

April 22, 1924.

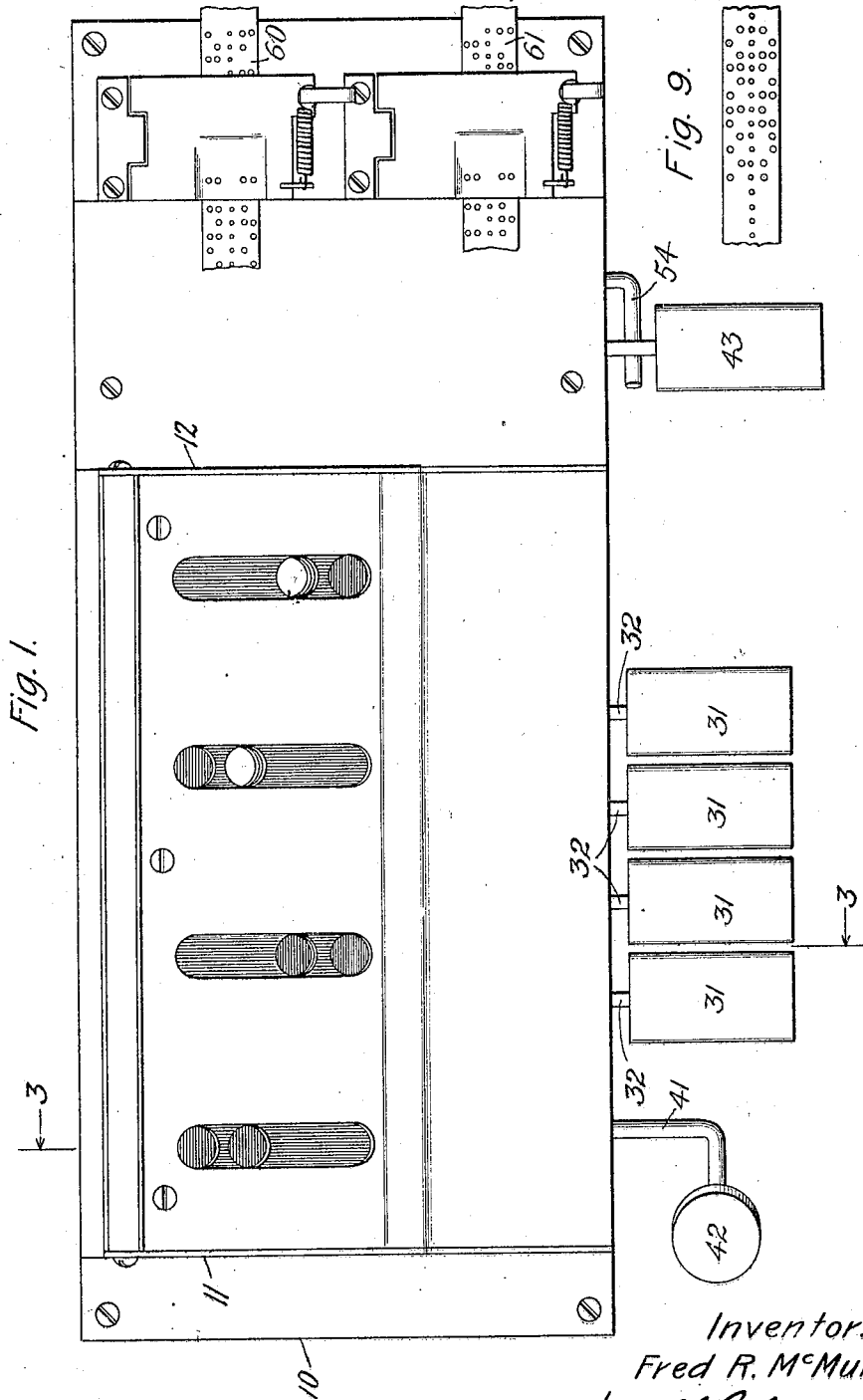
F. R. McMURRY

1,491,350

ENCIPHERING AND DECIPHERING MECHANISM

Filed Jan. 24, 1919

4 Sheets-Sheet 1



Inventor:
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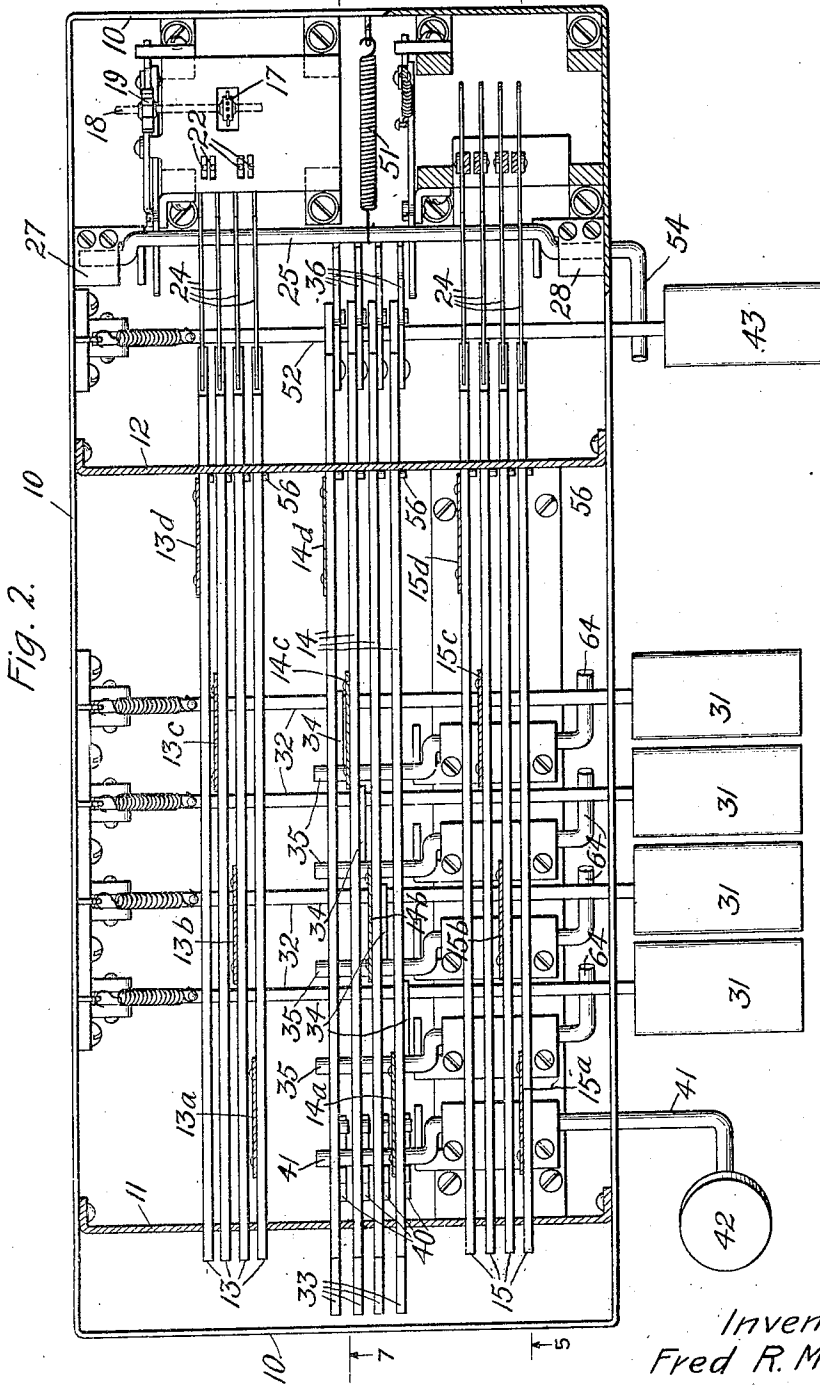
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4 Sheets-Sheet 2



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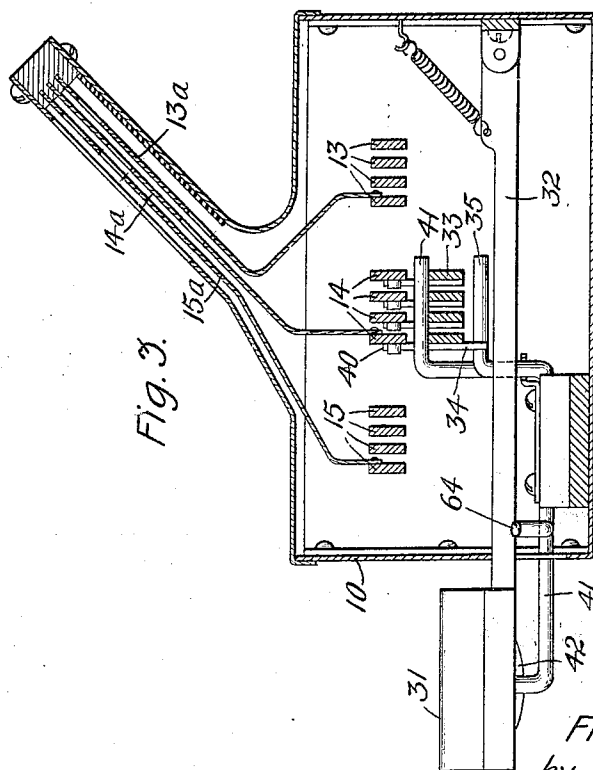
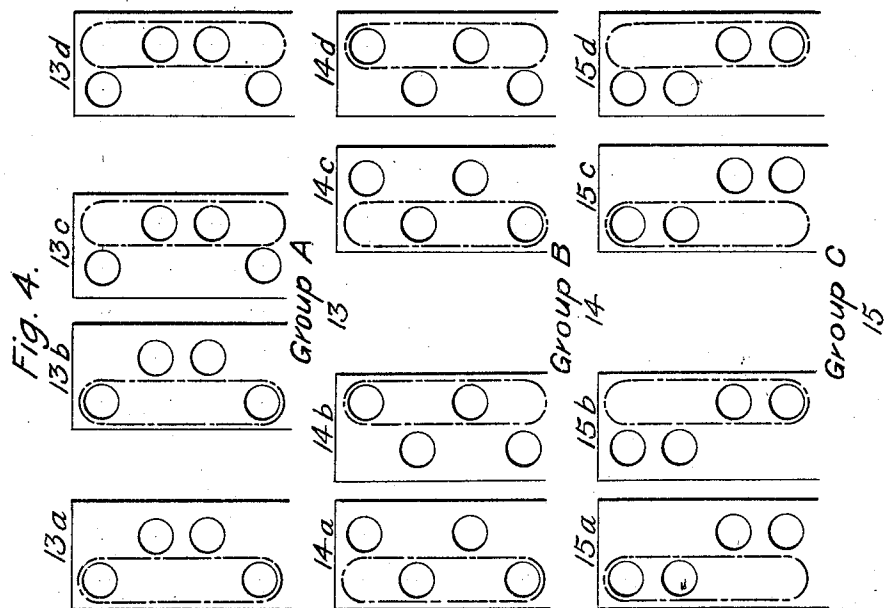
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4 Sheets-Sheet 3



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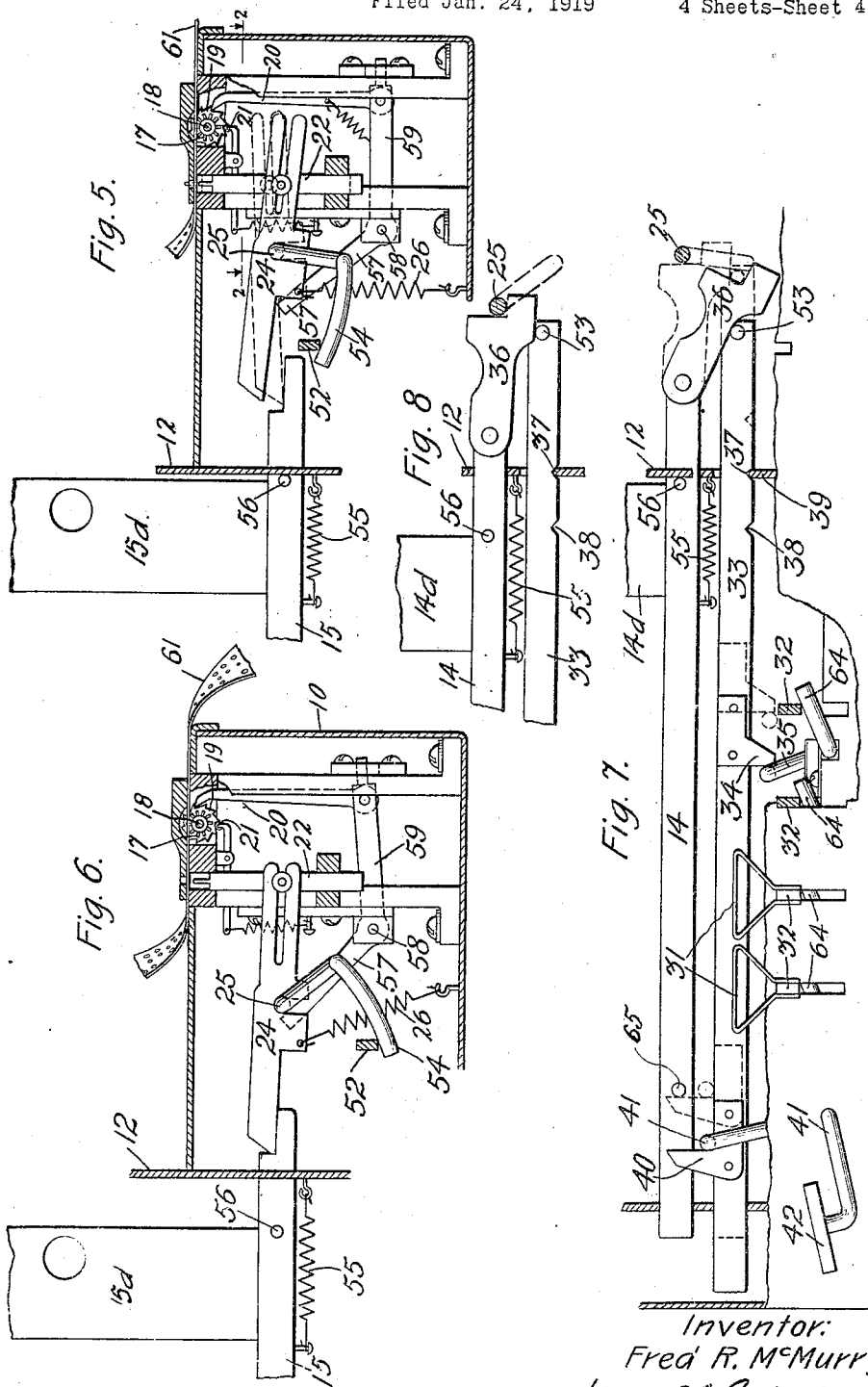
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ENCIPHERING AND DECIPHERING MECHANISM

Filed Jan. 24, 1919

4 Sheets-Sheet 4 .



UNITED STATES PATENT OFFICE.

FRED R. McMURRY, OF WESTWOOD, NEW JERSEY, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

ENCIPHERING AND DECIPHERING MECHANISM.

Application filed January 24, 1919. Serial No. 272,802.

To all whom it may concern:

Be it known that I, FRED R. McMURRY, a citizen of the United States, residing at Westwood, in the county of Bergen, State of New Jersey, have invented certain new and useful Improvements in Enciphering and Deciphering Mechanism, of which the following is a full, clear, concise, and exact description.

This invention relates to visual signal indicators and in particular to mechanisms for displaying a signal indication in code form.

Its main purpose is to decipher automatically a message enciphered according to a prearranged constantly varying rule, and to give a direct visual indication in code form of the true message. The invention, however, is equally useful for enciphering messages.

It has previously been proposed to employ, in connection with printing telegraph systems, a method of enciphering the message to be transmitted, which consists in transmitting over the line for each character of the message a set of impulses which represents the combination of the true message impulses with a second set of impulses arbitrarily chosen and changing for each character transmitted.

Such a result has been obtained by perforating the true message on a paper strip or tape in the form of the well known Baudot code, perforating a similar tape with another message or jumble of characters, running these two tapes in synchronism through two tape transmitters which jointly control the transmission of impulses to the line, or the energization of the electro-magnetic punch selecting members of a local perforator which perforates a third tape with an unintelligible sequence of characters representing a combination of the message tape and the cipher tape. This unintelligible or enciphered message is then transmitted over the line and may be recorded by any suitable receiving device, preferably a receiving perforator which will then perforate a tape duplicating that used for the transmission of the enciphered message.

For deciphering such a message it is essential that the receiving operator be provided with a duplicate of the original cipher tape. When so equipped, he can by run-

ring the cipher tape and the enciphered message tape in synchronism through two local tape transmitters, exert a joint control on the selecting mechanism of a local printer that will result in the printing of the original message in deciphered form.

Further secrecy of communication can be secured by employing two (or more) ciphering tapes simultaneously, and combining the effects of the two with the message tape.

The invention herein involved in the form chosen for illustration, provides a mechanical device for deciphering a message transmitted according to the system above outlined, and suitable for use in situations where electrical appliances are not available or ordinarily operable. The specific form herein illustrated comprises four sets of movable shutters, one set for each impulse element of a four impulse code. Each set is composed of three shutters each of which is provided with a plurality of openings which are so disposed with reference to the openings of the other shutters of that set, that a clear path for a beam of light will be provided if an odd number of the shutters of the set are shifted from normal position, but no such path will be provided if an even number of the shutters are shifted. The shutters may be shifted selectively under the control of three control devices, to each of which is assigned the control of one shutter of each set.

Two of these control devices are set for operation by means of perforated tapes, in this case the two cipher tapes, while the third control device is set for operation through the instrumentality of a set of manually operated keys, in accordance with the signal indication appearing on the enciphered message tape. When all three control devices have been thus set, the actuation of a single operating key moves the various selected shutters and gives a direct visual indication in code of the deciphered message. The release of the operating key moves the two cipher tapes along for the next character, and restores the shutters to normal, preparatory to the deciphering of the next character of the message. The true message may thus be spelled out, character by character, without the necessity of reference to an elaborate code book.

The invention will be more readily under-

stood from the following detailed description and claims, and by reference to the accompanying drawings illustrating the preferred form of applicant's invention, wherein
 5 Fig. 1 is a plan view of the deciphering instrument; Fig. 2 is a horizontal sectional view showing the arrangement of the selecting and selectable bars; Fig. 3 is a vertical sectional view along the line 3—3, Fig.
 10 1; Fig. 4 illustrates an arrangement of the various shutters, carried by the selectable bars, necessary to give the visual indication represented in Fig. 1; Fig. 5 is a vertical sectional view of one of the tape controlled
 15 mechanisms in unactuated position; Fig. 6 is another vertical sectional view of the mechanism illustrated in Fig. 5, but shown in actuated position; Fig. 7 is a vertical sectional view taken along the line 7—7, Fig.
 20 2; Fig. 8 is a partial view of the selectable bar illustrated in Fig. 7 but shown in its actuated position; and Fig. 9 represents a section of the enciphered message tape.

Referring particularly to Figs. 1, 2 and
 25 3, the deciphering instrument is enclosed in a rectangular frame structure 10, and the operating members and apparatus are supported primarily by the frame 10 and cross members 11 and 12. The selectable bars are
 30 arranged in three groups of four each. The outer groups 13 and 15 in the present embodiment are controlled by means of perforated tapes, while the bars of the center group 14 are controlled by manually operable
 35 keys 31, there being one key corresponding to each selectable bar of the key controlled group. Each selectable bar of each group carries a shutter which is provided with a plurality of openings therein and
 40 the shutters are arranged in four sets of three each. In the embodiment shown each shutter is provided with four openings, and the openings are so disposed that normally no set of shutters are arranged so that open-
 45 ings therein fall in alignment, but when the shutters are selectively actuated in accordance with predetermined conditions, the shutters will present one or more sets of holes in alignment so that a clear path for
 50 a beam of light is provided. For convenience in reading the indication when displayed in code form, the shutters may be mounted at any suitable angle, for example, as illustrated in Fig. 3.

At the right-hand end of the instrument
 55 are mounted two similar tape controlled devices, best illustrated in Figs. 5 and 6. One of the tape controlled devices controls the selective action of the selectable bars forming the group 13, while the other device controls the selective action of the group of
 60 bars 15. The tape controlled devices are in general similar in structure to the well-known automatic tape transmitters employed for transmitting signaling impulses,

and in the form herein illustrated, the devices differ from the usual tape transmitters only in that the selecting pins determine the movement of selectable shutter carrying
 70 members instead of closing contacts. The perforated cipher tapes are each fed forward by a feed wheel 17 provided with a plurality of radially extending pins, which cooperate with the row of feed holes punched
 75 longitudinally in the center of the tape. The feed wheel is mounted on a shaft 18, to which is rigidly secured a ratchet wheel 19. The shaft is rotated by a feeding pawl 20 cooperating with the ratchet, the operation
 80 of which will presently be described. To prevent backward rotation of the ratchet and feed wheel, a jockey roller 21 is provided, which permits the ratchet to be turned in one direction only. Arranged just be-
 85 neath and crosswise of each tape are four vertically mounted members 22, tapered at the upper ends into selecting pins and adapted to cooperate or register with holes in the tape to thereby determine which shut-
 90 ters of a particular group are to be actuated.

The pins are normally held spring-pressed against the tape, in readiness to register with the openings therein the instant they appear
 95 over the pins. Associated with each pin member 22 and forming a connecting link between each of the selectable bars 13 and 15 and the members 22 is a selecting member 24, normally pivoted on a rod 25. The
 100 forward end of each member 24 is adapted to engage a shoulder or offset portion of its associated selectable bar, while the opposite end of each selecting member 24 is bifurcated and cooperates with a post or extension
 105 23 attached to its associated selecting pin.

The selecting pins 22 and selecting members 24 are normally held in the positions indicated in full lines, Fig. 5. The parts
 110 are held in this position when there are no openings in the tape in position for the pins to pass through. However, the instant an opening appears in the tape immediately above a selecting pin, the pin and corresponding selecting member 24 will move under the action of spring member 26 into the
 115 dotted line positions Fig. 5, to thereby control the actuation of one of the selectable bars 13 and 15.

The irregularly shaped rod 25 is best illustrated in Fig. 2, supported at 27 and 28. The rod 25 is normally held in its retracted or unoperated position by means of retractile spring 51, one end of which is attached to the rod 25 and the other end to the frame
 125 10. The rod 25 is adapted to be rocked or oscillated, for purposes as will presently appear, by the depression of operating key 43.

Referring now particularly to Figs. 1, 2, 3, 7 and 8, a plurality of manually operable
 130

finger keys 31 and key levers 32 are provided for directly controlling the actuation of the selectable bars 14. Associated with and mounted just beneath each bar 14 but loosely connected thereto is a parallel bar 33. Attached to each bar 33 is a downwardly extending arm 34 which is adapted to be engaged by a rod or crank lever 35, whenever its associated key and key lever is depressed.

Referring particularly to Fig. 7, it will be seen that when a key lever 32 is depressed, it engages an arm or extension 64 of a rod 35, and causes the rod 35 to move its corresponding bar 33 to the right, as indicated in the dotted line position. When the bar 33 is moved to the right, a pin 53 carried thereby and normally in engagement with a pivotally mounted arm 36 carried by bar 14, raises the arm 36 into the dotted line position Fig. 7, in readiness to control the movement of its associated selectable bar. It will be noted that the movement of the bar 33 does not impart motion to its associated selectable bar 14, but merely places the bar 14 in condition for actuation. Each bar 33 may be provided with suitable holding means, such as V-shaped grooves 37 and 38 which are adapted to cooperate with the stationary V-shaped member 39 to hold the bars in either their actuated or unactuated positions, thereby making it unnecessary to hold a finger key depressed after it has once been actuated.

After one or more of the keys 31 have been depressed, in accordance with the code representations of the enciphered message tape to determine which of the selectable bars forming the group 14 are to be actuated, and the perforated tapes have been placed in position in the tape controlled devices to permit certain selecting pins to register therewith and determine the bars 13 and 15 which are to be selected, the operator depresses the operating key 43, thereby causing the key lever 52 to engage the arm or extension 54 of shaft 25 and rock the said shaft forward into the position illustrated in Figs. 6 and 8. Shaft 25 when rocked forward, forces those of the selecting members 24, which have been selected, forward against the shoulders of the selectable bars 13 and 15, thereby forcing the bars to the left against the action of the spring members 55 which normally hold the bars to the right or in their unactuated positions. The shaft 25 in moving forward also engages those arms 36, carried by the selectable bars 14, which have been selected, and forces the selectable bars 14 to the left in a similar manner against the action of the spring members 55 which normally hold the bars with their stop pins 56 resting against the cross member 12. Each of the selectable bars 14 is provided with a pin 65 which is adapted to engage an extension arm 40 of the actuated selecting bars 33

for the purpose of returning the actuated bars 33 to normal as the bars 14 are moved to their actuated positions.

The depression of key 43, in addition to operating the selectable bars and shutters to display the true message character in code, also controls the restoration of the selecting pins and the feeding of the perforated tapes forward to present a new combination in each of the cipher tapes. Referring particularly to Figs. 5 and 6, the selecting members 24 are normally pivoted on the shaft 25. However, when a bar 24 is selected and its forward end is brought into engagement with its corresponding selectable bar 13 or 15, its pivotal point shifts from rod 25 to the end of the selectable bar, and by means of the forward movement of the shaft 25 and the pull exerted on the member 24 by the spring 26, the bifurcated end of the member 24 is lowered, and in its downward movement withdraws the selecting pin from the opening in the tape. At the instant the selecting pins are withdrawn from the tape, the shaft 25 engages an arm 57 pivotally supported at 58, and through the action of an extension arm 59 the feeding pawl 20, cooperating with the ratchet 10 rotates the feed wheel 18 to feed the tape forward to present a new combination of perforations in the cipher tape for the selecting pins.

It is preferable that the key 43 be held depressed until the operator has read the signal or character displayed in code on the display board, and consequently the shaft 25 and the members controlled thereby are held in their actuated positions until the finger key 43 is released. The instant the key 43 is released, all of the selectable members 13, 14 and 15 which have been shifted are returned to normal under the action of their individual springs 55, and the various parts of the tape control selecting devices are likewise restored to normal. As illustrated in Figs. 5 and 6, the cipher tapes are fed forward by the depression of the operating key 43 to present a new cipher combination, and the selecting pins registering with the perforations of the new combination move into their selected position upon the release of the key 43. If desired, suitable means may be provided for holding the key 43 in its depressed position, together with means for releasing the holding means, although such an arrangement is believed to be neither necessary nor desirable.

For the purpose of correcting any errors which may be made by operating one or more of the keys 31 accidentally, and in order that such mistakes may be rectified before depressing the operating key 43, a finger key 42 is provided attached to a rocker arm 41 for restoring the bars 33 to normal. Each bar 33 is provided with an upwardly extending arm 40 against which the rocker

arm 41 normally rests. When a bar 33 has been erroneously actuated and moved to the right, the extension 40 and rocker arm 41 is likewise moved to the right as indicated in dotted lines Fig. 7. By depressing the finger key 42, any time before depressing the operating key 43, the actuated bars 33 may be restored to normal, thereby enabling the operator to erase the error and set up the correct combination.

A better idea of the invention and the method of displaying the message characters in code can perhaps be obtained by considering the positions of the shutters assumed in Fig. 4 to give the signal indication represented in Fig. 1. In Fig. 4 as illustrated the shutters carried by the several selectable bars and arranged in groups. Shutters 13^a, 13^b, 13^c and 13^d forming one group are carried by bars 13, shutters 14^a, 14^b, 14^c and 14^d forming a second group are carried by bars 14, and shutters 15^a, 15^b, 15^c and 15^d forming a third group are carried by bars 15. The broken line on each shutter in Fig. 4 illustrates the normal position of the shutter with reference to its corresponding slot or aperture in the target illustrated in Fig. 1. Certain of the shutters of Fig. 4 are illustrated as moved to the left, in accordance with particular sets of perforations in the enciphered message tape and the cipher tapes. In this figure it is assumed that shutters 13^c and 13^d of the first group controlled by perforated tape 60, shutters 14^b and 14^d of the second group controlled by finger keys 31, and shutters 15^b and 15^d of the third group controlled by perforated tape 61 have been actuated. Looking at the shutters of each set from front to back, none of the shutters 13^a, 14^a or 15^a of the first set have been shifted; of the second set, shutters 14^b and 15^b have been shifted; of the third set, shutter 13^c only has been shifted, and of the fourth set, shutters 13^d, 14^d and 15^d have been shifted. As hereinbefore mentioned, by shifting an odd number of shutters of a set, the openings therein will be so disposed as to place one opening of each shutter of a set in alignment so as to provide a clear path for a beam of light, and when an even number of shutters are shifted no such path will be provided. Therefore since an odd number of shutters have been shifted only in the third and fourth sets, signals will appear on the display board in the third and fourth positions only.

In the embodiment of the invention herein illustrated, two cipher tapes have been employed, it being understood that these tapes are continuous and duplicates of the tapes employed at the transmitting station for combination with the true message tape. However, the invention is not limited to the use of any particular number of cipher

tapes as it will be readily understood that the invention is equally applicable to the use of one or more cipher tapes. When two or more tapes are employed they are preferably prepared with an unlike number of characters represented in each tape.

Applicant does not lay claim to the particular selecting arrangement illustrated in the accompanying drawings as the selecting structure is being claimed by another in a separate application. Furthermore, applicant does not wish to be limited to any particular form of selecting mechanism or to any specific arrangement of displaying the deciphered message by visual signals, but desires to claim broadly mechanical means for translating an aggregation of characters or symbols into intelligence, and displaying said translated characters in code form.

What is claimed is:

1. A mechanically operated device having the parts thereof arranged in a unitary structure for enciphering and deciphering a message comprising a group of members operated in accordance with the secret code representations, another group of members positioned in accordance with the character representations of a prearranged code, and an all mechanical mechanism for combining the effects produced by the actuation of the two groups of members for giving an indication of such combined effects in code formation.

2. In combination, a plurality of movable bars arranged in groups, a signal controlling member carried by each of said bars and arranged in sets, manual means for selecting the members of one of said groups, a plurality of tape controlled devices for selecting the members of the other groups, and a signal under the control of each set of selectable members.

3. In combination, a display board having a plurality of apertures therein, shutters normally closing said apertures, shiftable members supporting each of said shutters, means for selectively determining which of said members are to be shifted, and means for operating said selected ones.

4. In combination, a display board having a plurality of apertures therein, a set of shutters with openings therein normally covering each of said apertures, and means for selectively shifting the shutters of a set to bring an opening of each shutter into alignment with its respective aperture.

5. In combination, a plurality of selectable bars, signal controlling shutters carried thereby, manually operable means for conditioning predetermined ones of said bars for actuation, automatic means for selectively conditioning predetermined ones for actuation, and means for actuating said conditioned bars.

6. A mechanism for enciphering and de-

5 ciphery messages comprising in a unitary structure, a display board, a plurality of selectable members, and means for selectively positioning said members in varying combinations with respect to the display board, whereby the resultant setting of said members may be readily detected.

10 7. A mechanism for enciphering and deciphering messages comprising in a unitary structure, a display board, a plurality of groups of selectable members, and means individual to each of said groups for positioning said members in predetermined combinations with respect to the display board, whereby the resultant setting of said members may be readily detected.

20 8. A mechanism for enciphering and deciphering messages comprising in a unitary structure, a display board, a plurality of groups of selectable members, means for operating the members in each group in varying combinations, and means operatively associated with said members and responsive to the movement thereof for permitting the detection of the conjoint setting of said members with respect to the display board.

9. A mechanism for enciphering and deciphering messages comprising in a unitary structure, a display board, a plurality of selectable members, means carried by each of said members, and mechanisms for selectively setting said members in predetermined combinations whereby said means are brought into operative relation with respect to said display board for giving a distinctive manifestation of the setting of said members.

10. In combination, a display board having a plurality of apertures therein, a plurality of selectable elements, indicating means carried by each of said elements and arranged to normally close the apertures in the display board, and means for selectively positioning said elements whereby said indicating means is positioned with respect to the apertures in the display board to give a manifestation in code form of the effects produced due to the setting of said elements.

In witness whereof, I hereunto subscribe my name this 16th day of January A. D., 1919.

FRED R. McMURRY.