Aug. 12, 1941. L. CASPER 2,252,060

SIGNAL STORING DEVICE

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FIG. 1

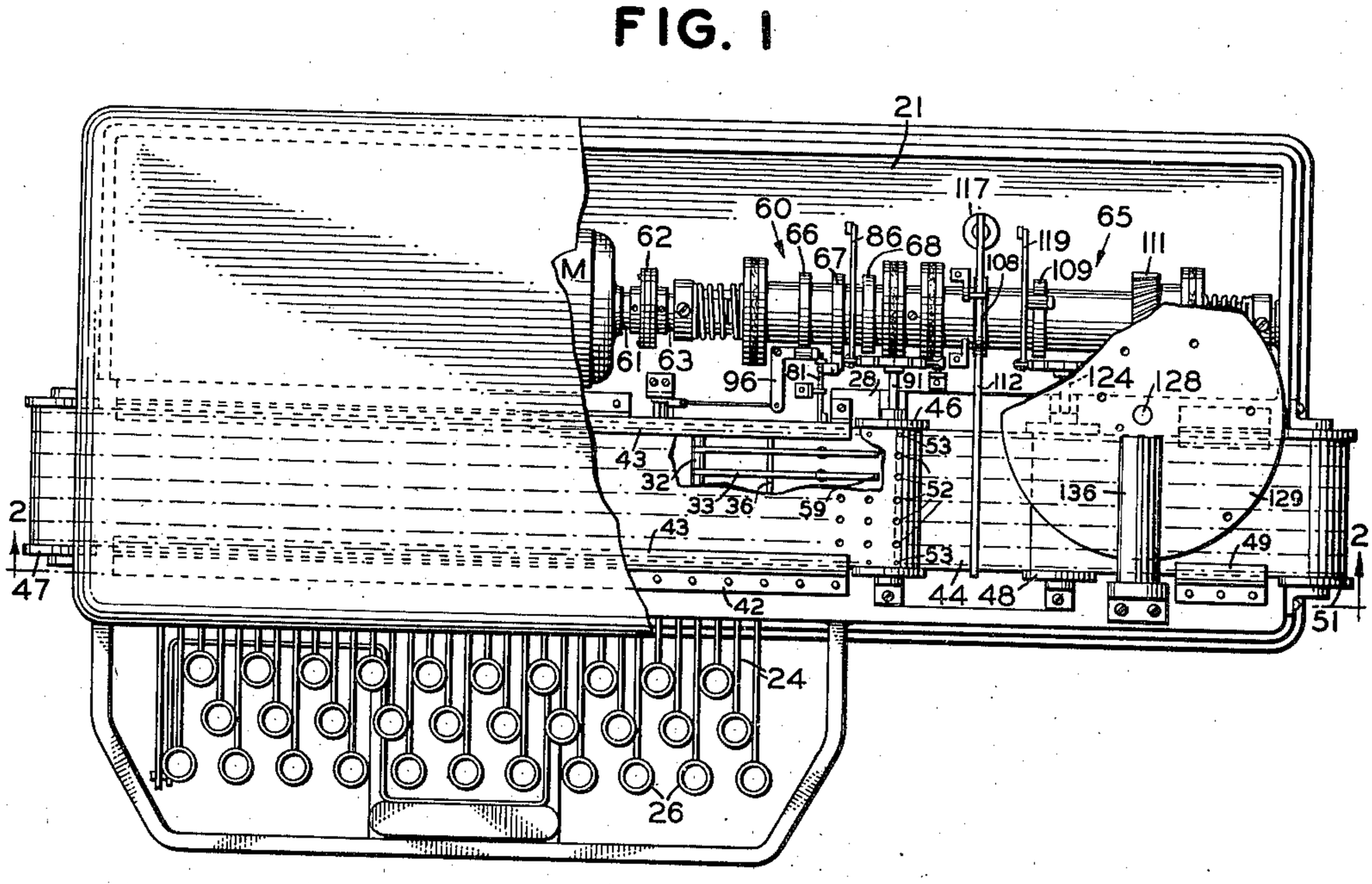


FIG. 2

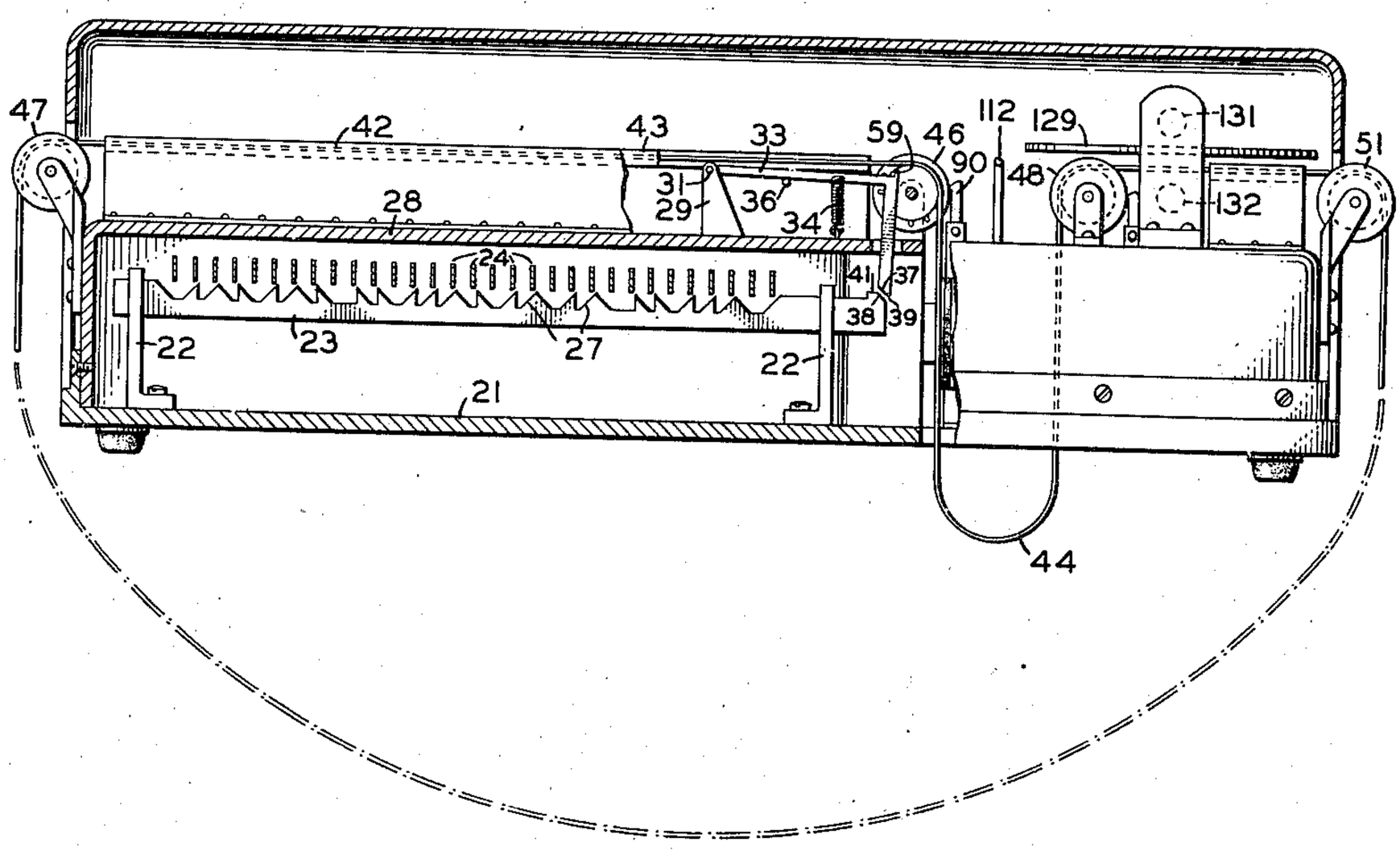


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FIG. 3

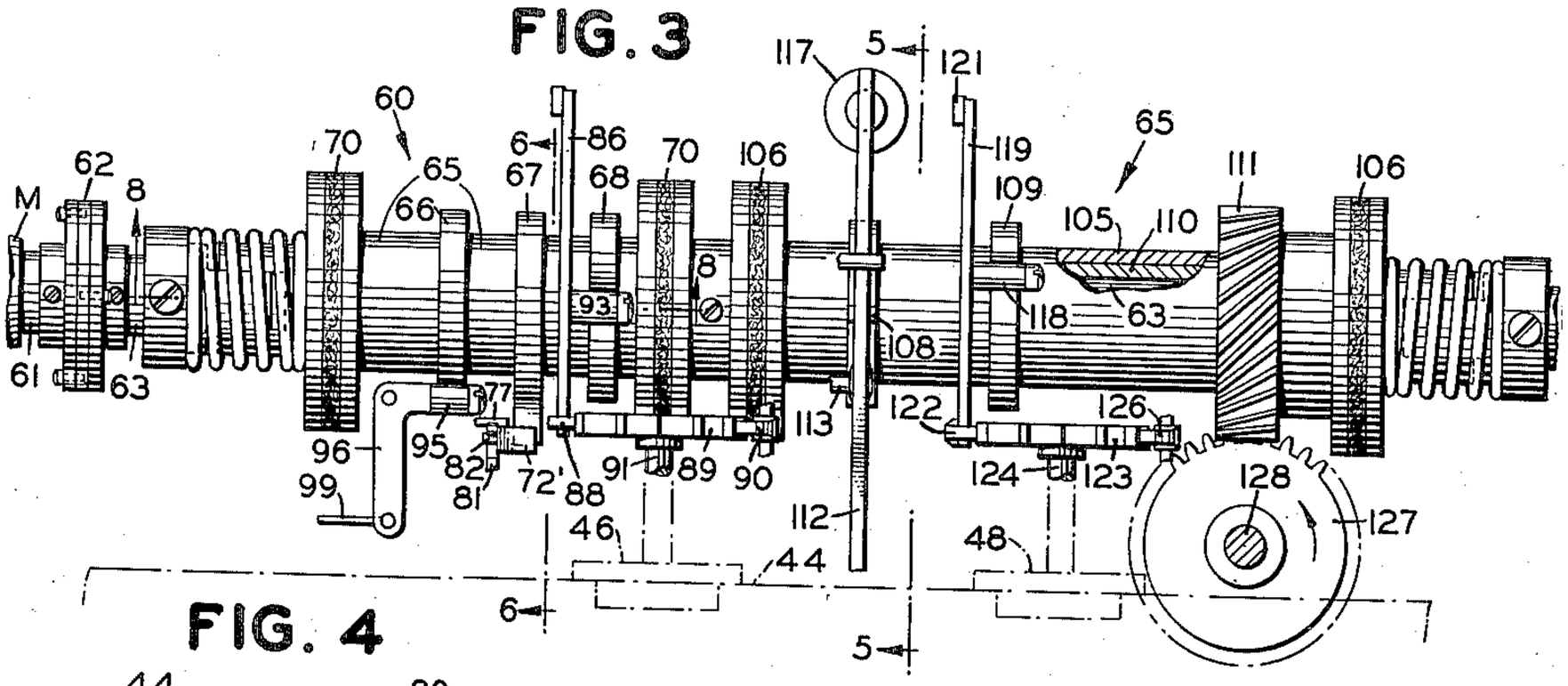



FIG. 4

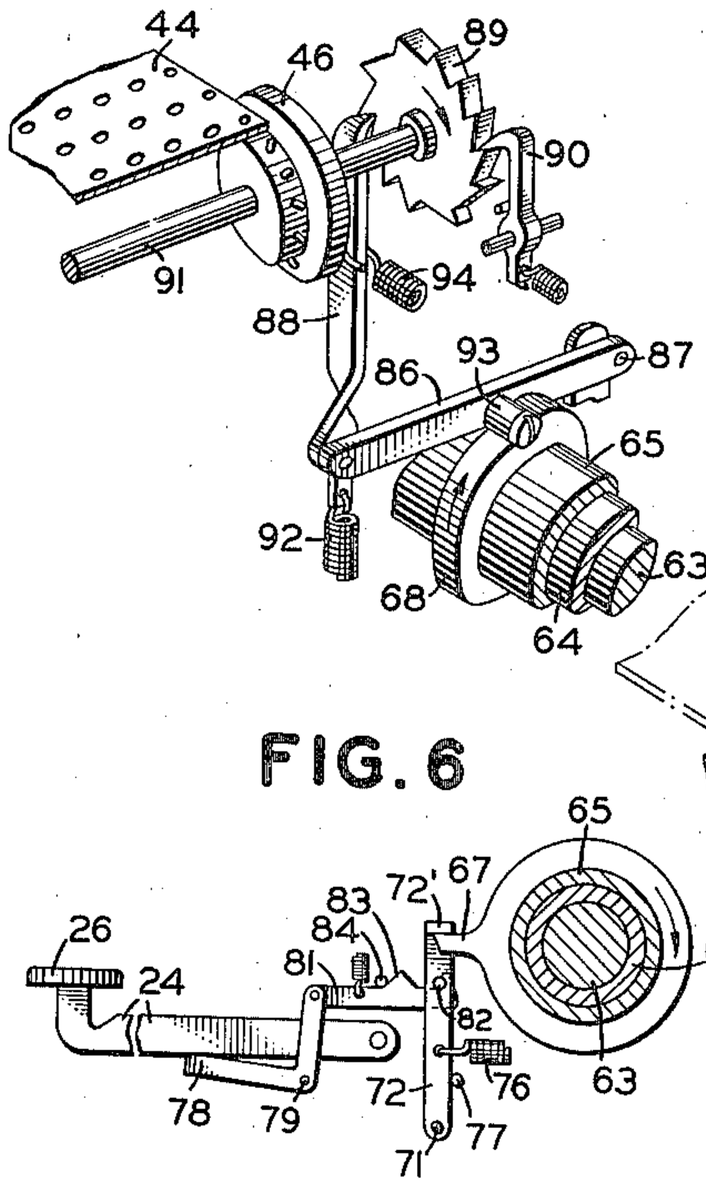



FIG. 5

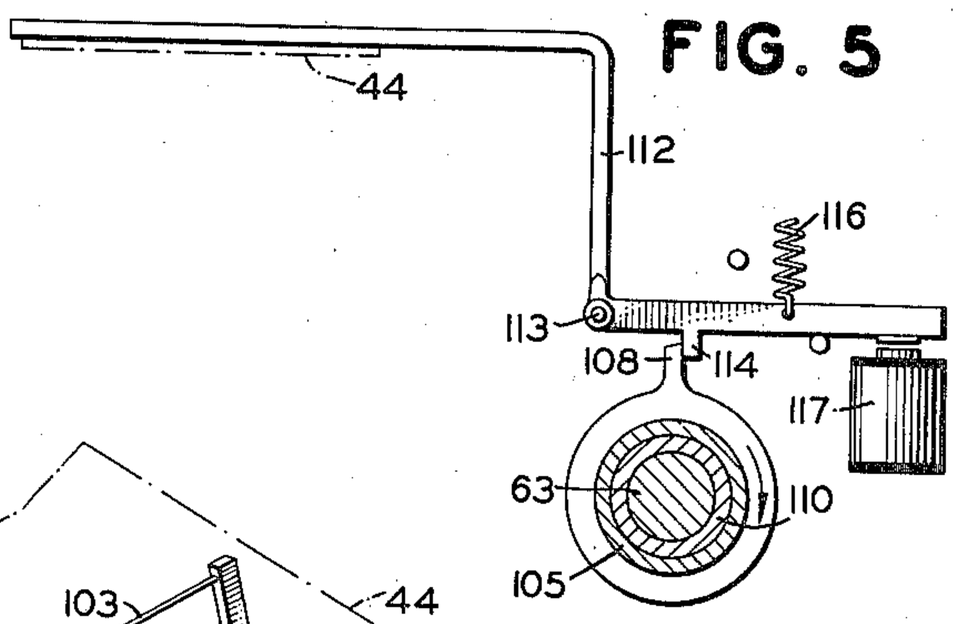



FIG. 6

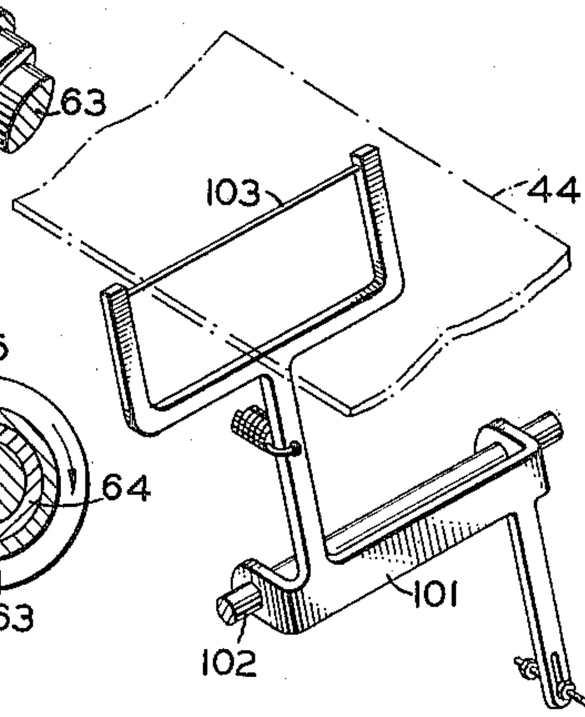



FIG. 7




FIG. 9

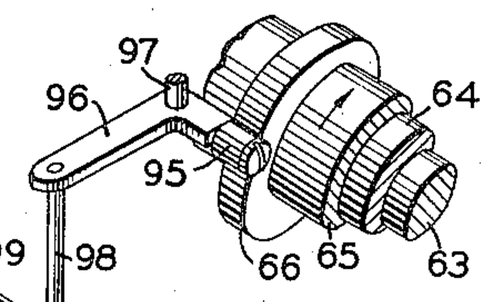
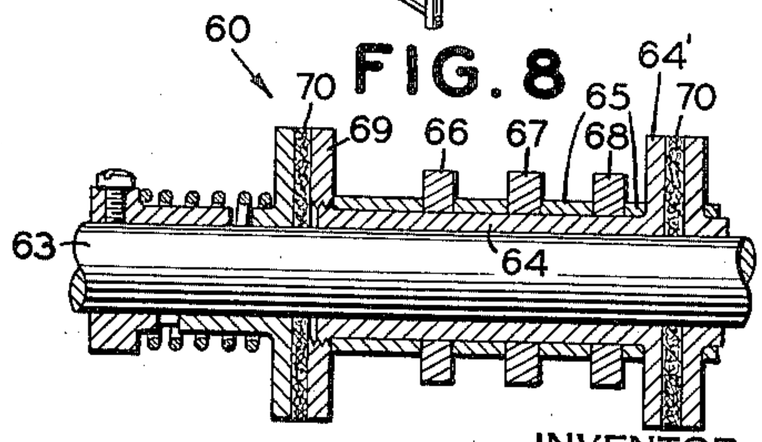



FIG. 8



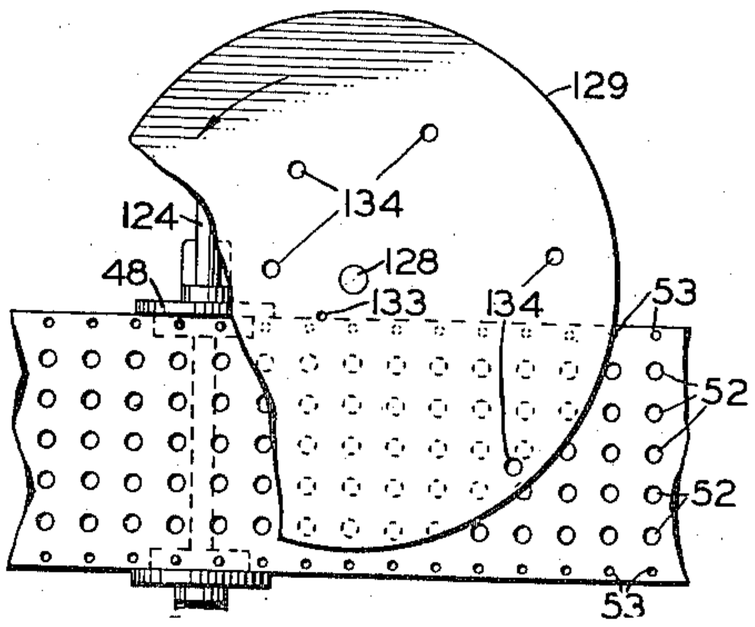




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FIG. 10

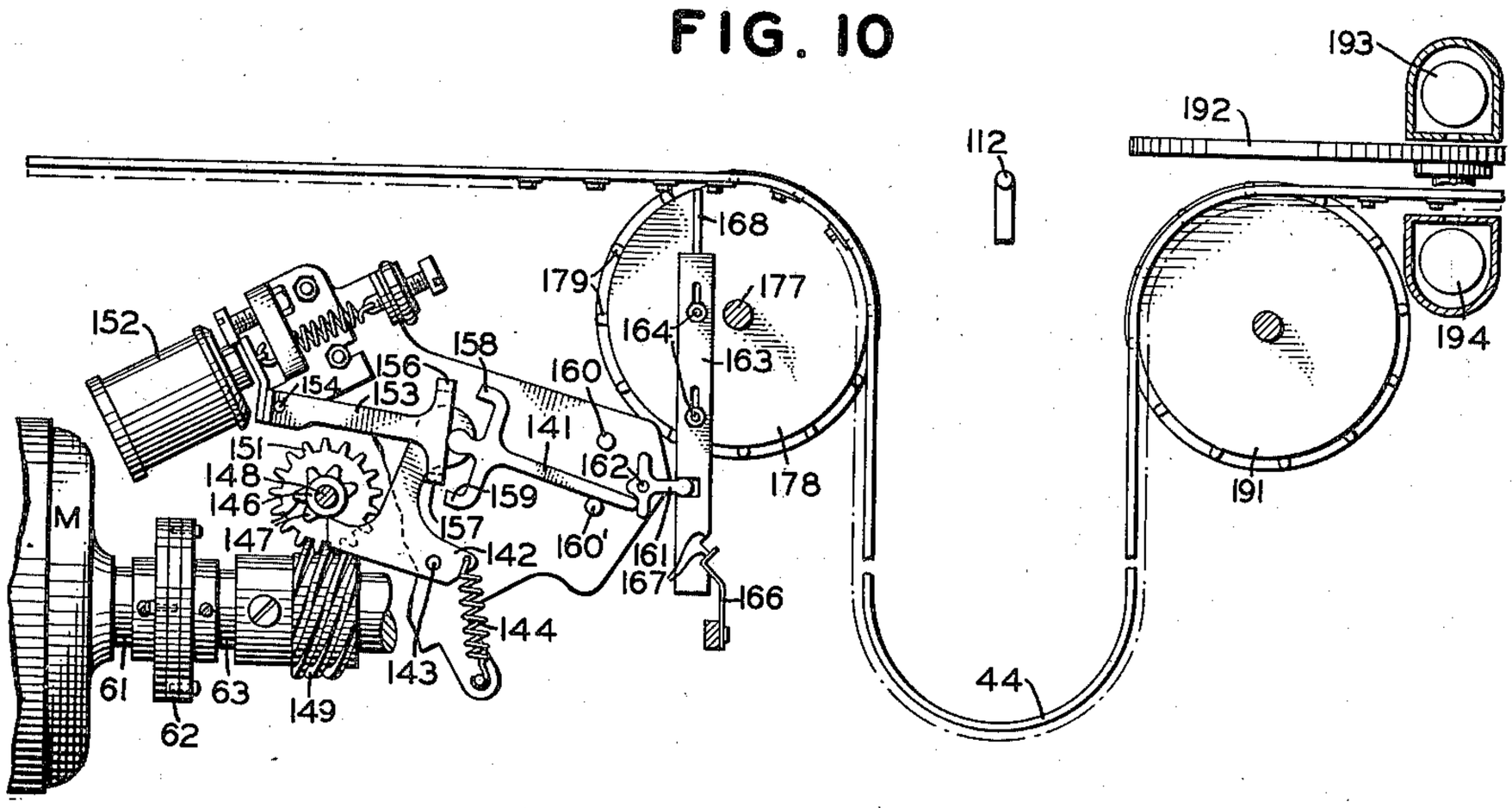



FIG. 11

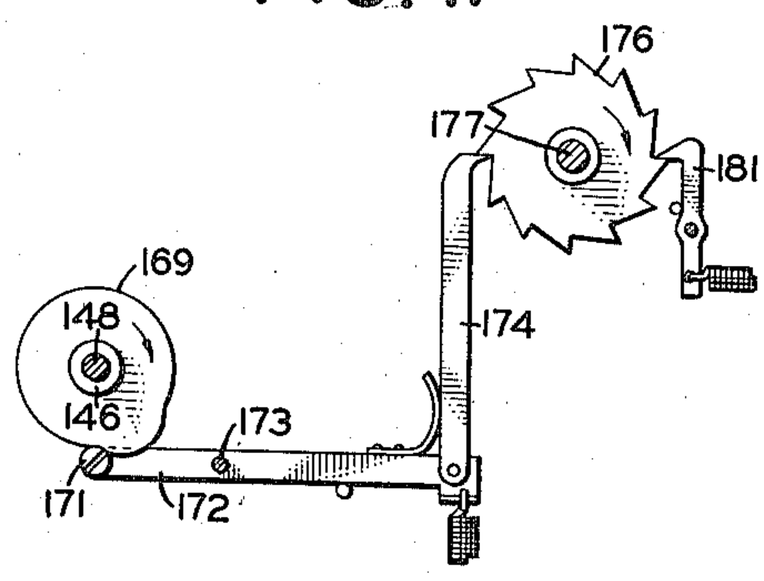



FIG. 12

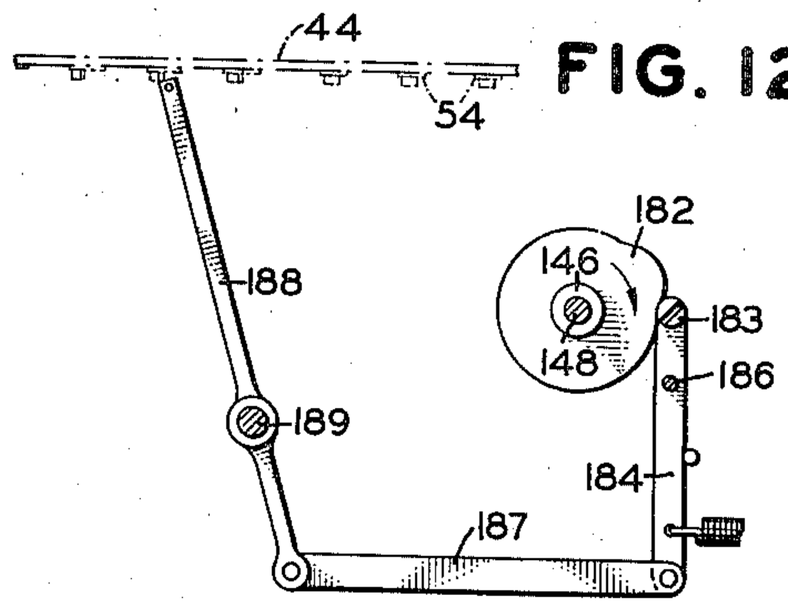



FIG. 14

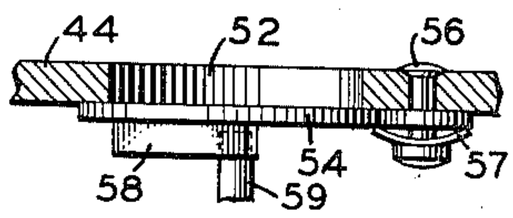



FIG. 15

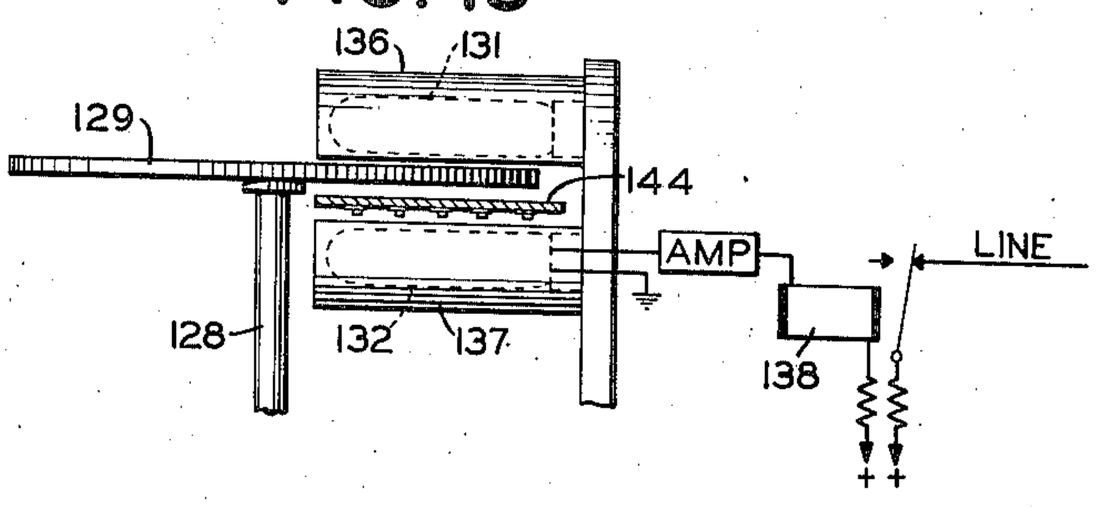
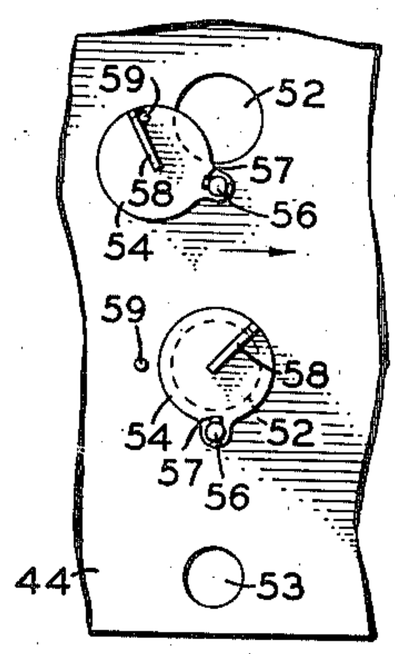



FIG. 13

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# UNITED STATES PATENT OFFICE

2,252,060

## SIGNAL STORING DEVICE

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Application December 2, 1939, Serial No. 307,229

18 Claims. (Cl. 178—17.5)

This invention relates primarily to telegraph apparatus and more particularly to apparatus for storing telegraph signals prior to their transmission over a line circuit. The invention is also applicable for use in the storage of telegraph signals incident to the retransmission thereof from one line circuit or channel of communication to another.

The present practice of storing telegraph signals of an appreciable number prior to their transmission over a line circuit is to employ a keyboard perforator which, as is well known in the art, causes a tape to be perforated in accordance with the actuated keylevers of the keyboard. The perforated tape is then subsequently used to selectively operate a tape transmitter which transmits signals representative of the perforations in the tape to the line circuit. Often times a keyboard transmitter which causes the transmission of signal code groups at the time of operating the keylevers is employed to send directly to a line circuit and obviously when such is the case it is necessary for a line circuit to be available at the time the keyboard is operated. When a sending circuit is not available the operator has to wait until one is available, such practice being obviously inefficient in regards to the operator's time. Furthermore, when manually operated keyboards are employed to transmit directly to a line circuit they invariably operate on the start-stop principle and the speed of operation of the keyboard is limited to that of the line circuit which may be much less than what the operator is capable of performing. In addition if the keyboard is not operated at its maximum speed, the line circuit is likely to be idle for intervals between characters and the loss in line time in the course of an extended length of time is likely to add up to an appreciable amount.

Accordingly, it is one of the primary objects of the present invention to provide a novel manner of storing telegraph signals whereby they may be stored for an indefinite period of time and subsequently transmitted over a sending circuit when such circuit is available.

The principles of the invention of storing telegraph signals are equally well applicable to signals received over one line circuit which are to be retransmitted over another line circuit and to the storage of signals originating at any one point.

It is another object of the invention in accordance with the above to provide a mechanism which enables more efficient use of line time in that the signals may be stored prior to their transmission and then transmitted at the maximum carrying speed of the line.

A further object of the invention is to provide a storage means for telegraph signals that may be used over and over again.

A still further object of the invention is to provide a mechanism for storing and transmitting telegraph signals which is efficient, capable of high speed operation, easily and cheaply manufactured and comprises a minimum number of parts.

These and further objects of the invention will be more apparent when taken in conjunction with the accompanying drawings and the following detailed description thereof.

In the preferred embodiment of the invention an endless belt is employed which has a series of transverse rows of so called signal determining holes therein. Associated with each of the signal determining holes or apertures in the belt is an individual shutter or vane and in one position these shutters cover their associated holes and prevent the passage of a light beam through the holes in the belt, while in their other position the holes are uncovered to allow the passage of a light beam therethrough. The shutters are selectively operated to uncover their associated holes or apertures and remain in their operated positions so that a transverse row of holes in the belt represent or form a group of code combinations which in turn represent a character in much the same manner as rows of holes in a perforated tape represent characters. The belt with the shutters set in various combinations then passes through a light beam which is in operative relation with a light sensitive device, such as a photoelectric cell and a scanning disc which successively scans a transverse row of holes in the belt. In accordance with the open or closed condition of the holes in the belt the light beam is allowed or prevented respectively from impinging upon the photoelectric cell. The photoelectric cell in turn in the preferred embodiment controls a relay which, dependent upon the condition of the photoelectric cell, controlls a transmission of electrical impulses to a line circuit. In this manner the open or closed positions of each respective hole in a transverse group of the same in the belt will control the transmission of respective signals to a line circuit of which the aforesaid photoelectric transmission apparatus is a part.

Provision is made for the formation of a loop in the belt between the point where the shutters are selectively operated and the point where the

belt is scanned and thus the storage of the signals is effected. Individual stepping mechanisms for the belt are employed in connection with the setting up or selecting position and the scanning position which enables independent movement of the belt at these two points, and if preferred at different speeds. After the belt leaves the scanning position the vanes or shutters are all reset to a normal position and the belt is ready to again pass through the selective position. Thus the belt may be used over and over again and the amount of the storage is determined by the length of the loop in the belt that can be formed between the selecting and scanning positions.

In one embodiment of the invention the vanes or shutters of the belt are selectively operated directly from a keyboard mechanism whereas in a second embodiment the vanes or shutters are selectively operated in response to received signals actuating an electric responsive selecting device. Hence the second embodiment may be used in connection with repeating or transmission of the telegraph signals from one circuit to another.

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

Fig. 1 is a plan view with certain parts broken away of the embodiment of the invention wherein the vanes or shutters of the belt are operated directly from a keyboard;

Fig. 2 is a vertical sectional view taken substantially on line 2—2 of Fig. 1;

Fig. 3 is a fragmentary plan view of the cam sleeves together with parts of elements operated thereby which are employed to perform various operations of the mechanisms shown in Figs. 1 and 2;

Fig. 4 is a fragmentary perspective view of one of the belt advancing mechanisms;

Fig. 5 is a sectional view taken substantially on line 5—5 of Fig. 3 showing the manner in which a lever operable by the loop in the belt is employed to release the scanning disc driving means and associated apparatus;

Fig. 6 is a sectional view taken substantially on line 6—6 of Fig. 3 showing the manner in which the frictionally driven cam sleeve associated with the selecting position is released for one revolution at a time in conjunction with the operation of each keylever;

Fig. 7 is a perspective view of the elements employed to reset the belt shutters to normal;

Fig. 8 is a sectional view taken substantially on line 8—8 of Fig. 3;

Fig. 9 is a plan view of the scanning disc showing its relation to the belt;

Fig. 10 is an elevational view of a start-stop electroresponsive selector and the elements controlled thereby for selectively operating the vanes of the belt.

Fig. 11 is a vertical sectional view of a part of the belt advancing mechanism associated with the apparatus of Fig. 10.

Fig. 12 is a vertical sectional view of the apparatus for resetting the vanes when employed with the apparatus of Fig. 10.

Fig. 13 is an enlarged fragment of a section of the underside of the belt.

Fig. 14 is a fragmentary transverse sectional view of the belt; and

Fig. 15 is a view showing the relation of the light source, the scanning disc, the belt and the photoelectric cell, together with the circuits controlled thereby.

Referring first to Figs. 1 and 2, the preferred embodiment of the invention wherein a set of keylevers is adapted to selectively control the selective operation of the shutters on the belt will first be described. The mechanism for selectively operating the shutters on the belt and the transmitting or scanning mechanisms are preferably included in a single unit, and in such an arrangement a common motor may be employed to drive both mechanisms. However, if desired, the selecting and transmitting units may be separated as will hereinafter be apparent.

A base plate or bottom mounting plate 21 is arranged to support and serve as a mount for the various elements of the machine. Two brackets 22 attached to the upper side of the base plate 21 have a series of vertical slots therein which guide a set of notched horizontal permutation members 23. In the preferred embodiment of the invention the number of permutation members 23 is five, one for each unit of the signaling code it being assumed that a five unit signaling code is employed. If it is desired, a six unit signaling code could be employed, then six permutations members will be necessary, the principles of the invention being the same in either case. The permutation members 23 are movable in the direction of their lengths in the brackets 22 to assume combinations of settings in a manner hereinafter described. Arranged above the permutation members 23 are a series of horizontal keylevers 24 which are pivotally supported adjacent their rear ends by means, not shown, and have at their forward ends key designating caps 26. The caps 26 are arranged in a manner similar to that of any well known telegraph keyboard.

The upper sides of the permutation members 23 have formed therein a series of sloped or beveled notches or surfaces, such as 27, with the notches on each one of the permutation members different from that on each of the others. The sloping surfaces 27 are arranged so that when the keylevers 24 are actuated in a downward direction, one at a time, the center portions thereof engage the surfaces 27 to move the members 23 in the direction of their length. As the arrangement of the beveled surfaces 27 is different in each of the permutation members 23 the actuation of a keylever 24 causes them to be moved to the right and the left in a combination representative of the actuated keylever in much the same manner as in the type of keyboard generally employed in telegraph machines.

Above the keylevers 24 and suitably supported from the bottom mounting plate 21, is a top mounting plate 28. Attached to the upper side of the plate 28 is a bracket 29 which has in the upper end thereof a horizontal pivot rod 31. Pivoted on the rod 31 intermediate with spacers 32 is a set of five L-shaped selecting or selector levers 33, each of the levers 33 being in substantially the same vertical plane as an associated one of the permutation members 23. A depending arm of each of the selecting levers 33 extends through a hole in the top mounting plate 28 so that the ends thereof are in operative relation with associated ones of the permutation members 23. Springs 34 attached to the selecting levers 33 tend to pivot the same in a clockwise direction against a stop 36 or into engagement with the right hand end of associated permutation members 23 as hereinafter described.

The lower end of the depending arms of each of the selector levers 33 has a beveled surface 37 thereon adapted to cooperate with another beveled surface 38 formed on the right hand end of associated permutation members 23. With a permutation member 23 in its left hand position, such as the first one shown in Fig. 2, there is a small clearance between the beveled surfaces 37 and 38 and the clockwise movement of the associated selector lever 33 by the attached spring 34 is limited by the stop 36. Such a position of a selector lever 33 is hereinafter referred to as being in its unoperated position. When one of the permutation members 23 is moved to the right into its right hand position, the beveled surfaces 37 and 38 engage with each other and cause a slight pivoting movement in a counterclockwise direction of the associated selecting lever 33. At the end of the movement of a permutation member 23 to the right, it has moved sufficiently to allow a horizontal surface 39 at the lower end of the depending arm of the selector lever 33 to rest on another horizontal surface 41 on the associated permutation member and such a position of a selector lever 33 is hereinafter referred to as being in its operated position. The permutation members 23 have no normal position but remain in either their right or left hand positions until moved by the actuation of another keylever. Thus, the selector levers 33 are operated in various combinations and remain in either one or the other of their two positions in accordance with the right and left hand positions of the permutation members 23. The manner in which the ones of the selector levers 33 that are positioned to an operated position control the settings of the hereinbefore mentioned shutters on the transmitting belt will presently be pointed out.

Attached to the upper side of the top mounting plate 28 in the section thereof above the keylevers 24 are two brackets 42 which have at their upper ends channel members 43. The openings of the channel members 43 face one another and serve as a guide for the transmitting belt indicated in general by reference numeral 44. The channels 43 extend substantially the distance between a feed roller or wheel 46 for the belt 44 and an idler roller or wheel 47 at the left hand edge of the machine. The movement of the belt through the channels 43 is from left to right and movement thereof through the channels 43 is effected by the feed wheel 46. As the belt 44 leaves the feed wheel 46 it next encounters a second feed wheel 48 associatd with the scanning mechanism. The feed wheel 48 feeds the belt through the scanning mechanism preferably positioned at the right of the keyboard mechanism. The belt is guided through the scanning mechanism by channels 49 similar to those over the keylevers. A second idler roller or wheel 51 guides the belt at the right hand edge of the mechanism. The belt 44 in leaving the idler wheel 51 passes underneath the complete mechanism back to the left hand side of the machine and over the roller 47.

The belt 44 is of substantial length and a loop is allowed to form underneath the machine between the rollers 47 and 51 which constitutes a supply. A hole is formed in the top mounting plate 28 and the base plate 21 between the feed wheels 46 and 48 to allow a loop of tape to form therebetween and such a loop constitutes the storage space in the belt or the place or location where signals set up in the belt are stored prior to the transmission thereof at the scanning position. Obvious arrangements may be made to store a considerable length of the belt in conjunction with the forming of a loop underneath the machine and also in conjunction with the loop adapted to form between the setting up and scanning positions. Such arrangements would save space in the event it was desired to employ a belt of considerable length.

The belt 44 which may be of metal or fabric or any other suitable material that is sufficiently flexible is of substantial width and has formed transversely of the length a series of so-called transmitting or signal determining holes 52. The number of transmitting holes in each transverse section of the belt 44 is five, one for each of the selector levers 33 and as the belt passes over the selector levers 33 a hole 52 in each transverse row is in substantial alignment with an associated one of the selector levers 33. In alignment with each row of transverse transmitting holes 52 are feed holes 53 on each edge of the belt which cooperate with axially extending pins on the feed rolls 46 and 48 to advance the belt as hereinafter described. Associated with each one of the transmitting holes 52 of the belt 44 as best shown in Figs. 13 and 14 are individual vanes or shutters 54. The shutters 54 are pivoted on pins or rivets, such as 56, in the belt and spring washers, such as 57, on the pins 56 tend to prevent the shutters from freely pivoting about the pins 56 and prevent movement thereof at undesired times. Each of the shutters 54 have depending therefrom projections 58 which cooperate as hereinafter described with pins 59 extending from the upper side of the selector levers 33 to selectively operate the shutters 54. The normal position of the shutters 54 is such that they completely cover their associated holes 52 and hence prevent passage of light therethrough when in the normal position.

The selector levers 33 are so positioned relative to the belt 44 that the pins 59 therein are in alignment with an associated longitudinal row of holes 52 in the belt. When one of the permutation members 23 is in its left hand position and the associated selector lever 33 in its unoperated position the pin 59 thereon is not in the path of movement of the projection 58 on its associated longitudinal row of shutters 54. Similarly with a permutation member in its right hand position, the pin 59 on the associated selector lever 33 is in the path of movement of the projections 58 on the shutters 54. Hence, as the belt 44 is advanced a distance equal to the distance between consecutive transverse rows of holes in a manner hereinafter described in conjunction with the actuation of a key lever 24, the permutation members 23 that happen to be in their left hand position control their associated selector levers so that the pins 59 thereon do not cooperate with the projections 58 on the shutters 54 while the pins 59 on the selectors associated with permutation members in their right hand positions engage the projections to pivot the shutters and open associated holes 52. Thus depending upon the position of the permutation members 23 at the time the belt 44 is advanced or stepped the shutters 54 in the transverse row of the belt in operative relation with the pins 59 are operated to uncover their associated holes 52 or remain in their normal position with the associated hole closed. Accordingly, the positions of the shutters in consecutive transverse rows represent according to a predetermined arrangement, consecu-

tively operated ones of the key levers 24. The manner in which the belt 44 is advanced concommitantly with the operation of each one of the key levers 24 will now be described in conjunction with the operation of the various other elements.

Suitably mounted in the rear of the machine is a motor M which furnishes power for the various functions of the machine. Coupled to the motor shaft 61, Figs. 1 and 3, by a coupling 62 is a shaft 63 which is suitably journalled and supported from the base 21. Mounted on the shaft 63 are two separate frictionally driven cam assemblies indicated in general by reference numerals 60 and 65, hereinafter referred to as the selecting and scanning cam assemblies, respectively. The selecting cam assembly 60 includes a sleeve 64, Fig. 8, which is loosely mounted on the shaft 63 and has a flange 64' formed on the right hand end thereof. Mounted on the sleeve 64 between spacers 65 is a shutter resetting cam 66, a stop arm 67 and a feed cam 68. A friction plate 69, threaded on the left hand end of the sleeve 64, clamps the cams 66 to 68 in position and to the sleeve for rotation therewith. Friction elements 70, such as felt washers, engage the right and left hand faces of the flange 64' and the friction plate 69, respectively, and tend to rotate the cam assembly 60 with the shaft 63, however, the cam assembly is normally held at rest in its normal rest position by an arrangement of elements hereinafter described.

Pivotally mounted at its lower end on a fixed pivot 71, Fig. 6, is a vertical stop lever 72 which has a section 72' at the upper end bent horizontally and normally engaging the stop arm 67 to hold the cam sleeve 64 at rest. A spring 76 attached to the stop lever 72 tends to pivot the same in a clockwise direction and hold the lever in its normal position against a stop 77. The lever is momentarily operated to release the cam assembly for one revolution at a time in conjunction with the operation of a keylever 24. Whenever any one of the keylevers 24 is actuated, a universal bail 78 common to all of the keylevers and pivoted at 79 is rocked a slight amount in a counter-clockwise direction. This manner of pivoting of the universal bail 78 causes the substantially vertical arm thereof to move the trip lever 81 toward the left and a hook at the right hand end thereof engages a pin 82 in the stop lever 72 to pivot the same and withdraw the section 72' from out of engagement with the arm 67. Thereupon the sleeve 64 is free to rotate with the shaft 63 through the action of the friction elements. A bevelled surface 83 on the trip lever 81 coacts with a stationary pin 84 to disengage the hook on the right hand end of the lever 81 with the pin 82 near the end of the movement of the universal bail 78. This allows the spring 76 to pivot the lever 72 back into its normal position where the upper horizontal section 72' thereof is in the path of the stop arm 67 to stop the same after each revolution. Thus in conjunction with the operation of each of the key levers 24, the cam assembly 60 is released for one revolution and the functions performed during the revolution thereof by the attached cams will presently be described.

In operative relation with the feed cam 68 on the sleeve 64 is a substantially horizontal lever 86, best shown in Fig. 4, which is pivoted at 87 and has attached to the free end thereof an upwardly extending pawl 88. The upper end of the pawl 88 cooperates with a ratchet wheel 89 fixed to a rod 91 for rotation therewith to which is also fixed the feed wheel 46. A spring 92 holds a follower 93 on the lever 86 in contact with the cam 68 while another spring 94 holds the upper end of the pawl 88 in engagement with the ratchet wheel 89. During each revolution of the sleeve 64 the high part of the cam 68 causes the lever 86 to operate the pawl 88 which in turn rotates or steps the ratchet wheel 89 and feed wheel 46 a distance equal to one tooth of the said ratchet. There are so many teeth on the ratchet wheel 89 as there are pins in the feed wheel 46 and thus the belt 44 will be stepped a distance equal to the distance between two consecutive transverse rows of holes therein on each revolution of the sleeve 64. A spring biased retaining pawl 90 prevents rotation of the ratchet wheel 89 in a reverse direction.

Obviously it is necessary that all the shutters 54 be in a closed position prior to their engagement with the pins 59 on the selector levers 33 and this resetting operation is accomplished by a so-called resetting mechanism shown in Fig. 7 and controlled by the cam 66. The cam 66 has in operative relation therewith a follower 95 mounted on an arm of a bell crank 96 pivoted at 97. Extending from the other one of the arms of the bell crank 96 is pin 98 to which is attached a link 99. The other end of the link 99 engages the depending arm of a resetting lever 101 pivoted on rod 102. The upwardly extending arm of the reset lever 101 is U shaped and carries a rod 103 in the uppermost part thereof. Throughout the above described elements the reset lever 101 is caused to rock first in a clockwise direction and then in a counter-clockwise direction. once for each revolution of the cam 66. During the clockwise movement of the lever 101 the rod 103 engages the projections 58 of any of the shutters 54 that happen to be in an opened position in the transverse row in operative relation therewith to close the same. Thus all the shutters 54 are positioned to their normal closed position as the belt 44 moves past the resetting mechanism. The timing of the reset and feed cams 66 and 68 respectively on the sleeve 64 are such that the belt 44 is preferably stationary during the operation of the reset lever 101. Thus on the actuation of each one of the key levers 24 the belt 44 is advanced a distance equal to that between two consecutive transverse rows of holes and during the movement thereof the row of shutters in operative relation with the pins 59 on the selector levers 33 are selectively opened and another transverse row of holes ahead of the pins 59 are closed by the resetting lever 101.

As hereinbefore stated the belt 44 after leaving its selecting position goes to the scanning position where each transverse row of holes is scanned in a manner hereinafter set forth. The scanning operation is controlled by a hereinbefore mentioned scanning cam assembly 65 which is frictionally driven from the shaft 63 through friction elements 106 in much the same manner as the cam assembly 60 is driven. Included in the cam assembly 65 is a stop arm 108, Fig. 5, a feed cam 109, Fig. 3, and a gear 111 intermediate with spacers 105 and mounted on a sleeve 110.

The rotation of the assembly 65 is controlled by a lever 112, Fig. 5, pivoted at 113 and having a projection 114 which cooperates with the stop arm 108. The upper horizontal section of the lever 112 is in operative relation with the section of the belt 44 between the feed wheels 46 and 48

of the selecting and scanning assembly respectively. When a loop in the belt 44 forms between the feed wheels 46 and 48, a spring 116 attached to the lever 112 is normally allowed to pivot the same in a counterclockwise direction as shown in Fig. 5 to withdraw the projection 114 from engagement with the stop arm 108 whereupon the cam assembly 65 is free to rotate. The rotation of the cam assembly 65 may continue until the loop in the belt decreases to such a size as to reengage the horizontal section of the lever 112 and pivot the same against the action of the spring 116 to place the projection 114 again in the path of the stop arm 108 whereupon further rotation with the cam assembly 65 is stopped. A magnet 117 may be associated with the lower arm of the lever 112 and the energization thereof will hold the lever in its normal position to prevent the release or to stop the cam assembly 65 although there may be a loop in the belt between the selecting and scanning mechanisms. The magnet 117 may be controlled by switching arrangements or other means and thereby prevent operation or the starting of the scanning mechanism independent of the size of the loop, however the cam assembly 65 is invariably stopped when the size of the loop decreases to a predetermined minimum. Thus by use of the magnet 117 an appreciable number of signals may be stored in the tape prior to the start of scanning operations.

In the preferred embodiment of the invention the scanning cam assembly 65 is not necessarily stopped after each revolution but when once started continues until the lever 112 is returned to its normal position.

A cam follower 118, Fig. 3, is associated with the feed cam 109 and is supported adjacent the center of lever 119, one end of which is pivotally supported at 121. The other end of the lever 119 carries a pawl 122 which cooperates with a ratchet wheel 123 to rotate or step the same one tooth on each revolution of the cam 109. The ratchet wheel 123 is fixed to a rod 124 to which is also fixed the scanning mechanism feed wheel 48. Thus through the above described elements, which operate substantially like that shown in Fig. 4 for advancing the belt through the selecting mechanism, the belt is advanced through the scanning mechanism. A holding pawl 126 cooperates with the ratchet 123 to prevent rotation thereof in a reverse direction.

The gear 111 of the cam assembly 65 meshes with another gear 127, which is attached to the lower end of a shaft 128. The shaft 128 is suitably journaled in a vertical position and has adjacent its upper end a scanning disc 129, Fig. 15. The gears 127 and 111 have a one to one ratio and therefore the scanning disc 129 will make one revolution for each revolution of the scanning cam assembly 65.

As shown in Fig. 15, a light source 131 and a photocell or similar light sensitive device 132 are arranged to have the belt 44 and disc 129 pass therebetween. Formed in the disc 129 at different radii from the center is a start pulse scanning hole 133, Fig. 9, and five intelligence or signal scanning holes 134. Beginning with the start pulse scanning hole 133, the intelligence scanning holes 134 are arranged substantially one-seventh of the angularity of the disc apart in a clockwise direction. As the holes in the disc 129 are at different radii each is adapted to scan a different longitudinal row or line of holes in the belt. The hole 133 scans one of the feed holes such as 53, Fig. 13, while the holes 134 scan associated ones of the holes 52 in the belt.

As the feed holes 53 have no shutters, each time the start pulse scanning hole 133 in the disc scans its associated feed hole, light from the source 131 is allowed to impinge upon the light sensitive device 132. At predetermined intervals thereafter each of the intelligence scanning holes 134 scan or pass over their associated holes in a transverse row in the belt 44 and depending upon the position of the individual shutters in this particular transverse row of holes, light from the source 131 is allowed or prevented from impinging upon the light sensitive device 132. A mask 136 on the light source 131 has a slit in the bottom thereof which permits light therefrom to only fall upon the transverse row of holes in the belt 44 in line with the axis of the scanning disc 129 while a similar slit in the upper side of the mask 137 on the light sensitive device 132 permits only light from the light source 131 to impinge thereupon.

The light sensitive device 132 is arranged to control a relay 138, Fig. 15, through an amplifier, if desired or necessary, in such a way that the relay 138 is energized when light impinges upon the light sensitive device. The tongue of the relay 138 is connected to battery and the break stop thereof connected to a line circuit. Thus for operated and non-operated conditions of the relay 138, the line circuit is opened and closed respectively. At the start of each revolution of the disc 129 the start pulse scanning hole 133 allows light from the source 131 to pass therethrough and the feed hole 53 to impinge the light sensitive device 132. This causes the relay 138 to operate to open the line circuit and transmit a start impulse. Following the transmission of the start pulse; the relay is operated or remains in its unoperated position in accordance with the the position of the shutters 54 on the row of holes being scanned. Accordingly, five impulses of open or closed line condition are transmitted to the line following a start impulse. The start pulse scanning hole 133 and the last intelligence scanning hole 134 are on radii approximately two-sevenths of the circumference of the disc 129 apart, and during this time the relay 138 becomes deenergized to close the line circuit and transmit a rest pulse following the code group. The time constant of the relay 138 is such that when operated it remains in an operated condition for a length of time substantially equal to that required for the disc to make one seventh of a revolution. Accordingly the relay 138 does not return to an unoperated position between the scanning of two or more consecutive open holes.

Although the scanning of the belt has been described in a manner wherein start-stop types of signals are transmitted on the scanning thereof, it will be obvious that with apparent changes such as the omission of the start pulse scanning hole and rearrangement of the other holes in the disc multiplex type signals could be transmitted to the line circuit.

The high part on the cam 109, Fig. 3, is arranged to operate its associated mechanism to feed the belt 44 through the scanning arrangement after the outside intelligence scanning hole 134 scans its associated hole and before the start pulse scanning hole scans its associated hole.

Although in the above described arrangements both the selecting and scanning cam assemblies are driven from a common shaft to operate at the same speed, they could be readily adapted

to operate at different speeds by any one of a number of well known arrangements. With the cam assemblies operating at different speeds, the speed of operation of the selecting mechanism may be limited only to the ability of the operator while the speed of the scanning mechanism is limited to the speed of the sending circuit.

A modification of the invention wherein the selecting is controlled by a signal responsive device which in turn controls the opening of the shutters **54** will now be described. The signal responsive means employed is substantially similar in construction and operation to that disclosed in a patent to S. Morton et al., No. 1,745,633, issued February 4, 1930, and comprises in general a set of selector or selecting fingers **141**, Fig. 10, arranged side by side between suitable guide plates, not shown. The left hand ends of the fingers **141** are rounded and are engaged in socket joints in one of the arms of associated bellcranks **142**. Each of the fingers **141** have an associated bellcrank **142** which are all pivoted at **143** and have individual springs, such as **144**, tending to pivot the same in a clockwise direction to hold leftwardly extending arms thereof in engagement with a cam sleeve **146**. Spirally arranged on the cam sleeve **146** for rotation therewith are a series of cams **147**, one individual to and in the same plane as each of the bellcranks **142**. The cam sleeve **146** is arranged to be frictionally driven from a shaft **148** in the usual manner which in turn drives its rotative force from a motor M through gears **149** and **151**. The starting and stopping of the cam sleeve **146** is controlled, through mechanism not shown, by a selector magnet **152** operating in response to received signals and as is the usual practice the cam sleeve is released for one revolution at a time in conjunction with the receipt of each character representing code group of signals. In addition to controlling the starting and stopping of the cam sleeve **146** the magnet **152** controls the pivoting of an armature lever **153** pivoted at **154**.

As the cam sleeve **146** rotates, the cams **147** successively engage associated ones of the bellcranks **142** to oscillate the same and in so doing slide the selector fingers back and forth. The armature lever **153** operates in timed relation with the bellcranks **142** and has projections **156** and **157** adapted to cooperate with arms **158** and **159**, respectively, of the selectors **141**. With the armature lever **153** in its retracted position, the projection **157** thereof is in alignment with the projections **159** on the selector fingers **141**. Similarly with the armature lever **153** in its energized or operated position, as shown, the projection **156** thereon is in alignment with the projections **158** on the selecting fingers **141**. Accordingly, as the cams **147** oscillate the bellcranks **142** to slide the selecting fingers back and forth either one or the other of the projections **158** or **159** will engage associated projections **156** or **157** on the armature lever **153** to shift the right hand end of the selector fingers **141** into engagement with either the upper or lower stop **160** or **160'** respectively. Associated with the right hand ends of the selector fingers **141** are a set of pivotally mounted T-shaped levers **161**, one individual to each selector lever **141**. The levers **161** are pivotally mounted at **162** and are operated by the right hand ends of the selector levers **141** as the bellcranks **142** are returned to their normal positions by the springs **144**. Depending upon the position of the armature lever **153** at the time the selecting fingers are operated toward the left, and the right hand ends thereof engage either the upper or lower arm of the levers **161** on the return movement to pivot the levers **161** from one position to the other. Associated with each of the horizontal arms of the levers **161** are associated shutter operating levers **163** which are adapted for movement in a vertical direction by virtue of vertical slots therein engaging horizontal pins **164**. Thus, depending upon the operation of the selecting fingers **141**, the levers **163** are operated to either their upper or lower position in combinations representative thereof. Jockey springs, such as **166**, are associated with each one of the shutter operating levers **163** which cooperate with notches **167** adjacent the lower ends thereof to jockey the same in either their upper or lower position. At the upper ends of the levers **163** are pins **168** which are substantially similar to the pins **59** on the selector levers **33**, Fig. 2, and are adapted to be moved into the path of the projections **58** on the shutters **54** on the belt **44**. When a lever **163** is in its upper position the pin **168** thereon is in the path of the projection **58** on the shutter in its associated longitudinal row of holes in the belt, and with the lever **163** in its lower position the pin **168** is out of the path of the projection **58**.

Fixed to the cam sleeve **146**, Fig. 11, is a cam **169** employed to feed the belt at the selecting position. A follower **171** on a lever **172** pivoted at **173** has a pawl **174** in the right hand end thereof adapted to cooperate with a ratchet wheel **176** to step or rotate the same one tooth for each revolution of the cam **169**. The ratchet wheel **176** is fixed to a shaft **177** to which is also fixed for rotation therewith a feed wheel **178**, Fig. 10, having pins **179** therein adapted to engage the feed holes of the belt to advance the same. A retaining pawl **181**, Fig. 11, cooperates with the ratchet wheel **176** to prevent rotation thereof in the reverse direction.

A second cam **182**, Fig. 12, rotatable with the cam sleeve **146** has an associated follower **183** located on the upper end of a lever **184** pivotally mounted at **186**. The lower end of the lever **184** has attached thereto the right hand end of a link **187**, the left hand end of which is attached to a resetting lever **188**. The resetting lever **188** is pivotally supported at **189** and for each revolution of the cam **182** the lever **188** oscillates to reset all the shutters **54** to their normal closed position. The timing of the cams **169** and **182**, Figs. 11 and 12, are such that the operation of their associated mechanisms do not interfere.

By means of the above described mechanisms the belt is advanced the distance between consecutive transverse rows of holes therein and during the advancement thereof the shutters **54** are selectively operated to uncover associated ones of the holes in accordance with the operation of the selector mechanism. Accordingly, successive transverse rows of holes in the belt **44** represent successive groups of code combinations. The belt **44** on leaving the feed wheel **178** associated with the selecting mechanism passes to the scanning mechanism, provision being made for the formation of a loop between the two units the same as in the keyboard controlled selector. The scanning mechanism associated with the signal responsive operated selector mechanism as shown in Fig. 10 may be substantially similar to that hereinbefore described associated with the keyboard operated selector, the scanning mechanism of Fig. 10 comprising a feed wheel **191**,

a scanning disc 192, a light source 193 and a light sensitive device 194.

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

What is claimed is:

1. In a signal storage telegraph device for storing code signals, an endless flexible storage member having a series of transverse rows of apertures therein, individual shutters associated with each one of said apertures, means for moving said flexible storage member, means independent of the movement of said storage member for successively positioning transverse rows of said shutters therein to normal positions and means for selectively operating said shutters from said normal position whereby opened and closed apertures in successive transverse rows of said storage member represent code signals.

2. In a signal storage telegraph device for storing code signals, an endless flexible storage member having a series of transverse rows of apertures therein, individual shutters associated with each one of said apertures, means for successively positioning transverse rows of shutters in said storage member to normal positions, a keyboard mechanism employing a set of keylevers, and solely mechanical means controlled by said keyboard mechanism for selectively positioning said shutters from said normal position whereby successive transverse rows of opened and closed apertures in said flexible member represent successively operated keylevers of said keyboard mechanism.

3. In a signal storage telegraph device for storing code signals, an endless flexible storage member having a series of transverse rows of apertures therein, individual shutters associated with each one of said apertures, means for moving said storage member, means operative independently of the movement of said storage member for successively positioning transverse rows of shutters therein to normal positions, a signal responsive device and means controlled by said signal responsive device during movement of said storage member for selectively moving said shutters from said normal position whereby opened and closed apertures in successive transverse rows in said flexible member represent successive operations of said signal responsive device.

4. In a cyclically operable signal storage telegraph device for storing code signals, an endless flexible storage member having a series of transverse rows of apertures therein, individual shutters associated with each one of said apertures, means operative independently of movement of said flexible storage member for successively positioning transverse rows of shutters therein to normal positions, means for moving said storage member a predetermined amount during each cycle of operation of said device, and mechanical means operative on said shutters during and dependent upon the movement of said storage member for selectively operating said shutters from said normal position whereby opened and closed apertures in successive transverse rows of said storage member represent code signals.

5. In a cyclically operable signal storage telegraph device for storing code signals, an endless flexible storage member having a series of transverse rows of apertures therein, individual shutters associated with each one of said apertures, means for successively positioning transverse rows of shutters in said storage member to normal positions, a keyboard mechanism comprising a plurality of keylevers, a first means controlled by the operation of any one of said keylevers at a time to initiate the operation of said device wherein said storage member is advanced a predetermined distance, a second means controlled by the operation of any one of said keylevers for selectively operating said shutters during the movement of said storage member whereby successive transverse rows of opened and closed apertures in said flexible member represent successively operated key levers of said keyboard mechanism.

6. In a signal storage telegraph device for storing code signals, an endless flexible storage member having a series of transverse rows of apertures therein, individual shutters associated with each one of said apertures, means for intermittently advancing said storage member, means operative independently of the advancement of said storage member for successively moving transverse rows of shutters in said storage member to normal closed positions, a signal responsive device and means operative during the movement of said storage member as controlled by said signal responsive device for selectively opening said shutters whereby opened and closed apertures in successive transverse rows in said flexible member represent successive operations of said signal responsive device.

7. In a signal storage device, a storage medium comprising an endless web or belt with a plurality of apertures therein, said apertures being in transverse and longitudinal rows in said medium, a shutter individual to each one of said apertures, a set of permutation bars, a set of selectors, one individual to each of said permutation bars and to each longitudinal row of apertures in said medium, means for operating said selectors to one or the other of two operated positions in accordance with the operation of said permutation bars and representative of actuated ones of said key levers, means operative following the operation of said selectors to advance said medium a distance equal to that between two consecutive transverse rows of apertures, and means operative by said selectors during the advancement of said medium for selectively operating said shutters whereby opened and closed apertures in transverse rows in said medium represent actuated key levers.

8. In a signal storage device, a storage medium comprising an endless web or belt with a plurality of apertures therein, said apertures being in transverse and longitudinal rows in said medium, a shutter individual to each one of said apertures, a set of permutations bars, a set of key levers for controlling the operation of said permutation bars, a set of selectors, one individual to each of said permutation bars and to each longitudinal row of apertures in said medium, means for operating said selectors to one or the other of two operated positions in accordance with the operation of said permutation bars and representative of the actuated one of said key levers, medium advancing means, means operative following the operation of said selectors to render said medium advancing means operative to advance said medium a distance equal to that between two consecutive transverse rows of apertures, and means dependent upon the position

of said selectors during the advancement of said medium by said advancing means for selectively operating shutters associated with said selectors in one of said positions relative to said apertures whereby opened and closed ones of said apertures in transverse rows in said medium represent actuated ones of said key levers.

9. In a signal storage device, a storage medium comprising an endless web or belt with a plurality of apertures therein, said apertures being in transverse and longitudinal rows in said medium, a shutter individual to each one of said apertures, a set of permutation bars, a set of key levers for controlling the operation of said permutation bars, a set of selectors in operative relation with said belt, one individual to each of said permutation bars and to each longitudinal row of apertures in said medium, means for operating said selectors to one or the other of two operated positions in accordance with the operation of said permutation bars and representative of the actuated one of said key levers, means for advancing said medium, means operative following the operation of said selectors to advance said medium a distance equal to that between two consecutive transverse rows of apertures, means operated by said selectors in one of said positions to engage associated ones of said shutters in the transverse row in operative relation therewith to change the position thereof during the advancement of said medium whereby said shutters close or open said apertures in the transverse row in operative relation with said selectors in permutations representative of the actuated key lever.

10. In a signal storage device, a storage medium comprising an endless web or belt with a plurality of apertures therein, said apertures being in transverse and longitudinal rows in said medium, a shutter individual to each one of said apertures, a set of permutation bars, a set of key levers for controlling said permutation bars, a set of selectors one individual to each of said permutation bars and to each longitudinal row of apertures in said storage medium, said selectors having two positions, one in the path of movement of said shutters and the other out of the path of movement of said shutters, a source of power, means operative in response to the actuation of a key lever to selectively position said selectors into one or the other of said two positions in accordance with an actuated key lever and release said source of power to advance said medium to move a transverse row of shutters past said selectors and means operable by said selectors in the path of movement of said shutters during the advancement of said medium to change the position of said shutters in respect to the associated apertures whereby opened and closed apertures in the transverse row moved past said selectors represent the actuated key lever.

11. In a signal storage device, a storage medium comprising an endless web or belt with a plurality of apertures therein, said apertures being in transverse and longitudinal rows in said medium, a shutter individual to each one of said apertures, a set of permutation bars, a set of key levers for controlling said permutation bars, a set of selectors one individual to each of said permutation bars and to each longitudinal row of apertures in said storage medium, said selectors having two positions, one in the path of movement of said shutters and the other out of the path of movement of said shutters, a source of power, means operative in response to the actuation of a key lever to selectively position said selectors into one of the other of said two positions in accordance with an actuated key lever and release said source of power to advance said medium to move a transverse row of shutters past said selectors and means controlled by said selectors in the path of movement of said shutters and operated solely by said source of power during the advancement of said medium to change the position of said shutters in respect to the associated apertures whereby opened and closed apertures in transverse rows moved past said selectors represent actuated key levers.

12. In a signal storage device, a storage medium comprising an endless web or belt with a plurality of apertures therein, said apertures being in transverse and longitudinal rows in said medium, a shutter individual to each one of said apertures, a set of permutation bars, a set of key levers for controlling said permutation bars, a set of selectors one individual to each of said permutation bars and to each longitudinal row of apertures in said storage medium, said selectors having two positions, one in the path of movement of said shutters and the other out of the path of movement of said shutters, a source of power, a web advancing means, a shutter resetting means for moving said shutters to normal positions, said resetting means located ahead of said selectors relative to the direction of movement of said web, means operative in response to the actuation of a key lever to selectively position said selectors into one or the other of said two positions and release said source of power to operate said resetting means and move a row of shutters past said selectors, and means operated by said selectors in the path of movement of said shutters during advancement of said medium to selectively move said shutters from said normal position whereby opened and closed apertures in the transverse row moved past said selectors represent the actuated key lever.

13. In a signal storage device, a storage medium comprising an endless web or belt with a plurality of apertures therein, said apertures being in transverse and longitudinal rows in said medium, a shutter individual to each one of said apertures, a signal responsive device comprising a set of selectors having two positions, one of said positions being in the path of movement of said shutters and the other out of the path of movement of said shutters, means controlled by said signal responsive device to set said selectors in accordance with received signals, a source of power, a web advancing means, a shutter resetting means positioned ahead of said selectors relative to the direction of movement of said web, means operative following the positioning of said selectors for releasing said source of power to operate said resetting means and said web advancing means to advance a row of shutters past said selectors, means operated by said selectors during such movement of said shutters to selectively operate the same whereby opened and closed apertures in said web represent according to a predetermined arrangement signals received on said signal responsive device.

14. In a signal storage device, a storage medium comprising an endless web or belt with a plurality of apertures therein, said apertures being in transverse and longitudinal rows in said medium, a shutter individual to each one of said apertures, a signal responsive device comprising a set of selectors having two positions, one of said

positions being in the path of movement of said shutters and the other out of the path of movement of said shutters, means controlled by said signal responsive device to set said selectors in accordance with received signals, a source of power, a web advancing means, a shutter resetting means positioned ahead of said selectors relative to the direction of movement of said web, means operative following the positioning of said selectors for releasing said source of power to operate said resetting means and said web advancing means to reset a row of shutters and advance a row past said shutters respectively, means determined by the position of said selectors and operated solely by said source of power during movement of said web to selectively operate said shutters whereby opened and closed apertures in successive transverse rows in said web represent according to a predetermined arrangement successive groups of code signals on said signal responsive device.

15. In a signal storage device, a storage medium comprising an endless web or belt with a plurality of apertures therein, said apertures being in transverse and longitudinal rows in said medium, a shutter individual to each one of said apertures, a set of selectors selectively positionable into one or the other of two positions, one of said positions being in the path of movement of said shutters and the other out of the path of movement thereof, means operative concomitantly with the positioning of said selectors for advancing said medium to move a transverse row of shutters past said selectors and means operative during the advancement of said medium to selectively position said shutters in accordance with the position of said selectors.

16. In a signal storage device, a storage medium comprising an endless belt, said belt having a series of transparent sections therein arranged in transverse and longitudinal rows, individual shutters associated with each of said transverse sections adapted to be moved to control the passage of light therethrough, a selecting means for selectively positioning said shutters to prevent or permit passage of light through associated transparent sections whereby successive transverse rows thereof represent code signals, means for moving said medium relative to said selecting means, a transmitting mechanism located adjacent said selecting means, said medium being arranged to move from said selecting means to said transmitting mechanism, a light source and a light sensitive device in said transmitting mechanism, means controlled by light from said source passing through transparent sections of said medium not covered by said shutters for controlling transmission of signals from said transmitting mechanism, means for forming a loop in said medium between said selecting means and said transmitting mechanism and means controlled by the size of said loop for initiating and stopping the operation of said transmitting mechanism.

17. In a signal storage device, a storage medium comprising an endless belt, said belt having a series of transparent sections therein arranged in transverse and longitudinal rows, individual shutters associated with each of said transverse sections adapted to be moved to control the passage of light therethrough, a selecting means for selectively positioning said shutters to prevent or permit passage of light through associated transparent sections whereby successive transverse rows thereof represent code signals, means for moving said medium through said selecting means, a transmitting means in spaced relation with said selecting means including a light source, a light sensitive device, a medium advancing means and a rotatable scanning disc, means for forming a loop in said medium between said selecting means and said transmitting mechanism, means controlled by said loop for controlling the operation of said medium advancing means and the rotation of said scanning disc, means operative on the rotation of said scanning disc to allow light from said source to successively scan a transverse row of transparent sections in said medium, means determined by the positions of said shutters to control the passage of said light through said transparent sections to said light sensitive device and means responsive to said light sensitive device for transmitting code signals representative of the conditions of said shutters in successive transverse rows on said medium.

18. In a signal storage device, a storage medium comprising an endless belt, said belt having a series of transparent sections therein arranged in transverse and longitudinal rows, individual shutters associated with each of said transverse sections adapted to be moved to control the passage of light therethrough, a selecting means for selectively positioning said shutters to prevent or permit passage of light through associated transparent sections whereby successive transverse rows thereof represent code signals, means for moving said medium through said selecting means, a transmitting means in spaced relation with said selecting means including a light source, a light sensitive device, a medium advancing means and a rotatable scanning disc, means for forming a loop in said medium between said selecting means and said transmitting mechanism, means controlled by the size of said loop for controlling the operation of said medium advancing means and the rotation of said scanning disc, a sending circuit, means controlled by light from said source passing through said transparent section in said medium for controlling said light sensitive device to transmit code signals representative of the positions of said shutters in successive transverse rows of said medium and means for maintaining said sending circuit in a predetermined condition on the stopping of said scanning disc.

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