signals for depositing said third size of mechanical element in said storage means whereby the two sizes of mechanical elements in said storage means representing messages are separated by said mechanical elements of said third size.

8. In a signal storage telegraph system, a source of telegraph signals, said signals being composed of code groups to represent messages with each message separated by code groups of predetermined character, a supply of three different types of mechanical elements, a storage means for receiving and retaining said mechanical elements in the order in which they are deposited therein, a mechanical element selecting mechanism, means including said selector mechanism for selecting mechanical elements of two types and depositing the same in said storage means in accordance with received message signals, and means controlled by said predetermined code groups separating each message group of signals for depcsiting said third type of mechanical element in said storage means whereby the two types of mechanical elements in said storage means representing messages are separated by said mechanical elements of said third type.

9. In a signal storage telegraph system, a source of telegraph signals, said signals being composed of code groups to represent messages with each message separated by code groups of predetermined character, a supply of three different sizes of mechanical elements, a storage means for receiving and retaining said mechanical elements in the order in which they are deposited therein, a first signal responsive device, means controlled by said first device for selecting and depositing in said storage means mechanical elements of two sizes in accordance with the individual impulses of each code group, a second signal responsive device, and means including said second device for selecting and depositing a mechanical element in said storage means of said third size in response to the code groups of predetermined character separating said message groups.

10. In a signal storage telegraph system, a source of telegraph signals, said signals being composed of code groups to represent messages with each message separated by code groups of predetermined character, a supply of three different sizes of mechanical elements, a storage means for receiving and retaining said mechanical elements in the order in which they are deposited therein, a first signal responsive device, means controlled by said first device for selecting and depositing in said storage means mechanical elements of two sizes whereby one size of mechanical represents all signals of one line condition and the other size of mechanical represents the other of the two line conditions of which the signals are composed, a second signal responsive device, and means including said second device for depositing at least one mechanical element of said third size in said storage means in response to the code group of predetermined character separating said message groups in addition to the mechanical elements of said first two sizes deposited in said storage means in accordance with the individual impulse of the code groups of predetermined character separating said messages.

11. In a telegraph system, a plurality of sources of message groups of signals of two different line conditions with each group including code groups indicating the destination of the individual messages, a plurality of first storage means and a plurality of selecting means with a first storage means and a selecting means individual to each source of signals, a supply of two different sizes of mechanical elements, means including said selecting means for arranging the two different sizes of mechanical elements in associated first storage means in accordance with the two line conditions of received signals, a plurality of transmitting circuits, a plurality of second storage means and transmitting means, a transfer mechanism, means including said transfer mechanism for transferring said arranged mechanical elements from any one of said first storage means to any one of said second storage means, a mechanical element sensing means included in said transfer means, means including said sensing means and the mechanical elements representing the destination of and accompanying each message group of arranged mechanical elements for determining to which particular second storage means said transfer mechanism transfers an arranged message group of mechanical elements, and means including said transmitting means for transmitting over said transmitting circuits messages representative of the message groups of mechanical elements transferred to associated second storage means.

12. In a telegraph system, a plurality of sources of message groups of signals of two dif-

ferent line conditions with each group including code groups indicating the destination of the individual messages, a plurality of first storage means and a plurality of selecting means with a first storage means and a selecting means individual to each source of signals, a supply of two different sizes of mechanical elements, means including said selecting means for arranging the two different sizes of mechanical elements in associated first storage means in accordance with the two line conditions of received signals, a plurality of transmitting circuits, a plurality of second storage means and transmitting means, a transfer means common to all of said first and second storage means, means including said transfer means for receiving and storing at least a part of a message group of elements from a first storage means, said part including the elements indicating the destination of the message, a transmitting mechanism in said transfer means for transmitting signals in accordance with the mechanical elements therein, an indicating mechanism controlled by said transmitted signals, means including said indicating mechanism for indicating the destination and indicating the desired second storage means for said message, and means including said transfer means for transferring the entire message group of elements to the desired second storage means to control the associated transmitting means to transmit representative signals over the associated transmitting circuit.

13. In a telegraph system, a plurality of primary storage means for storing therein message groups of different mechanical elements representing messages with a part of each message group containing message destination indicating elements, a plurality of destination representing secondary storage means, means for removing at least a part of a message group of elements from a primary storage means, said part including the message destination indicating elements, means controlled by the removed part of a message group of elements for indicating the destination of the message and means for conveying the removed part and the remainder to the respective secondary storage means.

14. In a telegraph signal storage system, a plurality of primary storage mediums for receiving and storing groups of mechanical elements of different characteristics therein arranged to represent messages with each message group of elements including message destination indicating elements, a transfer means, a reading means included in said transfer means, means for associating said transfer means with any one of said primary storage mediums to receive the mechanical elements therefrom, a plurality of secondary storage mediums representing message destinations, means for associating said transfer means with any one of said secondary storage mediums, and means including said reading means as controlled by said message destination indicating elements for automatically controlling said transfer means to transfer said mechanical elements to the representative secondary storage medium.

15. In a telegraph system of the type described, a storage medium for storing and maintaining in the order in which they are deposited therein mechanical elements of different characteristics, means for depositing said mechanical elements in and removing the same from said storage medium, means for separating said elements into message groups while in said storage medium, an indicating means having a normal position, means for operating said indicating means away from said normal position on the depositing of a message group of elements in said storage medium, and means for operating said indicating means toward said normal position on the removal of a message group of elements whereby the distance of said indicating means away from said normal position indicates the number of message group of elements in said storage medium.

16. In a telegraph system of the type described, a storage medium for storing and maintaining in the order in which they are deposited therein mechanical elements of different characteristics, means for depositing said mechanical elements in and removing the same from said storage medium, means for separating said elements into message groups while in said storage medium, an indicating means having a normal position, means for operating said indicating means a predetermined amount away from said normal position on the depositing of each message group of elements in said storage medium, means for operating said indicating means said predetermined amount toward said normal position on the removal of each message group of elements therefrom whereby the amount of said indicating means away from said normal position indicates the number of message group of elements in said storage medium, a differential gear arrangement included in said indicating means, and means including said gear arrangement whereby both of said last two mentioned means may operate simultaneously.

17. In a telegraph system, a plurality of storage mediums for storing and maintaining in the order in which they are deposited therein message groups of mechanical elements of different characteristics, means for depositing in and removing from said mediums message groups of said elements, an indicating device for each storage medium for indicating the number of message groups of elements therein, said indicating devices being operable in one direction from a normal position on the depositing of a message group of elements in the associated storage medium and operable in an opposite direction toward said normal position on the removal of each message group of elements from the associated storage medium, an individual contact associated with and operable by each of said indicating devices, an individual magnet in shunt relation with each of said contacts operable by a current of predetermined value, a relay in series relation with all of said first magnets and contacts operable by a current of a greater value than said predetermined value, a mechanical element transferring means for transferring said arranged elements from any of said storage mediums to other means, a control for said transfer means including means controlled by said relay, a cyclically operable means, and means including said cyclically operable means for operating said relay with said contacts closed and for operating only a magnet with associated contacts open.

18. In a telegraph system, a plurality of primary storage mediums for storing and maintaining in the order in which they are deposited therein message groups of mechanical elements of different characteristics, means for depositing in said mediums message groups of said elements, with each message group of elements including destination indicating elements, a plurality of

secondary storage mediums representing destinations, said secondary mediums including preferred and deferred storage mediums, an automatic transfer device for removing said elements from any of said primary storage mediums and depositing the same in any one of said secondary storage mediums, a sensing device in said transfer means, means including said sensing device as controlled by said destination indicating elements for controlling said transfer means to transfer said elements to the secondary storage medium representing the destination and means controlled by predetermined of said destination indicating elements for controlling said transfer means to automatically transfer the elements to either the preferred or deferred storage medium representing a destination.

19. In a telegraph system, a plurality of primary storage mediums for storing and maintaining in the order in which they are deposited therein message groups of mechanical elements of different characteristics, means for depositing in said mediums message groups of said elements, with each message group of elements including destination indicating elements, a plurality of secondary storage mediums representing destinations, said secondary mediums including preferred and deferred storage mediums, an automatic transfer device for removing said elements from any of said primary storage mediums and depositing the same in any one of said secondary storage mediums, a sensing device in said transfer means, means including said sensing device as controlled by said destination indicating elements for controlling said transfer means to transfer said elements to the secondary storage medium representing the destination, means controlled by predetermined of said destination indicating elements for controlling said transfer means to automatically transfer the elements to either the preferred or deferred storage medium representing a destination, a manually operable switch, and means including said switch for controlling said transfer device to automatically deposit all of said elements for a given destination in a preferred storage medium or a deferred storage medium.

20. In a signal storage system of the type described, a plurality of primary storage means for receiving and storing groups of mechanical elements of different characteristics arranged to represent messages with each message group of elements including destination indication indicating elements, a plurality of secondary storage means representing message destinations, a first rotatable member and a second rotatable member interposed between said primary and secondary storage means, means determined by the rotative position of said rotatable members for completing a passageway for said elements from any one of said primary storage means to any one of said secondary storage means, means controlled by the presence of a message group of elements in a primary storage medium for automatically positioning said first rotatable member into operative relation therewith and means controlled by the destination indicating elements in a message group for automatically positioning said second rotatable member into association with the indicated secondary storage means.

21. In a signal storage telegraph system, a plurality of primary storage means for storing elements of different character to represent by said different character telegraph signals, a plurality of secondary storage means for storing said elements, an element transferring means and means including said transferring means for transferring said elements from any one of said primary storage means to any desired one of said secondary storage means.

22. In a signal storage telegraph system, a plurality of primary storage means for storing elements of different character to represent by said different character telegraph signals, a plurality of secondary storage means for storing said elements, an element transferring means, means including said transferring means for transferring said elements from any one of said primary storage means to any desired one of said secondary storage means, and means controlled by predetermined of the elements of a primary storage means for controlling the operation of said transferring means.

23. In a signal storage telegraph system, a plurality of primary storage means for storing elements of different character to represent by said different character telegraph signals, a plurality of secondary storage means for receiving and storing elements from said primary storage means, means for establishing a connection from any desired one of said primary storage means to any desired one of said secondary storage means to permit the passage of elements contained in a primary storage means to a secondary storage means, and means controlled by the character of the elements in a primary storage means for controlling said connecting means.

24. In a signal storage telegraph system, a plurality of primary storage means for storing elements of different character to represent by said different character telegraph signals, a plurality of secondary storage means for receiving and storing elements from said primary storage means, a first sensing means to sense the presence of elements in said primary storage means, a second sensing means to sense the character of predetermined of said elements of a primary storage means, a transferring means for transferring elements from any one of said primary storage means to any desired one of said secondary storage means and means including said first and second sensing means to control said transferring means.

25. In a signal storage telegraph system, a plurality of primary storage means for storing elements of different character to represent by said different character telegraph signals, means to separate said elements in said storage means into groups, a plurality of secondary storage means for receiving and storing elements from said primary storage means, a transferring means for transferring said elements from any one of said primary storage means to any desired one of said secondary means, and means for controlling said transferring means to prevent the transfer of more than one group of elements at a time from a primary storage means to a secondary storage means.

26. In a signal storage telegraph system, a plurality of primary storage means for storing elements of different character to represent by said different character telegraph signals, means to separate said elements in said storage means into groups, a plurality of secondary storage means for receiving and storing elements from said primary storage means, a transferring means for transferring said elements from any one of said primary storage means to any desired

one of said secondary means, and means including predetermined of the elements of a group of a primary storage means to determine to which secondary storage means said transferring means transfers said groups of elements.

27. In a signal storage telegraph system, a plurality of primary storage means for storing elements of different character to represent by said different character telegraph signals, means to separate said elements in said storage means into groups, a plurality of secondary storage means for receiving and storing elements from said primary storage means, a transferring means for transferring said elements from any one of said primary storage means to any desired one of said secondary means, and means including predetermined of the element of each group of elements in said primary storage means for automatically controlling said transferring means to transfer said groups to the secondary storage means indicated by said predetermined elements.

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