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APPARATUS FOR FORMING TELEGRAPH TAPE.

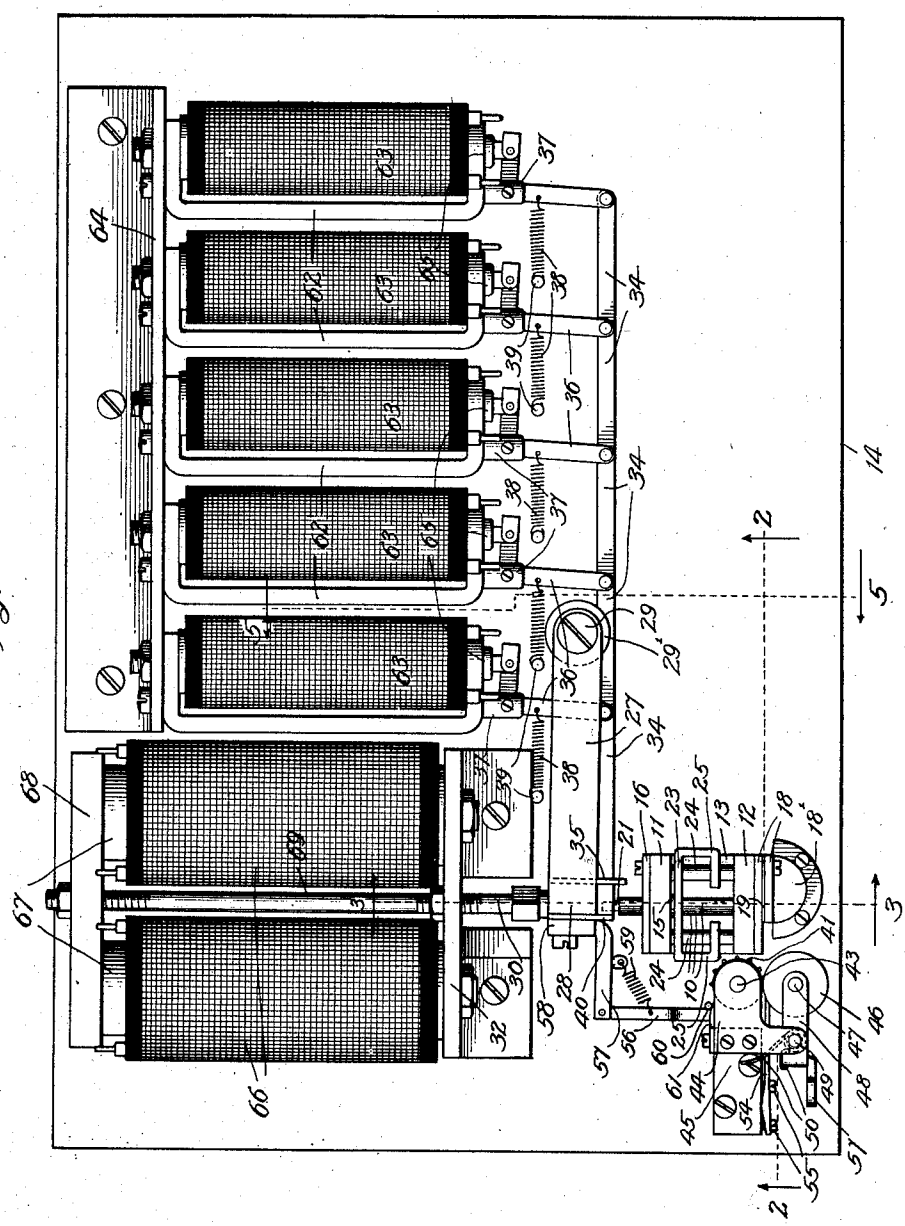
APPLICATION FILED JUNE 18, 1912.

**1,174,427.**

Patented Mar. 7, 1916.

5 SHEETS—SHEET 1.

Fig. 1.



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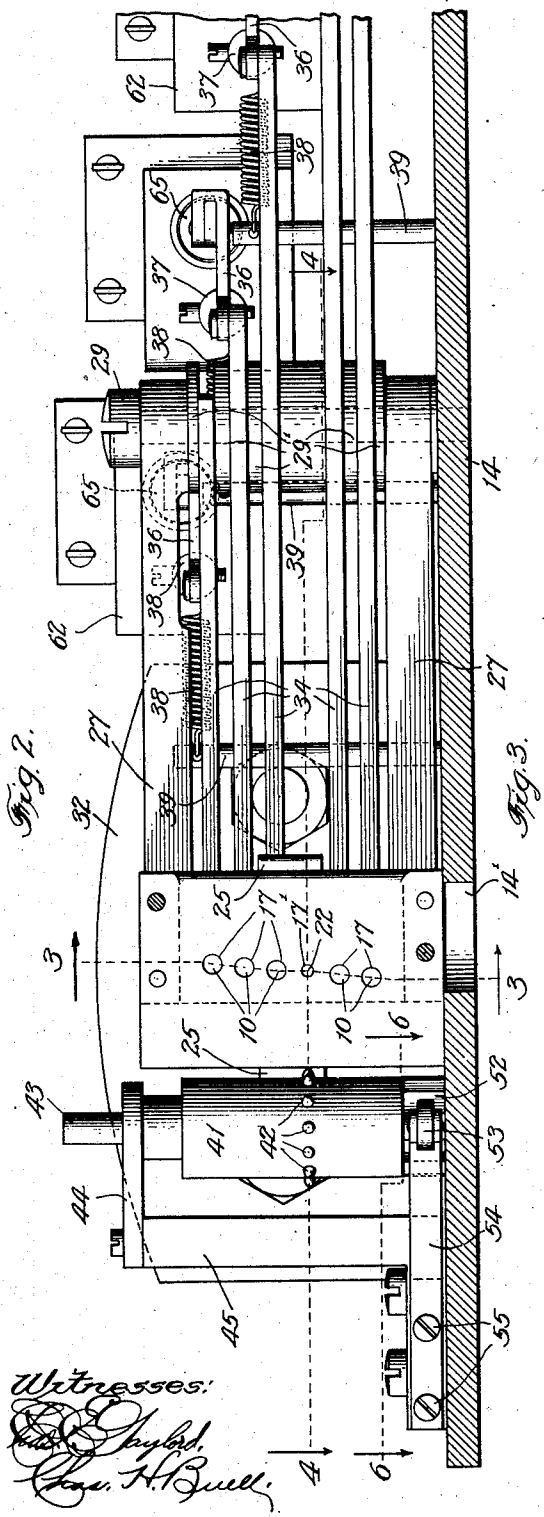

Fig. 2.

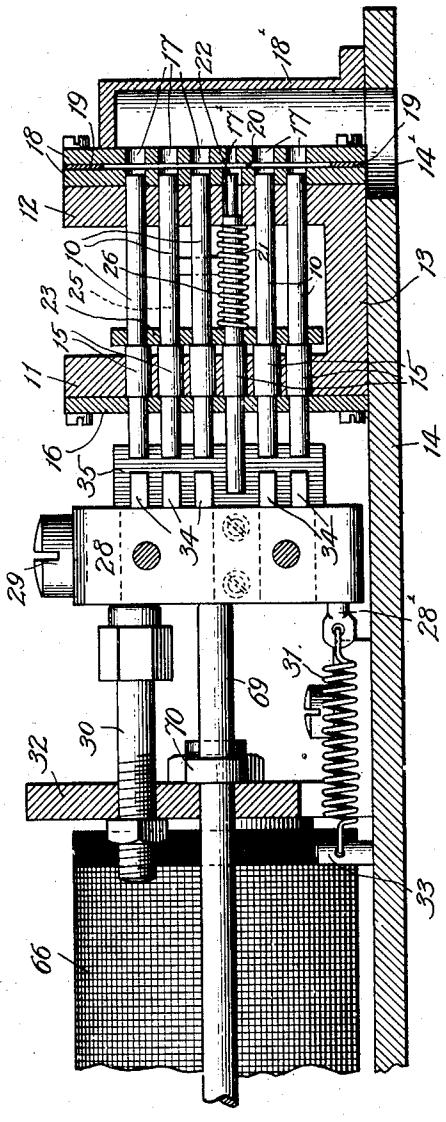

Fig. 3.

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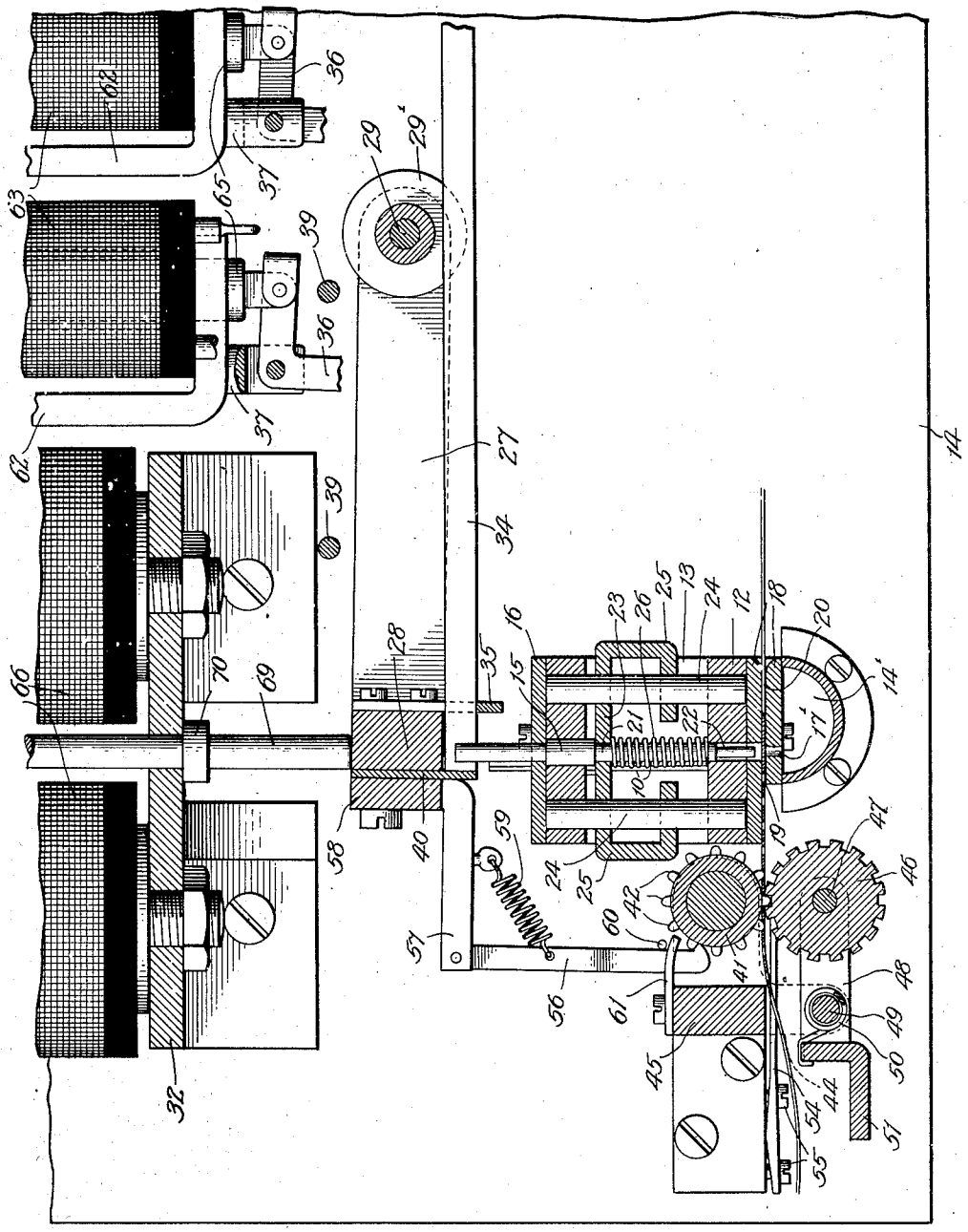

Fig. 4.

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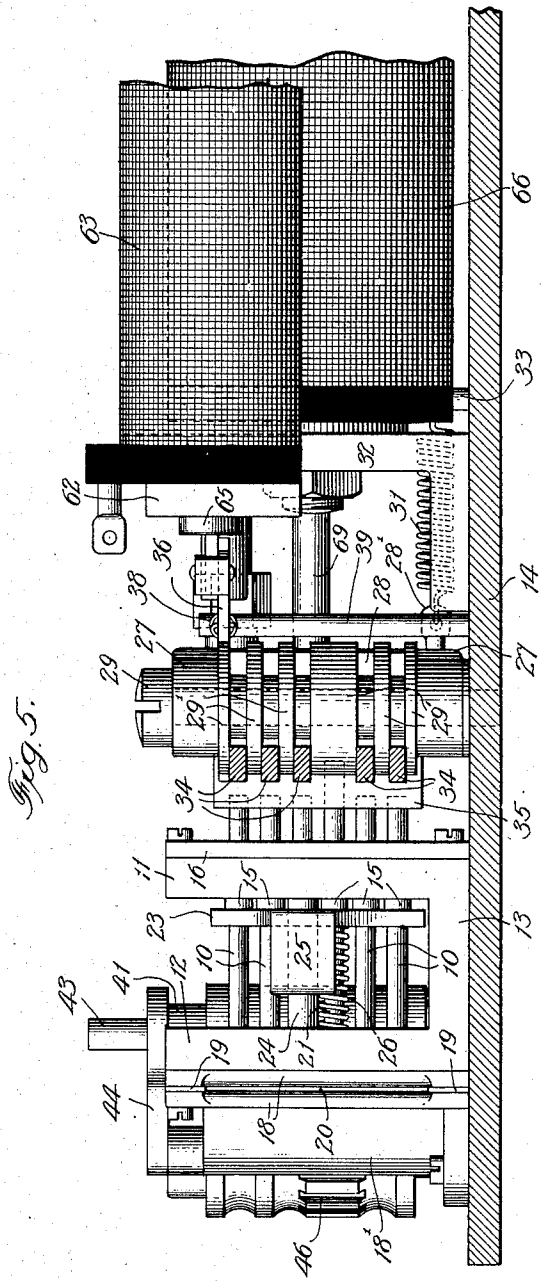

Fig. 5.

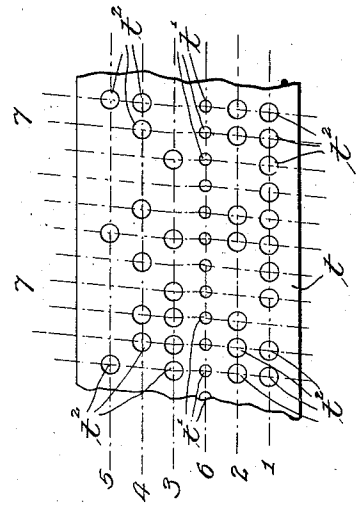

Fig. 7.

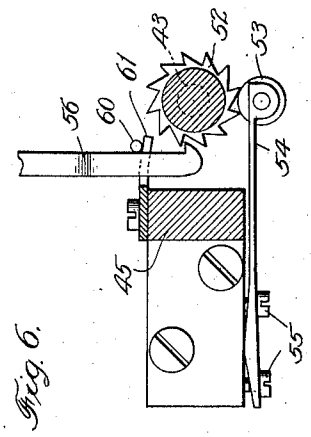

Fig. 6.

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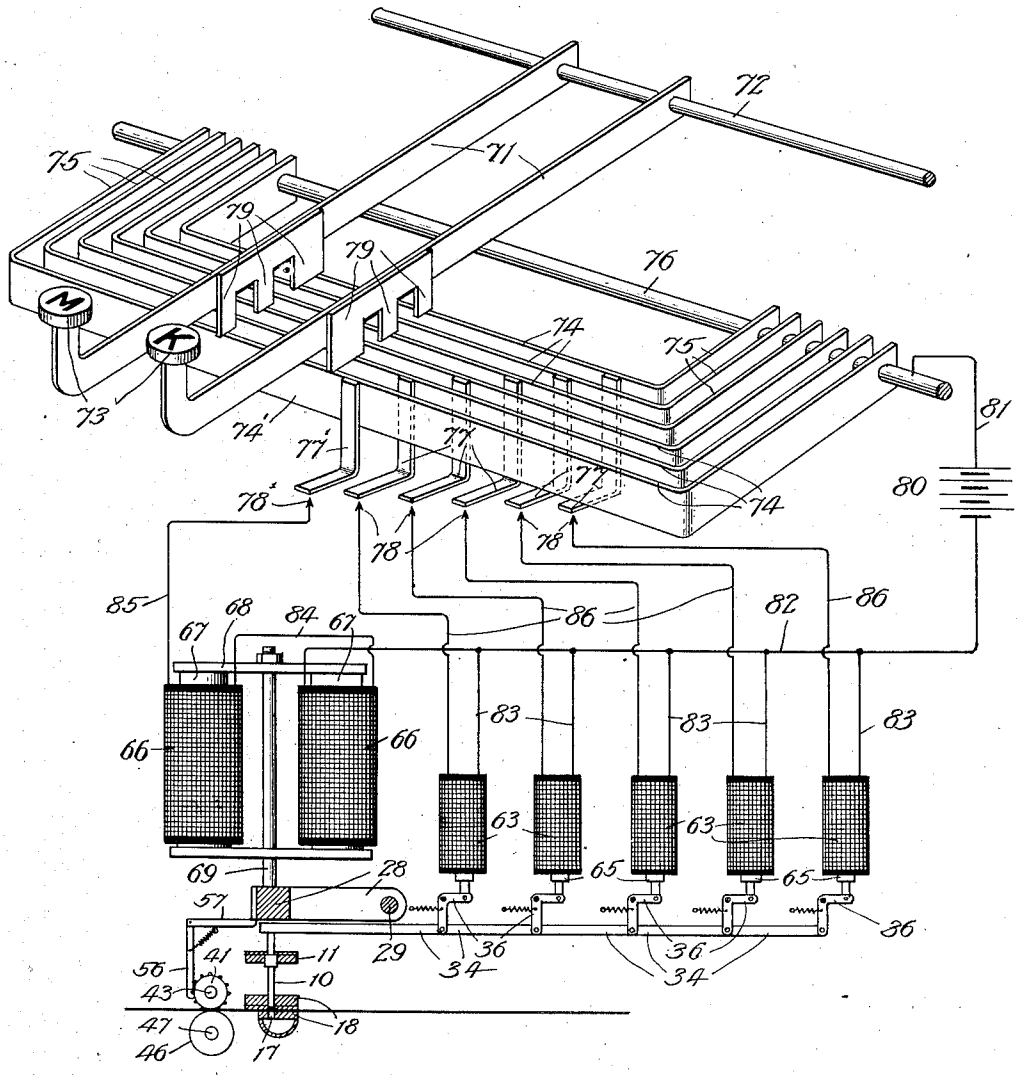
5 SHEETS—SHEET 5.

Fig. 8.




Witnesses:
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Chas. H. Buell.

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Attys.

# UNITED STATES PATENT OFFICE.

CHARLES L. KRUM AND HOWARD L. KRUM, OF CHICAGO, ILLINOIS, ASSIGNORS TO MORKRUM COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF MAINE.

## APPARATUS FOR FORMING TELEGRAPH-TAPE.

1,174,427. Specification of Letters Patent. Patented Mar. 7, 1916.

Application filed June 18, 1912. Serial No. 704,318.

*To all whom it may concern:*

Be it known that we, CHARLES L. KRUM and HOWARD L. KRUM, citizens of the United States, and residents of Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Apparatus for Forming Telegraph-Tape, of which the following is a full, clear, and exact description.

The invention relates to apparatus for perforating or embossing telegraph tape in accordance with the different characters or signals.

The invention seeks to provide a simple and effective apparatus which may be operated by a set of finger keys to provide the tape with a series of switch controlling perforations or embosses and which series are variably arranged to distinguish the separate characters or signals corresponding to the different operating finger keys, the arrangement being such that the perforations or embosses necessary to represent any one character or signal are formed upon the tape at a single operation when the corresponding key is shifted.

A further object of the invention seeks to provide a simple and effective electro-magnetically controlled apparatus for punching or embossing telegraph tape and which may be controlled either by a keyboard or by a line circuit extending from a distant station.

The invention also seeks to improve and simplify punching apparatus for telegraph tape and provide a construction in which the perforations or embosses representing each character or signal are formed on the tape in a transverse series or row.

The invention consists in the features of improvement hereinafter set forth, illustrated in the preferred form in the accompanying drawings and more particularly pointed out in the appended claims.

In the drawings, Figure 1 is a plan view of the improved apparatus. Fig. 2 is a vertical section on an enlarged scale and taken on the line 2—2 of Fig. 1. Fig. 3 is a vertical section on the lines 3—3 of Figs. 1 and 2. Fig. 4 is a horizontal section on the line 4—4 of Fig. 2. Fig. 5 is a vertical cross-section on an enlarged scale and taken on the line 5—5 of Fig. 1. Fig. 6 is a detail horizontal section taken on the line 6—6 of Fig. 2. Fig. 7 is a portion of the tape formed by the improved apparatus. Fig. 8 is a diagrammatic view illustrating the operating keys and controlling circuits.

The tape is perforated or embossed by a number of reciprocating formers or punches 10. These punches are preferably in the form of short, cylindrical, steel rods and are arranged in a vertical series within openings formed in the upright supports or guides 11 and 12 therefor. In the construction shown, the guides 11 and 12 form parts of a U-shaped bracket 13 which is fixed to a base plate 14. The punches 10 are provided with enlarged portions 15 which fit within the openings in the guiding support 11. The inner end portions of the punches extend beyond the enlarged portions 15 thereof, through a stop plate 16 which is secured to the face of the supporting guide 11. The punches are spring-held in normal position with the shoulders at the inner ends of the enlarged portions 15 thereof engaging the stop plate 16.

The outer ends of the punches or formers 10 extend through the supporting guide 12 and into a series of perforations 17 of a die-block. The die-block, in the construction shown, is formed of two plates 18 which are fastened to the outer face of the support or guide 12 and which are held spaced from one another by thin strips 19, interposed between their upper and lower ends. This construction forms a guide-way 20 within which the tape to be perforated or embossed is held in a vertical plane, and through which it is fed in a horizontal direction. The edges of the plates 18, at the entrance of the guide-way, are preferably rounded, (see Fig. 4), so that the tape may be readily inserted.

In the particular construction shown, there are five punches 10 and the two at the lower portion of the series are separated from the three at the upper portion thereof. An additional punch 21 is arranged between

the upper and lower punches 10, and is similar in construction, except that its inner end extends beyond the inner end of the punches 10 and its operative end portion 22 is somewhat reduced. The corresponding opening 17′ in the outer plate 18 of the die-block, is correspondingly reduced and the holes formed by this punch are smaller than those formed by the punches 10. The punch 21 is uniformly actuated at each operation of the apparatus to form a longitudinal row of holes in the tape, which are adapted to be engaged by a toothed feed wheel, whereby the tape is advanced. The punches 10 are variably operated and form switch controlling perforations in the tape.

The formers or punches 10 are normally held in retracted position out of the path of movement of the tape, through the guideway 20, by a stripper plate 23 which is perforated to receive the punches and which is mounted to slide horizontally on a pair of guide-rods 24 extending between the upright supports 11 and 12. Preferably, also, the stripper plate is provided with L-shaped portions 25 extending outwardly from its side edges and which are also perforated to slidably engage the guide-rods 24. The stripper plate 23 is spring-held in engagement with the outer ends or shoulders of the enlarged portions 15 of the punches 10 and 21. Preferably, a spring 26 is coiled about the punch 21 and extends between the upright support 12 and the face of the stripper plate. By this means, the punches are held normally retracted, with the enlarged portions thereof in engagement with the stop plates 16. The spring-actuated stripper plate also serves to retract the punches after they have been operated.

A common actuator is provided for the punches, together with means for shifting the actuator once for every operation of the machine. The actuator directly and uniformly operates the punch 21 which forms the regular series or longitudinal row of holes by which the tape is fed. These holes are indicated at $t'$ on the portion of the tape $t$ shown in Fig. 7. A number of devices control the operation of the actuator upon the punches 10, said devices being shiftable into and out of operative position, so that the punches 10 are variably actuated at each operation of the machine to form different series of perforations which represent the different characters or signals.

The common actuator, in the preferred construction shown, is in the form of a U-shaped bail and comprises a pair of horizontal arms 27, which are connected at their outer ends by a vertical bar 28 and are pivotally mounted at their inner ends upon a vertical stud 29 fixed to the base plate. The actuator bar 28 is arranged opposite the inner ends of the punches 10 and 21 and is held in normal position against a stop 30 (see Fig. 3) by a spring 31. The stop pin 30 is adjustably threaded through an L-shaped bracket 32 mounted on the base plate. The spring 31 extends between a stud 28′ on the actuator bar 28 and a pin 33 which rises from the base plate.

The forward movement of the actuator bar 28 effects the operation of the punches. The punch 21, as stated, is uniformly and directly operated by the actuator. The punches 10 are variably operated and the devices which control the operation of the actuator thereon are preferably in the form of a series of shifters 34, the ends of which are interposed between the outer face of the actuator 28 and the inner ends of the punches 10. In the construction shown, there are five of these shifters or bars 34, corresponding in number with the series of punches 10. The inner ends of the shifter bars are mounted within guide openings or slots formed in a plate 35 which is fixed to the side face of the actuator bar 28 and projects forwardly therefrom. The outer ends of the bars extend between a series of spaced guiding washers 29′ on the stud 29 and are connected to a series of bell cranks 36, pivotally mounted on studs 37. Springs 38 extend between the bell cranks and a series of vertical pins 39 which rise from the bed plate 14. These springs hold the bell cranks 36 and the shifter bars 34 in normal position with the ends of the bars engaging a stop plate 40, which is fixed to one of the side faces of the actuator bar 28 and projects forwardly therefrom, as most clearly shown in Fig. 4.

The bars 34 are shifted longitudinally by the bell cranks 36, so that the inner ends thereof are moved into and out of operative position between the outer face of the actuator 28 and the inner ends of the punches 10. When any one of the shifter bars is in normal position shown, the forward movement of the actuator will effect the operation of the corresponding punch. If the shifter bar is withdrawn from position between the end corresponding punch and the actuator bar, the forward shift of the latter will not operate the punch corresponding to the shifter which has been withdrawn.

The punches 10 are adapted to form perforations in the tape upon five longitudinal lines indicated at 1, 2, 3, 4 and 5 in Fig. 7. The uniformly operated punch 21 forms a longitudinal series of uniformly spaced holes $t'$ upon the line indicated at 6 in Fig. 7. At each operation of the actuator, a hole $t'$ is formed and one or more holes $t^2$ are formed by the operation of the punches 10. It is obvious that by withdrawing one or more of the controlling shifters 24 at each operation of the machine, the holes $t^2$

in the different transverse rows or series on the tape may be variably arranged and serve to distinguish the different characters or signals.

The tape is advanced one step at each operation of the actuator 28 by a feed wheel 41, which is arranged on the delivery side of the guide-way 20 and is provided with a series of rounded pins or teeth 42 for engaging the holes $t'$ of the tape. The shaft 43 of this feed wheel is journaled at its lower end in the base plate 13 and, at its upper end, in an arm or bracket 44 which is secured to the upper end of an upright 45. The tape is held in engagement with the feed wheel by a second wheel 46, which is grooved to mesh with the pins or teeth 42, and the shaft 47 of which is journaled in a swinging bracket 48. This swinging U-shaped bracket is pivotally mounted upon a vertical shaft 49 fixed at the lower end of the base plate and at its upper end to the plate or bracket 44. A spring 50, coiled about the pivot pin or shaft 49, engages the frame 48 and tends to press the wheel 46 carried thereby against the tape, so that the latter is firmly held in engagement with and is accurately advanced by the feed wheel 41. A portion 51 of the frame 48 serves as a finger piece by which the frame may be shifted against the tension of the spring 50 and the wheel 46 moved away from the feed wheel 41 to permit the insertion of the tape.

The feed wheel 41 is intermittently advanced by a pawl and ratchet mechanism. The ratchet 52 (see Fig. 6) is fixed to the lower end of the feed wheel and is arranged to be engaged by retaining and actuating pawls or dogs. The retaining dog or pawl is in the form of a roller 53 arranged upon the end of a spring arm 54, the latter being connected by adjusting screws 55 to one side of the base portion of the upright 45. The roller is thus spring-held into engagement with the teeth of the ratchet wheel 52, to yieldingly hold the latter and the feed wheel against movement.

The actuating pawl 56 is pivotally mounted at its inner end to an arm 57, this arm being mounted on a base portion 58 which is rigidly secured to the actuator bar 28. A spring 59 extends between the pawl 56 and the arm 57 whereon it is pivoted and holds the pawl against a fixed guide pin 60. A slotted guide 61 fixed to the upright 45, engages the pawl 56 and guides its movement.

The actuator pawl 56 is provided with a hooked outer end which, at each forward movement of the actuator bar 28 to effect the operation of the punches 10 and 21, moves idly over the teeth of the ratchet wheel 52. With the backward restoring movement of the actuator bar, the punches are quickly withdrawn from the tape by the spring pressed stripper 23, and the pawl 56 acts upon the teeth of the ratchet wheel to advance the feed wheel and the teeth one step. By this arrangement, the tape is held accurately in position against movement during the operation of the punches and is advanced one step for the next operation as soon as the punches are withdrawn.

The common actuator bar 28 and the separate controlling devices or shifters 34 may be operated directly from a keyboard, but, preferably, these parts are operated through the medium of electro-magnets. For this purpose, the studs 37, which carry the bell cranks 36 are mounted upon the frames 62 of a set of small magnets 63, these frames being in turn fixed at their rear ends to an upright plate or bracket 64 on the rear edge of the base plate 14. These magnets are arranged in inclined series, as shown in Fig. 2, and the armatures thereof are directly connected to the bell cranks 36. Preferably, these magnets are in the form of solenoids and are provided with cores 65 which are pivotally connected to the bell cranks.

The actuator is operated by a large double-spool magnet 66. The spools of this magnet are preferably in the form of solenoids. They are mounted at their forward ends on the bracket 32 on the base plate. The cores are arranged at the rear portions of the spools and are connected by a transverse bar 68. A rod 69 is adjustably threaded through the central portion of the bar 68 and extends forwardly therefrom through an opening in the bracket 32 (see Fig. 3), and engages the actuator bar 28. In the idle position of the parts, a collar or flange 70 on the rod 69, engages the outer face of the bracket 32.

By employing operating magnets for the actuator and punch controlled devices or shifters, the apparatus can be operated electrically, either from a keyboard or by any suitable electric selective means, which in turn is actuated by the transmission of signals over the line from a distant station.

The keyboard controlling means is shown in Fig. 8. A set of key levers 71 are pivotally mounted upon a fulcrum rod 72, and the upturned, forward ends are provided with finger pieces 73. Forty-two of these keys are shown, but it is understood that the others are arranged in banks or series somewhat similar to those of an ordinary typewriter. Beneath the set of keys extends a series of bars 74. These bars are preferably in the form of bails and are provided with rearwardly projecting end portions 75, which are mounted upon a common pivot rod 76. Each of the bails is arranged to operate or control a suitable switch. In the form shown, a series of switch arms 77 are

mounted upon the bars or bails 74 and these switch arms are arranged to coöperate with a series of contacts 78. The bars or bails 74 are variably actuated by a series of teeth 79 upon the keys. These teeth are variably arranged for each key or key lever, so that each key will operate a characteristic combination of these bars. That is to say, all of the bars are operated by different keys, but each key is arranged to operate a combination of bars that is different from that operated by any of the other keys, the teeth 79 on the keys being variably arranged to effect this action. All of the keys, however, are arranged to operate the outermost bar 74 which controls the switch 77'.

The battery 80 is grounded on one side or connected by a conductor 81 to the pivot 76 carrying the bars or bails 74. The other side of the battery is connected by a conductor 82 and a series of branches 83 to the several controller magnets 63. This conductor is also connected to one of the spools of the magnet 66. These spools are connected together by a conductor 84 and the other terminal of the magnet is connected by a conductor 85 to the contactor 78'.

The set of five magnets 63 which operate the controlling shifters 34 are respectively connected by a series of conductors 86 to the series of contacts 78.

When any key is depressed, the bar 74' is shifted and one or more of the bars 74 are depressed to close the switch 77' and one or more of the switches 77. In this way, one or more of the magnets 63 will be operated at the operation of any key and the magnet 66 will be uniformly operated at each operation of the apparatus. The combination of magnets 63 and the combination of shifters 34 moved at each operation will correspond to the character or signal represented by the actual operated key, and the perforations formed in the tape will also correspond to this character or signal. The magnets 63 are relatively light and quick acting, while the heavy magnet 66 which effects the operation of the punches, is somewhat slower. The controllers 34 will thus be operated before the actuator 28 is operated by the rod 69. If desired, the bars 74 may be arranged to close the switches 77 before the switch 77' is closed.

While the tape formed by the punch may be used to transmit different codes, the particular system with which the punch is employed uses an alphabet in which the different characters and signals are represented by permutations of five positive and negative impulses. The polarity of the five impulses of the permutation are determined by the selective operation of a set of five pole changers. If desired, these pole changers can be controlled directly by the tape. Preferably, however, they are controlled by a set of five switches, which are operated by the transverse series of perforations of the tape. If, for example, in any one series of perforations, there is no perforation on the line 1, then the first pole changer of the set will remain in normal condition connected to the negative side of the line battery. If there is a perforation at this point, it will be shifted and will be connected to the positive side of the line battery. Similarly, the other four pole changers will remain in normal position in connection with the negative side of the line battery or will be shifted and connected to the positive side thereof, in accordance as to whether or not there are perforations at the positions indicated by the lines 2, 3, 4 and 5 in Fig. 7. The pole changers are thus variably controlled by the tape and are successively connected to the line to transmit the impulses by means of a suitable distributer or transmitting switch mechanism which is operated in definite timed relation to the speed of movement of the tape.

In order to enable the continuous advance of the tape in transmitting a message, and effect the selective operation of the switches controlled thereby in timed relation to the speed of operation of the transmitter switch mechanism, the transverse series of holes or perforations are preferably inclined, as indicated by the transverse dotted lines 7 of Fig. 7. For this purpose, the punches 10 and the openings wherein they are guided (see Fig. 2), are correspondingly inclined.

The transmitter employing the tape herein referred to is set forth and claimed in a companion application Serial No. 704,317 filed by us of even date herewith.

It is obvious that the circuits of the electro-magnets can be controlled by an electric selective apparatus at the receiving end of a telegraph line, such as shown, for example, in the application of Howard L. Krum for electric selective systems, filed May 31, 1910, Serial No. 564,120, so that the tape thus formed could be used for recording the message at the receiving station or for retransmitting the same. It should be noted that all of the holes representing a given character are formed in the tape at each operation and that the spaces occupied by the transverse rows or series which represent the different characters are all uniform. It is obvious that the punches or formers 10 and the coöperating die plates could be shaped to form switch operating bosses on the tape. In the construction shown, the punches perforate the tape and the holes 17 and 17' of the die plate are covered by a casing 18' so that the portions cut out of the tape by the punches are directed through an opening 14' in the base plate.

It is obvious that numerous changes may be made in the details set forth without departure from the essentials of the invention.

We claim as our invention:—

1. In an apparatus for forming telegraph tape, the combination of a series of formers, a common actuator therefor, a series of devices normally spring-held in operative position and controlling the operation of said actuator upon said formers, a set of finger keys, means controlled by each of said keys for shifting a characteristic combination of said controlling devices in operative position and for operating said actuator, and means connected to and operated by said actuator for advancing the tape at each operation, substantially as described.

2. In an apparatus for forming telegraph tape, the combination of a series of formers, a series of shifters therefor movable into and out of operative position, an actuator for operating said shifters, a punch uniformly operated by said actuator for forming a longitudinal row of feed openings in the tape, a feed wheel coöperating with said feed openings, a series of finger keys, and means controlled by said finger keys for uniformly operating said actuator and said feed wheel and for variably operating said shifters, substantially as described.

3. In an apparatus for forming telegraph tape, the combination of a tape guide, a number of punches arranged in a series transverse to the path of movement of the tape, a series of shifters therefor normally in operative position, an actuator for said shifters, an additional punch operated by said actuator for forming a longitudinal row of feed openings in the tube, a feed wheel coöperating with said feed openings, a set of finger keys, means controlled by said finger keys for variably operating said shifters, and means controlled by said finger keys for uniformly and alternately operating said actuator and said feed wheel, substantially as described.

4. In an apparatus for perforating telegraph tape, the combination with a guide for the tape, of punches for perforating the tape arranged in a series transversely to the path of movement thereof, a series of punch shifters movable into and out of operative position, a common reciprocating actuator for said shifters, selecting means for uniformly operating said actuator and variably operating said shifters in different combinations corresponding to the different characters or signals, an additional punch directly and uniformly operated by said actuator, a toothed feed-wheel arranged to engage the perforation of the tape formed by said additional punch, a ratchet on said wheel, and a spring-held pawl connected to said reciprocating actuator and operated on the return strokes thereof to intermittently advance said feed wheel, substantially as described.

5. In an apparatus for perforating telegraph tape, the combination with a guide for the tape, of punches for perforating the tape arranged in a series transversely to the path of movement thereof, a series of punch shifters movable into and out of operative position, a common reciprocating actuator for said shifters, selecting means for uniformly operating said actuator and variably operating said shifters in different combinations corresponding to the different characters or signals, an additional punch directly and uniformly operated by said actuator, a toothed feed-wheel arranged to engage the perforation of the tape formed by said additional punch, a pawl connected to said reciprocating actuator and operating on the return strokes thereof to intermittently advance said feed wheel, and a common spring-actuated stripper for said punches, substantially as described.

6. In an apparatus for perforating telegraph tape, the combination of a die-block having a guide-way for the tape, a series of reciprocating punches operating transversely through said die-block, a reciprocating actuator, a series of punch shifters movable longitudinally into and out of operative position between said actuator and said punches, said actuator having a guide opening through which said shifters extend and the latter being movable transversely with said actuator to operate said punches, selecting means for uniformly operating said actuator and variably moving said shifters longitudinally in different combinations corresponding to the different characters or signals, an additional punch directly and uniformly operated by said actuator, a toothed feed-wheel arranged to engage the perforations of the tape formed by said additional punch, and means mounted on said reciprocating actuator and operating on the return strokes thereof to intermittently advance said feed wheel, substantially as described.

7. In an apparatus for forming telegraph tape, the combination of a series of formers, a common actuator therefor, a series of devices movable into and out of operative position and controlling the operation of said actuator upon said formers, and key controlled electro-magnetic means for uniformly operating said actuator and advancing the tape, and key-controlled magnetic means for variably operating said controlling devices in different combinations corresponding to the different characters or signals, substantially as described.

8. In an apparatus for forming telegraph

tape, the combination of a series of formers, a common actuator therefor, a series of devices movable into and out of operative position and controlling the operation of said actuator upon said formers, electro-magnets for operating said actuator and said controlling devices, and selective switch mechanism for uniformly effecting the operation of said actuator magnet and the variable operation of different combinations of said controller magnets, substantially as described.

9. In an apparatus for forming telegraph tape, the combination of a series of formers, a common actuator therefor, a series of devices movable into and out of operative position and controlling the operation of said actuator upon said formers, separate electro-magnets for operating said actuator and said controlling devices, switches controlling the circuits of said magnets, and a set of fingers for operating said switches, each of said keys being arranged to effect the operation of said actuator magnet and of a characteristic combination of said electromagnets, substantially as described.

10. In an apparatus for forming telegraph tape, the combination of a series of formers, a common actuator therefor, a series of devices movable into and out of operative position and controlling the operation of said actuator upon said formers, separate electro-magnets for operating said actuator and said controlling devices, selective switch mechanism for uniformly operating said actuator magnets and for variably operating said controller magnets in different combinations, and means for intermittently advancing the tape operated by said actuator magnet, substantially as described.

11. In an apparatus for forming telegraph tape, the combination of a series of formers, a common actuator therefor, a series of devices movable into and out of operative position and controlling the operation of said actuator upon said formers, separate electro-magnets for operating said actuator and said controlling devices, a set of finger keys, and a series of switch operating bars arranged transversely of said set of keys and controlling respectively the circuits of said magnets, each of said keys having means for operating the bar controlling said actuator magnet and a characteristic combination of the other bars of the series, substantially as described.

12. In an apparatus for forming telegraph tape, the combination with means for guiding and intermittently feeding the tape, of a series of punches arranged transversely to the path of movement of said tape, a corresponding series of shifters for said punches movable into and out of operative position, a common reciprocating actuator for said shifters, separate electro-magnets for operating said actuator and said shifter and selecting means for uniformly operating said actuator magnet and variably operating said shifter magnets in different combinations corresponding to the different characters or signals, substantially as described.

13. In an apparatus for forming telegraph tape, the combination with means for guiding and intermittently feeding the tape, of a series of punches arranged transversely to the path of movement of said tape, a corresponding series of shifters for said punches movable into and out of operative position, a common reciprocating actuator for said shifters, separate electro-magnets for operating said actuator and said shifters, and a set of finger keys, each of said keys having means for effecting the operation of said actuator magnet and of a characteristic combination of said shifter magnets.

14. In an apparatus for forming telegraph tape, the combination with means for guiding the tape, of a series of reciprocating punches arranged transversely of the path of movement of the tape, a series of shifters for said punches movable into and out of operative position, a reciprocating actuator for said shifters, separate electro-magnets for operating said actuator and said shifters, selecting switch mechanism for uniformly operating said actuator magnet and variably operating said shifter magnets in different combinations corresponding to the different signals or characters, and means connected to said reciprocating actuator and operating on the return strokes thereof to intermittently advance the tape.

15. In an apparatus for forming telegraph tape, the combination with means for guiding the tape, of a series of reciprocating punches arranged transversely of the path of movement of the tape, a series of shifters for said punches movable into and out of operative position, a reciprocating actuator for said shifters, separate electro-magnets for operating said actuator and said shifters, selecting switch mechanism for uniformly operating said actuator magnet and variably operating said shifter magnets in different combinations corresponding to the different signals or characters, an additional punch uniformly operated by said actuator, a feed wheel arranged to engage the holes formed in the tape by said additional punch, and a pawl connected to and operated by said actuator and acting in the return strokes thereof to intermittently advance said feed wheel.

16. In an apparatus for forming telegraph tape, the combination with means for

guiding the tape, of a series of reciprocating punches arranged transversely of the path of movement of the tape, a series of shifters for said punches movable into and out of operative position, a reciprocating actuator for said shifters, separate electro-magnets for operating said actuator and said shifters, a set of finger keys, means controlled by each of said keys for operating said actuator magnet and a characteristic combination of said shifter magnets, and a feeding device operated by said actuator magnet and arranged to intermittently advance the tape upon the return strokes of said actuator, substantially as described.

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