

G. S. VERNAM.
CIPHERING DEVICE.

APPLICATION FILED JULY 23, 1920.

Patented May 23, 1922.

3 SHEETS—SHEET 1.

1,416,765.

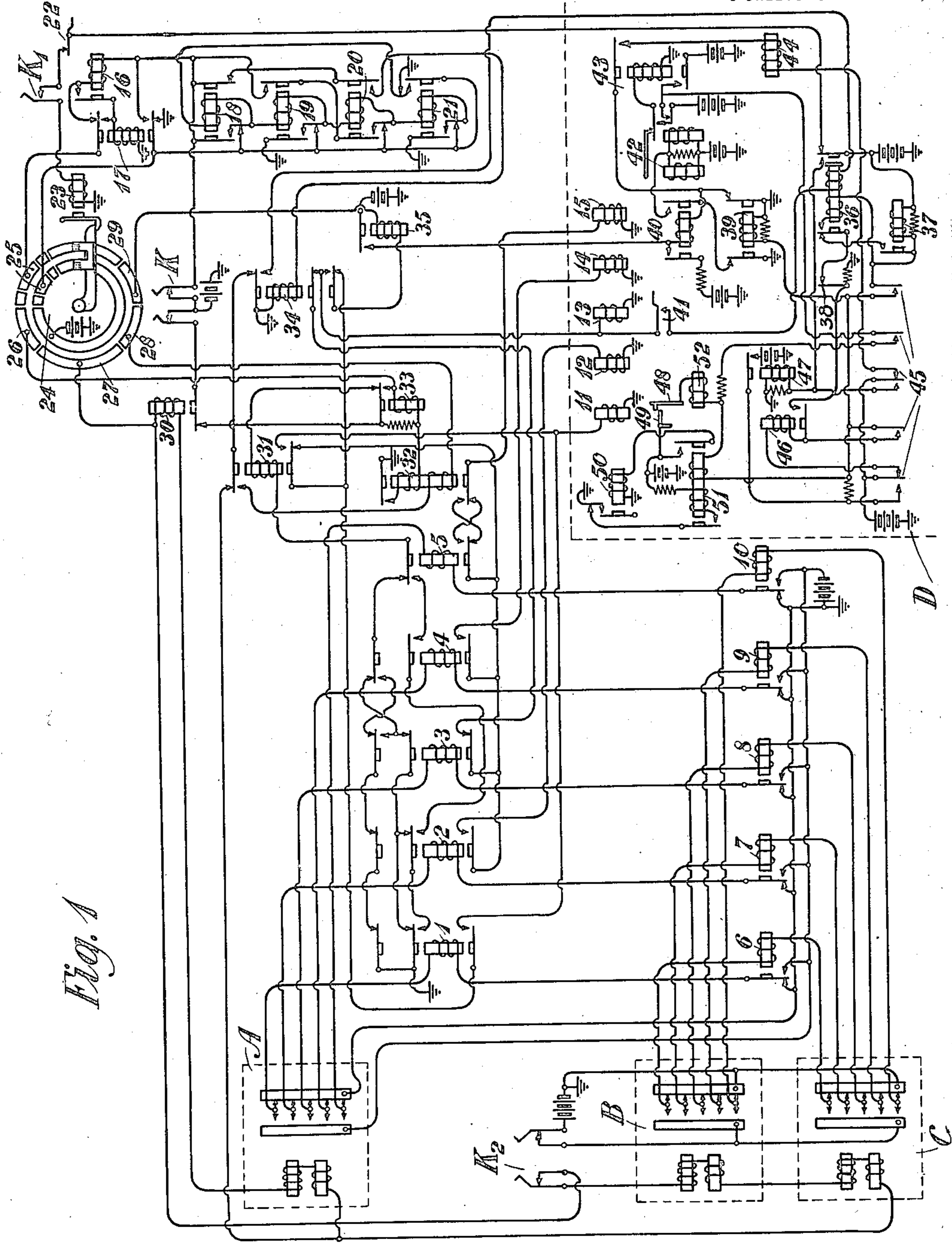


Fig. 1

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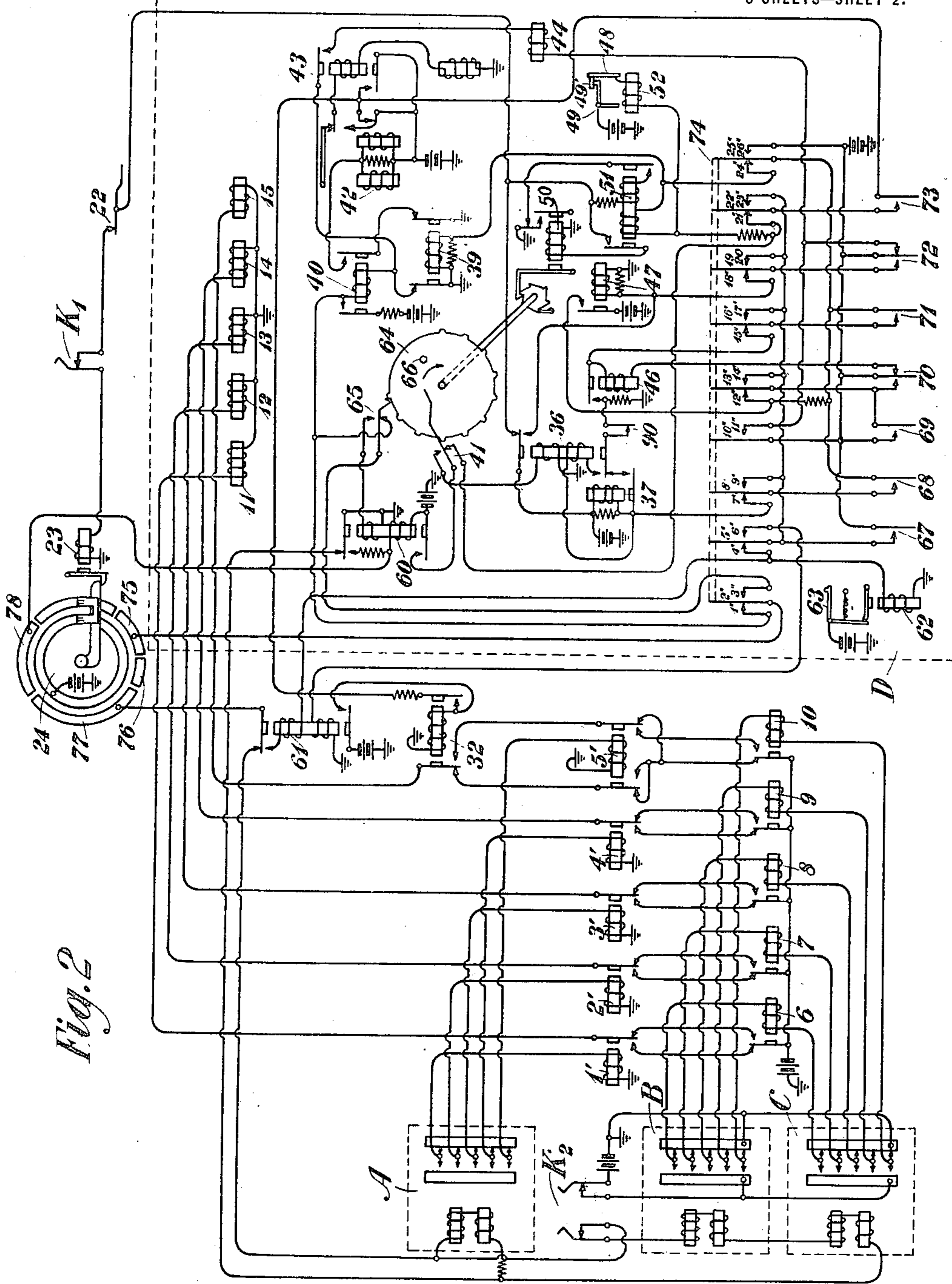


Fig. 2

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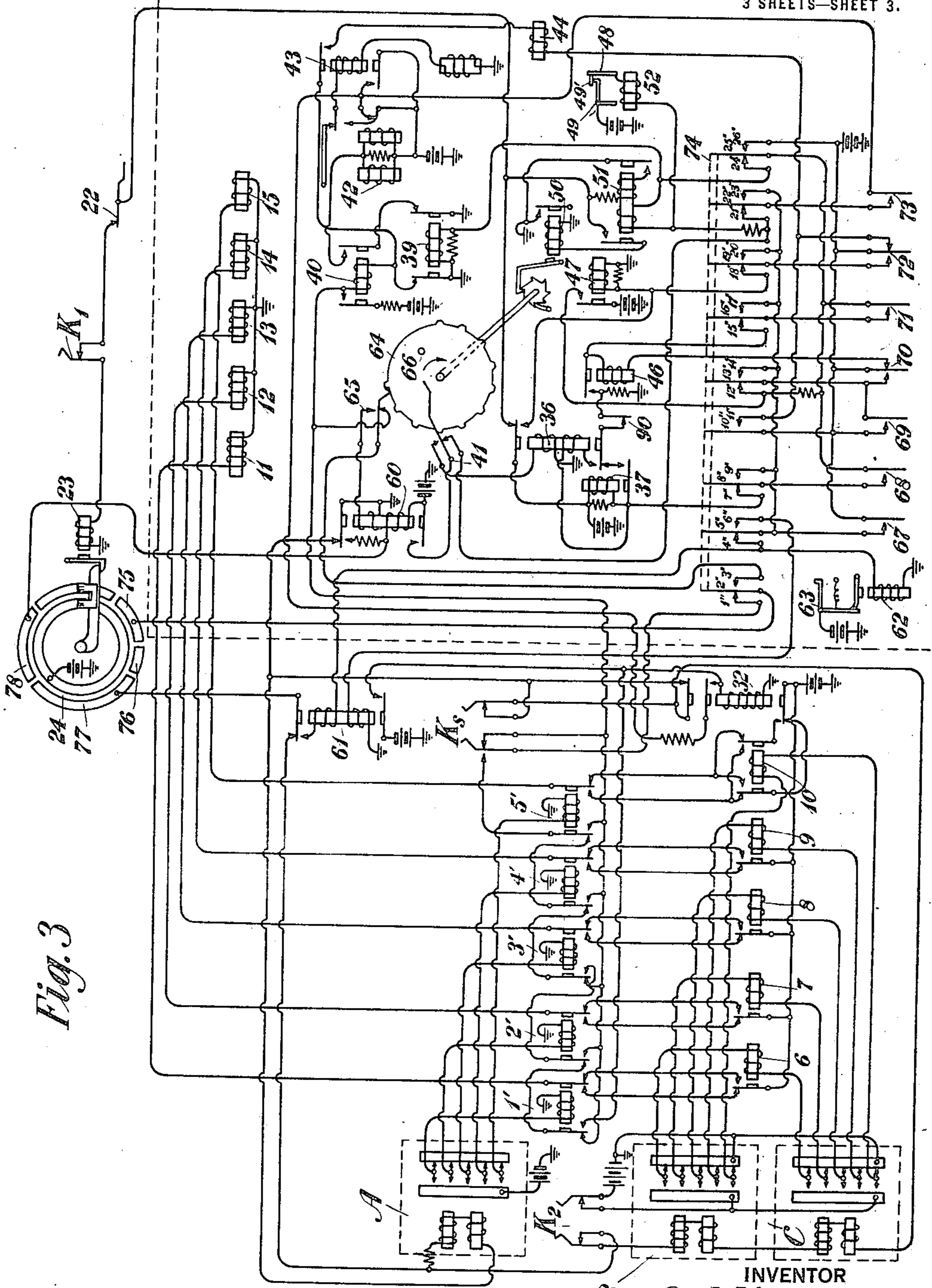


Fig. 3

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GILBERT S. VERNAM, OF BROOKLYN, NEW YORK, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

CIPHERING DEVICE.

1,416,765.

Specification of Letters Patent. Patented May 23, 1922.

Application filed July 23, 1920. Serial No. 398,358.

To all whom it may concern:

Be it known that I, GILBERT S. VERNAM, residing at Brooklyn, in the county of Kings and State of New York, have invented certain Improvements in Ciphering Devices, of which the following is a specification.

This invention relates to a device for enciphering and deciphering messages and more particularly to a device of this character which is adapted for use with messages prepared in code formation.

Arrangements have been developed for enciphering and deciphering code messages by the use of printing telegraph equipment, in which arrangements the characters of a message, when in code formation, are combined in effect with the code combinations of one or more perforated key tapes and the resulting code combinations make up the characters of the enciphered message. Such an arrangement is illustrated in detail in the U. S. Patent, No. 1,320,908, issued November 4, 1919, to R. D. Parker. In this device the code combinations of the enciphered or deciphered message are recorded on a perforated tape or the corresponding characters may be printed if desired and the message may then be transmitted in any desired manner to its destination.

One of the well-known codes utilized with messages prepared by printing telegraph equipment is the Baudot code in which each character is represented by a combination of five "marking" or "spacing" impulses. In a five-unit code of this sort there are thirty-two different code combinations of which twenty-six are used to designate letters of the alphabet and the remaining six combinations are used as "stunt" signals to control operations of the printing mechanism, such as "line feed," "carriage return," etc. In the above mentioned method of enciphering messages these six "stunt" signals will ordinarily appear at irregular intervals in the cipher message and therefore they must be recorded in some way in the written or printed form of the message. The presence of these "stunt" signals can not be avoided by omitting them from the original message and key tapes because of the fact that they are produced by various combinations of

letters in the message with letters in the key tapes. If an ordinary printer is used to record the cipher message the result would be a badly confused message due to the fact that the "stunt" signals occur at other than the proper times. To avoid confusion of this sort printed characters must be used to represent the "stunt" signals in the printed form of the message. It might also be possible to utilize numerals or punctuation marks for this purpose. A cipher message prepared in the above manner is not in desirable form for transmission over the ordinary commercial types of telegraph or cable lines for the following reasons. The usual practice in preparing cipher messages for transmission over commercial lines is to divide the letters into groups of five. The telegraph companies count each group of five letters as one word in charging for such messages. Mixed groups containing both letters and numerals are not accepted for transmission by cable and when transmitted over land lines each such group is counted as five words. As the numerals designating "stunt" signals might appear frequently in the cipher message it will be seen that the charge for transmitting such a message over a commercial line would be exceedingly high. Accordingly it is the general purpose of this invention to provide arrangements for preparing the cipher messages in a desirable form for transmission over commercial lines. This may be accomplished by providing means for recording each "stunt" signal as two letters according to some arbitrary code and by providing means for separating the letters into groups of five. Other objects and features of the invention will appear more fully from the detailed description of the invention hereinafter given.

The invention may be more fully understood from the following description together with the accompanying drawing in the Figs. 1, 2, and 3 of which are shown a preferred form of the invention and modifications thereof. Like reference characters have been used to denote like parts in all of the figures of the drawing.

In the arrangement illustrated in Fig. 1

each "stunt" signal is automatically represented in the enciphered message by two letters according to some prearranged arbitrary code. For example the following code may be used:

- E L represents line feed,
- E H represents space,
- E O represents carriage return,
- E K represents letter shift,
- E J represents figure shift,
- E T represents blank tape,
- E Z represents letter "e".

While the effect of using such a code may be to increase the length of the message, nevertheless as numbers are not used the message may be transmitted at a reasonable cost. Any one of the twenty-six letters may be used to designate the "stunt" signals. The letter "e" was chosen with the above code simply because its use slightly simplifies one of the automatic circuit arrangements to be described later.

In the arrangements of Fig. 1 are shown three tape transmitters, A, B and C. The code combinations representing characters of the original message will be set up by the tape on the contacts of transmitter A. Cipher tapes, arbitrarily chosen, will be run through transmitters B and C and will set up their combinations thereon. Associated with transmitters B and C are the relays 6, 7, 8, 9 and 10. Associated with transmitter A over the contacts of relays 6, 7, 8, 9 and 10 are the selecting relays 1, 2, 3, 4 and 5. With such an arrangement the code combinations of the original message tape will be combined with the code combinations of the cipher, or key tapes and the result will be set up as enciphered code combinations on the relays 1, 2, 3, 4, 5. The principles of operation of the above arrangement are described in detail in the aforementioned patent to R. D. Parker and no further description thereof will be given. Connected with the contacts of relays 1, 2, 3, 4 and 5, are the magnets 11, 12, 13, 14 and 15 of a printer D, whereby a printed record may be made of the code combinations set up on selecting relays 1, 2, 3, 4 and 5.

Associated with the selecting relays and the usual mechanism of the printer D are a plurality of relay arrangements for dividing the letters into groups of five, for automatically returning the carriage at the end of the line, and for substituting two letters for the "stunt" signal combinations. The relays 16, 17, 18, 19, 20 and 21 are termed counting relays as they serve to space the letters in groups of five. There is also provided a control key K, a starting key K_1 , an auto-stop lever 22, and the cipher cut-off key K_2 . The relays associated with the arrangements are a transmitter relay 30, an

"e" relay 31, a "fifth-impulse" relay 32, a control relay 33, a spacing relay 34, and the release control relay 35. A distributor 24 is also provided for timing certain of the operations of the mechanism.

The mechanism of the printer D is well-known in the art and is disclosed in full in the Patent No. 1,215,604, granted February 13, 1917, to G. M. Yorke. The printer mechanism comprises the carriage return magnet 37, the carriage contacts 38, and the margin contacts 41. Associated with the release control relay 35 is a printer relay 40, the release magnets 42, the start relay 43, and the start magnet 44. There are also provided the "stunt" contacts 45 with which are associated the shift magnet 46, the line feed magnet 47, the printing magnet 52, the space lock relay 51, and the space magnet 50. A margin relay 36 is also added to the printer. Included in the arrangements is a type shaft 48 and the stop bar 49. As the mechanism of the printer D is well-known in the art no detailed description of its operation will be given.

The operation of the arrangements of Fig. 1 will now be described. If the cipher cut-off key K_2 is operated, the cipher transmitters B and C and the cipher relays 6, 7, 8, 9 and 10 will not operate and the printer will record each character as it is set up on the message transmitter A. If the control key K is also operated, none of the relay arrangements associated with the selecting relays and the printer will function and the printer will operate in a normal manner and will record every character as set up on the selecting relays, that is, it will print or it will space, carriage return, line feed, etc., in a normal manner. The relay arrangements which do not function when the control key K is operated are the counting relays 16, 17, 18, 19, 20 and 21, spacing relay 34, "e" relay 31, fifth pulse relay 32, control relay 33, and margin relay 36, and these relay arrangements do not operate for the following reasons.

(1) As no battery is connected to them none of the counting relays 16, 17, 18, 19, 20 and 21 can operate.

(2) The circuit for operating the spacing relay 34 is open at the right hand contact of counting relay 20.

(3) The circuit for operating the "e" relay 31 is open at the left hand contact of the control key K.

(4) The circuit of the lower winding of the fifth-pulse relay 32 is open at the upper front contact of the "e" relay 31, and the circuit of its upper or locking winding is open at its own front contact and also at the left hand contact of the control key K.

(5) The circuit of the control relay 33 is open at the upper front contact of the fifth-pulse relay 32.

(6) The circuit of the margin relay 36 is open at the upper front contact of the spacing relay 34.

As none of these relays can operate when the control key K is operated, the printer will operate in a normal manner, as has been pointed out, and will record every character as set up on the selecting relays, that is, it will print or it will space, carriage return, line feed, etc., in a normal manner.

The operation of the circuit under the above conditions is as follows: When the starting key K_1 is operated it will close a circuit from battery through right hand back contact of margin relay 36 and the auto-stop contacts 22 to operate the distributor start magnet 23. The auto stop contacts 22 are provided in the mechanism for the following purpose. When the operator starts to write out a message, she will perforate the message on a tape. Before the complete message is perforated on the tape, it may be desirable to insert the tape into the tape transmitter A and to start the ciphering device in operation. The operator will then continue to perforate the message on the tape while one end of the tape is being fed into the tape transmitter A. If, under these circumstances, the speed of the operator in perforating the tape should be slower than the rate of speed at which the other end of the tape is being fed into the tape transmitter, it will be seen that the tape might become torn. In order to prevent this, the tape is run underneath a lever which is known as an auto stop contact, and if there is danger of the tape being torn, it will first push this auto stop lever upwards and thereby open a circuit which will stop the operation of the ciphering device, and thereby prevent the tape from being torn. This will release the distributor brush arm which will rotate continuously until this circuit is opened at the auto-stop contact 22 or the starting key K_1 . Each character in the message tape will operate one or more contacts of the message transmitter A and this in turn will set up the combination representing this character on the selecting relays 1, 2, 3, 4 and 5. When the brush crosses segment 29 a circuit will be closed from battery, through the brush, segment 29, winding of release control relay 35, lower back contact of spacing relay 34, to the lower armature of selecting relay 1, and also through the back contact of "e" relay 31, to the lower armatures of selecting relays 2, 3, 4 and 5. This circuit will be extended through the contacts of any selecting relays that are operated and through the windings of any of the corresponding selecting magnets 11, 12, 13, 14 and 15 to ground. The closing of this circuit will operate one or more of the selecting magnets 11, 12, 13, 14 and 15 and also the release control relay 35. The oper-

ation of the release control relay 35 will connect battery to the printer relay 40 and thus start the printer D in operation in the usual manner. The printer will then record the selected character in the usual manner. When the brush crosses segment 27 the message transmitter magnet and the transmitter relay 30 will be operated over a circuit from battery, through the brush, segment 27, winding of transmitter relay 30, winding of message transmitter magnet, back contact of "e" relay 31, and back contact of spacing relay 34, to ground. The message transmitter magnet will step the message tape in transmitter A ahead one step and set up the combination for the next character. The operation of the transmitter relay 30 will have no effect at this time as its armature is connected to an open contact of the control key K. The above described operations will be repeated with each revolution of the brush arm. In case a blank tape signal is set up in the message transmitter none of the selecting relays will operate, and, therefore, the circuit of the release control relay 35, and of the selecting magnets 11, 12, 13, 14 and 15, will be left open. Under these conditions the release control relay 35 will not operate when the brush crosses segment 29, and, therefore, the printer will not operate.

The operation of the circuit arrangements of Fig. 1 when the control key K is operated and the cipher cut-off key K_2 is not operated is as follows: When the cipher cut-off key K_2 is in its normal position the cipher transmitter B and C and the cipher relays 6, 7, 8, 9 and 10 will be operated under the control of the two cipher tapes, and the selecting relays 1, 2, 3, 4 and 5, will be under the combined control of the cipher relays and the message transmitter A. Under these conditions the character set up on the selecting relays, and therefore on the selecting magnets, will be produced by combining the character in the message tape with the corresponding characters in the two key tapes. The stepping magnets of the cipher transmitters B and C will also be connected to segment 27 so that all three tapes will be stepped ahead simultaneously, and the printer will record a series of characters representing the combination of the three tapes.

The operation of the circuit arrangements of Fig. 1 when the control key K and the cipher cut-off key K_2 are both unoperated will now be described. Under these conditions it is pointed out that the printer will automatically substitute two letters for each "stunt" signal and also for the letter "e" as indicated by the aforementioned code. The printer will also space the letters in groups of five and the carriage will return automatically and the paper will feed at the end of each line.

One end of the winding of the "e" relay 31 is connected to battery through the back contacts of the control relay 33, and the transmitter relay 30, and the left hand contacts of the control key K. The other end of the winding of this relay 31 is connected to the contacts of the selecting relays 1, 2, 3, 4 and 5. These selecting relays are so wired that "e" relay 31 will be operated whenever a code combination representing a "stunt" signal, or the letter "e" is set up on the selecting relays, but the "e" relay 31 will not be operated by any other code combination. The code combinations representing "stunt" signals and the letter "e" in the code commonly utilized are as follows:

Letter shift	-----	+++++
Figure shift	-----	++-++
Blank tape	-----	-----
Line feed	-----	-+-----
Space signal	-----	---+---
Carriage return	-----	----+--
Letter "e"	-----	+-----

The operating circuits for "e" relay 31 when the above signal combinations are set up may be traced through the contacts of the selecting relays as follows:

(1) For the letter shift signal
(+++++),
and the figure shift signal (++-++),
from the winding of "e" relay 31 through the front contacts of selecting relays 5, 4, 2, and 1, to ground.

(2) for the blank tape signal
(-----),
and the line feed signal (-+-----),
from the winding of "e" relay 31, through the upper back contact of relays 5 and 4 and middle back contacts of relays 3 and 1, to ground.

(3) For the letter "e"
(+-----),
from the winding of "e" relay 31, through the upper back contacts of relays 5 and 4, through the middle back contacts of relays 3 and 2, and the middle front contact of relay 1, to ground.

(4) For the space signal
(---+---),
from the winding of "e" relay 31, through the upper back contacts of relays 5 and 4, upper front contact of relay 3, and upper back contacts of relays 2 and 1 to ground.

(5) For the carriage return signal
(----+--),
from the winding of "e" relay 31, through upper back contact of relay 5, upper front contact of relay 4, and upper back contacts of relay 3, 2, and 1, to ground.

From the above description it will be seen that, whenever a code combination representing a "stunt" signal or the letter "e" is set up on the selecting relays, the "e" relay 31 will be operated. It is pointed out

that for all other code combinations set up on the selecting relays, their arrangement is such that the operating circuit of "e" relay 31 will not be closed. As the "e" relay 31 will not operate if a succession of letters, other than letter "e" or "stunt" signals, is set up on the selecting relays, accordingly the fifth-pulse relay 32 and control relay 33 will not operate, and the printer will record the letters set up on the selecting relays exactly as if the control key K was operated, except that a space will be introduced between each group of five characters as will be explained later.

The operation of the circuit arrangement when a "stunt" signal or the letter "e" is set up on the selecting relays, thereby causing "e" relay 31 to be operated, will now be described. When the brush of the distributor crosses segment 29 a circuit will be closed from battery, through the brush, segment 29, release control relay 35, back contact of spacing relay 34, front contact of "e" relay 31, and through the winding of selecting magnet 11, to ground. This will operate the release control relay 35 and selecting magnet 11, which will cause the printer to print the letter "e." When the brush crosses segment 28, a circuit will be closed for operating the fifth-pulse relay 32 through the upper front contact of "e" relay 31 and the upper back contact of the spacing relay 34. The fifth-pulse relay 32 will lock itself through its upper winding and through the back contact of the transmitter relay 30 and the left hand contact of the control key K. The lower armature of the fifth-pulse relay 32 will switch selecting magnet 15 from the front contact to the back contact of selecting relay 5. This, however, will have no effect at this time as the circuit of the armature of selecting relay 5 is open at the lower back contact of "e" relay 31. When the brush crosses segment 27, the transmitter relay 30 and the stepping magnets of the transmitter A, B and C will not operate as their circuits are open at the upper back contact of "e" relay 31. The combination set up on the selecting relays will, therefore, be retained. When the brush crosses segment 26, the control relay 33 will operate through the winding of the fifth-pulse relay 32 in parallel with a resistance. The control relay 33 will lock itself to battery through the back contact of the transmitter relay 30 and will release "e" relay 31. When the brush crosses segment 29 on its next revolution, a circuit will be closed through the release control relay 35, lower back contacts of spacing relay 34 and "e" relay 31 to the armatures of the selecting relays and windings of the selecting magnets. This will operate the release control relay 35 and the selecting magnets and will set up on the selecting magnets the signal

combination that is on the selecting relays except that selecting magnet 15 will operate if selecting relay 5 is released and will not operate if selecting relay 5 is operated, or, in other words, the fifth impulse will be reversed. Under these conditions the printer will record the second letter representing the particular "stunt" signal as shown in the aforementioned code. When the brush crosses segment 27, the stepping magnets of the transmitters A, B and C will be operated thus setting up a new code combination on the selecting relays. The transmitter relay 30 will also be operated and will release the control relay 33 and the fifth-pulse relay 32, thus restoring the circuit to its normal condition. The above description covers the operation of the circuit in substituting two letters for each "stunt" signal and for the letter "e."

The automatic spacing of the letters into groups of five and the operation of returning the carriage at the end of a line will now be described. The spacing operation is controlled by a group of counting relays 16, 17, 18, 19, 20 and 21. Relays 16 and 17 operate as follows: It is assumed that the printer carriage is at the beginning of a new line when the control key K is restored to its normal position. When the brushes cross segments 25 during their first revolution, relay 16 will be operated over a circuit from battery, right hand contact of control key K, winding of relay 16, upper back contact of relay 17, outer segment 25, brush, inner segment 25, and lower back contact of relay 17, to ground. Relay 16, on operating, prepares a circuit for operating relay 17, but relay 17 is short-circuited at this time and will not operate until the brushes leave segments 25. When the brushes pass off of these segments, relay 17 will be operated in series with relay 16. When the brushes cross segments 25 on the second revolution, relay 16 will be short-circuited and released. The path of the current at this time is from battery, through the right hand contacts of control key K, lower front contact of relay 17, inner segment 25, brush, outer segment 25, upper front contact and winding of relay 17, to ground. When the brushes pass off of segments 25, this circuit will be interrupted and relay 17 will be released. The third revolution of the brushes will cause relays 16 and 17 to operate again, and the fourth revolution of the brushes will cause them to release again. In other words relays 16 and 17 will both be operated and both released on alternate revolutions of the brushes.

The relays 16 and 17 control the series of counting relays 18, 19, 20 and 21 in the following manner. As previously described during the first revolution of the brush the first letter will be printed and relays 16 and

17 will operate. Relay 17 on operating will close a circuit for operating counting relay 18. This circuit will extend from battery through the right hand contacts of the control key K through the lower front contact of relay 17, left hand back contact and winding of relay 18, and right hand back contact of relay 21 to ground. Relay 18 will lock itself through its left hand front contact. Relays 19, 20 and 21 will not operate at this time as their windings are short circuited.

The second revolution of the brush will cause the printing of the second letter and will release relays 16 and 17. Relay 17 on releasing will operate relay 19 over a circuit extending from battery through the contacts of the control key K, left hand front contacts of relay 18, winding and left hand back contacts of relay 19 and back contact of relay 17 to ground. Relay 19 will lock itself to ground through its left hand front contact. Relays 20 and 21 will not operate at this time as their windings are short circuited.

The third revolution of the brush will cause the printing of the third letter and the operation of relays 16 and 17. Relay 17 on operating will close a circuit for operating relay 20. This circuit will extend from battery through the contacts of the control key K, lower front contact of relay 17, left hand back contacts and winding of relay 20, and left hand front contact of relay 19 to ground. Relay 20 will lock itself to battery through its left hand front contact and the right hand front contact of relay 19. Relay 21 will not operate at this time as its winding is short circuited. The closing of the right hand contact of relay 20 will have no effect at this time as its circuit is open at the back contact of relay 18.

On the fourth revolution, the brush will cause the printing of the fourth letter and will release relays 16 and 17. Relay 17 on releasing will close a circuit for operating relay 21. This circuit extends from battery through the contacts of the control key K, right hand front contact of relay 19, left hand front contact of relay 20, winding and left hand back contact of relay 21 and back contact of relay 17 to ground. Relay 21 will lock itself to ground through its left hand front contact. Relay 21 will also disconnect the direct ground connection from the winding of relay 18 and will connect relay 18 to ground through the back contact of relay 17. This will have no effect on relay 18 at this time.

On the fifth revolution, the brush will cause the printing of the fifth letter and will operate relays 16 and 17 again. When relay 17 operates it will connect battery instead of ground to relay 18 which will release relay 18. Relay 18 on releasing will connect relay 19 to battery through the lower

front contact of relay 17. This will have no effect on relay 19 at this time. Relay 18 on releasing also closes a circuit for operating the spacing relay 34. This circuit extends from battery through the contacts of control key K, right hand back contact of relay 18, right hand front contact of relay 20 and winding of spacing relay 34 to ground. The spacing relay 34 on operating will open the circuit of the stepping magnets of the transmitters A, B and C, and the transmitter relay 30. It will also open the circuit which normally extends from the release control relay 35 to the lower armatures of the selecting relays and will connect the release control relay 35 directly to selecting magnet 13.

When the brush crosses segments 29 on its sixth revolution, a circuit will be completed from battery, through the brush, segments 29, release control relay 35, lower front contact of the spacing relay 34, and winding of the selecting magnet 13, to ground. This will operate selecting magnet 13 and the release control relay 35. The operation of selecting magnet 13, sets up in the printer the combination representing a "space". The release control relay 35 closes the circuit for operating the printing relay 40, thus starting the operation of the printer. Operating under these conditions the printer will introduce a space after the fifth letter. During the previous (fifth) revolution of the brush, the tapes have been stepped forward in the transmitters A, B, and C, thus setting up on the selecting relays the combination representing the next letter to be printed. The circuit of the stepping magnets of the transmitters will be held open at the contacts of the spacing relay 34 during this (the sixth) revolution, and therefore the combination for the next letter will remain on the selecting relays.

When the brush crosses segments 25 (during the sixth revolution), relays 16 and 17 will be released. Relay 17 on releasing will connect ground instead of battery to relay 19. This will release relay 19 and it in turn will release relays 20 and 21. Relay 20 on releasing will open the circuit of the spacing relay 34. The counting relays and the spacing relay are thus restored to normal. The operations described above, will be repeated during every six revolutions of the brush with the result that a space will be introduced after each group of five letters.

The operation of returning the carriage at the end of each line is as follows. The margin contacts 41 in the printer are to be adjusted so that they will close while the tenth group of five letters is being printed. These margin contacts 41 are operated by a cam or projection which is provided on the space ratchet mechanism. When the space ratchet wheel moves to a position so that the car-

riage is close to the end of a line, this cam or projection will strike and close the contacts 41. In the above mentioned patent to Yorke, these margin contacts might be operated by a cam or projection, such as the projection 5^d in Figure 1. These contacts prepare a circuit for operating the margin relay 36, but this relay cannot operate until the spacing relay 34 operates. The operation of the margin relay is as follows. The spacing relay 34 will be operated when the brush crosses segments 25 after printing the fifth letter of the tenth group. When the brush crosses segments 29 on the next revolution a circuit will be completed from battery, through the brush, segments 29, release control relay 35, lower front contact of spacing relay 34, and in parallel through selecting magnet 13, to ground, and through the margin contacts 41, margin relay 36, and upper front contacts of spacing relay 34, to ground. This will operate the release control relay 35, selecting magnet 13 and the margin relay 36. The printer will space in the usual manner. The margin relay 36 on operating locks itself to battery through the carriage return magnet 37, thus operating the carriage return magnet 37. It also closes a circuit at its right hand front contact for operating the line feed magnet 47 and opens the circuit of the distributor start magnet 23 at its right hand back contact thus allowing the brush arm to come to rest after completing this revolution. The brush arm will remain at rest until the comparatively slow carriage return operation has been completed. The line feed magnet 47 will feed up the paper and the carriage return magnet 37 will allow the carriage to return to the beginning of a new line. The carriage contacts 38 will be opened when the carriage has been completely restored and this will release the margin relay 36 and the carriage return magnet 37. The margin relay 36 on releasing will close the circuit for operating the distributor start magnet 23 again.

Whenever a "stunt" signal or the letter "e" occurs as the last character of the five letter group, a space will be introduced between the two letters which are substituted for the "stunt" signal or the letter "e" in the manner which will now be described. For purposes of illustration, we may assume that a "stunt" signal or letter "e" has been set up on the selecting relays and that the brush arm has rotated with the result that the printer has recorded the letter "e" and the fifth-pulse relay 32 and control relay 33 have been locked up and the "e" relay 31 has been released. Also as the letter "e," or "stunt" signal is the fifth letter of a group the spacing relay 34 will also operate. The spacing relay 34 causes the printer to introduce a space (or carriage return and line feed) after the letter "e" as previously described. It also

opens the circuit of the stepping magnets of the transmitters and the transmitter relay 30 and prevents their operation. The "stunt" signal combination is therefore held on the selecting relays and as the transmitter relay 30 cannot operate the control relay 33 and the fifth-pulse relay 32 will remain locked up. The apparatus is therefore left in condition so that the second letter designating the "stunt" signal will be printed during the next revolution of the brush.

In Fig. 2 is illustrated a modified arrangement of the invention which is adapted to prepare the cipher message in suitable form for transmission over a commercial telegraph or cable line and which comprises means for substituting letters for the "stunt" signals, means for dividing the letters into groups of five, and means for automatically restoring the carriage and feeding the paper at the end of the line. In the arrangements of Fig. 2 these results are accomplished by making certain modifications in the construction of the printer itself, rather than by the use of relay arrangements, as in Fig. 1.

In the arrangements of Fig. 2 two letters will be substituted for each "stunt" signal in accordance with the following code:

- S L represents line feed.
- S H represents space.
- S O represents carriage return.
- S K represents letter shift.
- S J represents figure shift.
- S T represents blank tape.
- S Y represents letter S.

The "stunt" contacts in the printer are used for controlling the substitution of these letters for the "stunt" signals and contacts operated by the space ratchet wheel are used to control return of the carriage, the line feeding and the spacing between five-letter groups.

The printer D is of a type well-known in the art such as is illustrated in the Patent No. 1,215,604, to G. M. Yorke. Associated therewith are the "stunt" contacts 67 to 73 inclusive. There is also associated with the printer a printing relay 40, clear out relay 39, release magnet 42, start relay 43, start magnet 44, printing magnet 52, with which are associated the type shaft 48, the striking arm 49' and the stop bars, such as 49. There is also provided the space lock relay 51, space magnet 50, line feed magnet 47, shift magnet 46, margin relay 36, and the carriage return magnet 37. There is also provided a gang switch 74 shown in its normal position and the gang switch contacts 1" to 26" inclusive. A cam 64 is provided driven by the space ratchet mechanism and this cam controls the margin contacts 41 and the space control contacts 65. Associated with the space control contacts is the space

control relay 60. The selecting magnets of the printer are shown as 11, 12, 13, 14 and 15. Associated with the printer is the distributor 24 for timing certain of the operations, and the "S" relay 61 and the fifth-pulse relay 32. The other arrangements consist of the selecting relays 1', 2', 3', 4' and 5', the ciphering relays 6, 7, 8, 9, and 10, the message transmitter A, and the cipher transmitters B and C of which no further description will be given as their operation is substantially the same as in Fig. 1. Like reference characters have been used to denote like parts in both figures of the invention.

The following modifications in the printer unit D will now be described.

(1.) The stop bar 63 for the letter S is to be arranged so that it will be controlled by the armature of a magnet 62 instead of being controlled by the selecting discs. This can be done by changing the shape of the stop bar so that its vertical leg will extend past the selecting disc with its end opposite the armature of a stop magnet mounted in the crown assembly.

(2.) An extra "stunt" bar is to be added and the selecting discs are to be slotted so that this bar will operate and close the contact 69 whenever the blank tape signal is received, or in other words whenever none of the selecting magnets are operating. Under ordinary conditions the contacts operated by the "stunt" bar will simply operate the clear out relay 39 to clear out the printer. This "stunt" contact replaces the release control relay.

(3.) In order to control the carriage automatically so as to space the letters in groups of five and so as to return the carriage and feed up the paper at the proper time, the cam 64 is to be connected to the space ratchet wheel for operating two sets of contacts as shown in the circuit diagram. This cam rotates with each operation of the space magnet 50 and operates space control contacts 65 after the fifth letter is printed, and then after every sixth succeeding operation of the printer. As will be explained, the circuit arrangements are such that these space control contacts introduce the space after each group of five letters.

(4.) The margin contacts 41 are to be adjusted to operate while the tenth group of five letters is being printed and as will be explained they cause the carriage to return after the last character of this tenth group in each line is printed.

(5.) The carriage return relay 37 and a space control relay 60 are added to the printer to control the automatic spacing and carriage return operations.

(6.) The cam switch 74 is added to the printer and is so arranged that if it is in one position the printer will operate in a

normal manner and when it is in another position the printer will automatically substitute two letters for each "stunt" signal and will also introduce spaces after each group of five characters, etc.

The operation of the circuit arrangements with the cam switch 74 and the cipher cut-off key K_2 , operated will now be described.

When the cam switch 74 is in its normal position, as shown on the drawing, the printer will operate in the normal manner and will record every character as set up on the selecting magnets; that is, it will print the letters set up on the selecting magnets and will space, carriage return, or line feed, etc., when the signals representing these functions are set up on the selecting magnets. If the cipher cut-off key K_2 is also operated the cipher transmitters B and C and cipher relays 6, 7, 8, 9, and 10 will not operate and the printer will record each character as it is set up on the message transmitter. The printer is used in this way for recording such parts of the message as the address, etc., which are not put in cipher.

The operation of the circuit under these conditions is as follows:

When the starting key K_1 is operated it will close a circuit from battery, over the back contact of the margin relay 36 and the auto-stop contacts 22 to operate the distributor start magnet 23 this will allow the distributor brush arm to rotate continuously until this circuit is opened either at the auto-stop lever 22 or starting key K_1 . Each letter in the message tape will operate one or more contacts of the message transmitter A and this in turn will set up the combination representing this letter on the transmitter relays 1', 2', 3', 4' and 5' and this will set up the same combination on the selecting magnets 11, 12, 13, 14 and 15 in the printer (as none of the cipher relays are operated). When the brush crosses segment 75 an impulse will be sent through cam switch contacts 2'' and 1'' to operate the printing relay 40 and start the operation of the printer. When the brush crosses segment 77 the stepping magnet of message transmitter A will be operated and this will force all five transmitter contacts against the right hand bus bar, thus releasing the transmitter relays and the selecting magnets. The transmitter magnet will also advance the message tape one character. When the brush passes off of segment 77 the transmitter magnet will be released and this will set up on the transmitter contacts, the transmitting relays and the selecting magnets the combination representing the next character of the message. These operations will be repeated with each revolution of the brush arm. Under these conditions the printer will

operate normally on every signal except "blank tape" and the letter S.

The operation of the printer for the signals "blank tape" and the letter S will now be described. When there are no holes in the tape none of the transmitter contacts, and therefore none of the transmitter relays or selecting magnets will be operated and the slots in the five selecting discs will be in alignment opposite the blank "stunt" bar. When the printing relay 40 operates it will operate the release magnets 42 and they will release all of the stop bars and "stunt" bars. The blank "stunt" bar will enter the slots and operate the blank stunt contacts 69. This will close the circuit from battery, through the blank "stunt" contacts 69, cam switch contacts 13'' and 12'', through a resistance, cam switch contacts 25'' and 24'', through the winding of the clear out relay 39 to ground. The closing of this circuit will operate the clear out relay 39 and release the printing relay 40 and release magnets 42, thus clearing out the printer and leaving it ready for the next letter. When the signal representing the letter S is received selecting magnets 11 and 13 will operate with the result that the slots in the selecting discs will be in alignment opposite the S "stunt" bar. The printing relay 40 and release magnets 42 will operate as usual and the S "stunt" contacts 67 will be closed. The release magnets 42 also operate a set of contacts which close a circuit for operating the start relay 43 which in turn operates the start magnet 44 and releases the type shaft 48. The S "stunt" contact 67 closes the circuit from battery through cam switch contacts 5'' and 4'', and through the winding of the S magnet 62 to ground. This will operate the S magnet 62 and allow the inner end of the S stop bar 63 to rise in the path of the striking arm. The striking arm on the type shaft will come into contact with the S stop bar, which will stop the type wheel with the letter S opposite the printing arm. The circuit will then be closed from battery, through the S stop bar 63 and striking arm 49', through the windings of the printing magnet 52, space lock relay 51 and clear out relay 39 to ground, which will operate the printing magnet 52 to print the letter S and will cause the printer to space and clear out in the usual manner.

It should also be observed that when the cam switch is in its normal position S relay 61, the fifth pulse relay 32, space control relay 60 and margin relay 36 cannot operate for the following reasons:

(1) The operating circuit of relay 61 is open at cam switch contact 6''.

(2) The circuit of the winding of the fifth pulse relay 32 is open at the front contact of S relay 61.

(3) The circuit of the operating winding of the space control relay 60 is open always, either at the outer space control contact 65 or at cam switch contact 3". The circuit of the locking winding of this relay is also either open or connected to battery at both ends.

(4) The circuit of the operating winding of the margin relay 36 is open either at the outer margin contact 41 or at the lower front contact of the space control relay 60.

The operation of the circuit arrangement with the cam switch in its normal position and the cipher cutoff key in its normal position is as follows:

When the cipher cutoff key is in its normal position the cipher transmitters and cipher relays will be operated under the control of the two key tapes. This is the normal condition of the apparatus when it is used for deciphering incoming messages. When the cipher cutoff key is normal the cipher relays will operate under the control of the two key tapes and the selecting magnets will be controlled both by the transmitter relays and the cipher relays so that the character set up on the selecting magnets will be produced by combining the character in the message tape with the corresponding character in the two key tapes. The magnets in the two cipher transmitters will be connected in parallel with the magnet of the message transmitter so that all three tapes will step forward simultaneously when the brush crosses segment 77. Under these conditions the printer will record a series of characters produced by combining the three tapes.

The operation of the circuit arrangement with the cam switch operated and the cipher cutoff key normal is as follows:

The cam switch is operated for printing the enciphered part of an outgoing message. Under these conditions the printer will automatically substitute two letters for each stunt signal and also for the letter "S," and the printer will also space the letters into groups of five, the carriage will return automatically and the paper will feed up at the end of each line.

In this circuit arrangement the letter "S" is used to designate the stunt signals instead of the letter "e" because this requires less change in the printer unit as the printer is normally equipped with a stunt bar operating on the letter "S" signal. By providing a suitable stunt bar and stunt contacts, any letter could be used as a designating letter.

The operation of substituting two letters for the stunt signals (and letter "S") will be described without considering the automatic spacing and carriage return operations.

If the combinations of holes in the three tapes are such as to set up on the selecting

magnets a combination representing any letter (except "S"), the printer will operate as usual to record the selected letter. If, however, the tapes combine so as to set up on the selecting magnets a combination representing the letter "S" or one of the six stunt signals the printer will operate as described below.

When the rotating brush crosses segment 75, the printing relay 40 will operate and will cause the successive operation of the release magnets 42, start relay 43 and start magnet 44, thus releasing the typeshaft 48. If a stunt or letter "S" combination is set up on the selecting magnets 11 to 15 inclusive, the slots in the selecting discs will be in alignment opposite one of the seven "stunt bars" and when the release magnets 42 operate, this selected "stunt bar" will enter the slots and operate its "stunt contacts."

The stunt contacts will close a circuit for operating the "S" relay 61. Depending on which of the stunt contacts 67 to 73 inclusive are operated, the current will take one of the following paths:

(1) For the letter "S"—from battery, through the "S" stunt contacts 67, cam switch contacts 5" and 6", and winding of the "S" relay 61 to ground.

(2) For carriage return—from battery, through cam switch contacts 26" and 25", carriage return stunt contacts 68, cam switch contacts 8", 9" 5" and 6", and winding of "S" relay 61 to ground.

(3) For blank tape—from battery, through "blank" stunt contacts 69, cam switch contacts 13", 14" 5" and 6", and winding of "S" relay 61 to ground.

(4) For letter shift—from battery, through "letters" stunt contacts 70, cam switch contacts 13", 14", 5" and 6", and winding of "S" relay 61 to ground.

(5) For figure shift—from battery, through cam switch contacts 26" and 25", "figures" stunt contact 71, cam switch contacts 16", 17", 5" and 6", and winding of "S" relay 61 to ground.

(6) For line feed—from battery, through line feed stunt contacts 72, cam switch contacts 19", 20", 5" and 6" and winding of "S" relay 61 to ground.

(7) For space—from battery, through lower front contact of start relay 43, space stunt contact 73, cam switch contacts 22", 23", 5" and 6", and winding of "S" relay 61 to ground.

The distributor segments are to be so spaced in relation to the speed of the rotating brush arm that sufficient time will elapse for the successive operation of the printing relay 40, release magnets 42 and "S" relay 61 while the brush is crossing segment 75 and the dead segment 76 following it. Under these conditions "S" relay 61 will operate before the brush reaches segment 77

and will prevent the operation of the transmitter magnets while the brush crosses the segment 77.

The "S" relay 61 closes a circuit at its lower contact for operating the fifth-pulse relay 32 which locks itself to battery through the lower front contact of the start relay 43. The fifth-pulse relay 32 switches the circuit in such a way that selecting magnet No. 15 will be deenergized if it had been previously operated and will be energized if it had been previously unoperated, but the presence of the stunt bar in the slots of the selecting discs will prevent any change in the position of the fifth selecting disc at this time.

The "S" relay 61 also prepares a circuit for operating the "S" magnet 62. When the brush crosses segment 77 the "S" magnet 62 will be operated over a circuit extending from battery through the brushes, segment 77, upper front contact and upper winding of "S" relay 61 and winding of "S" magnet 62, to ground. The operation of the "S" magnet 62 will release the "S" stop bar 63 and allow its inner end to rise into the path of the rotating striking arm 49'. When the striking arm comes into contact with the "S" stop bar, the type shaft will stop in position to print the letters "S" and a circuit will be closed from battery through the "S" stop bar 63, striking arm 49', printing magnet 52, space-lock relay 51, and clear-out relay 39 to ground, which will cause the printer to print the letter "S" and to space and clear out in the usual way.

When the printer clears out, the circuit of the lower winding of the "S" relay 61 will be opened at the stunt contacts. The upper winding of this relay will be opened when the brush passes off of segment 77 (and the "S" magnet 62 will be released at this time). The "S" relay 61 will release when the circuits of both windings are open. As this cannot occur until after the brush has passed off of segment 77, it is evident that the message transmitter magnets cannot operate during this revolution of the brush arm and therefore, the same combination will be held on the cipher relays and transmitter relays.

The contacts of release magnet 42 are so arranged that they connect battery to the fifth-pulse relay 32 locking circuit before the start relay 43 releases. Therefore, the fifth-pulse relay 32 will remain locked up after the printer has cleared out. Under these conditions the selecting magnets will remain operated in the same combination as for the stunt signal except that the fifth-pulse will be reversed. This will be the combination for selecting and printing the second of the two letters representing this particular stunt signal.

During the next revolution of the brush arm, the printer will print this second letter in the usual manner and the tape transmitters will step forward to set up the combination representing the next letter or stunt signal. A retardation coil is connected in series with the start relay 43 to make it slightly slow in operating so that it will not connect battery to the locking contact of the fifth-pulse relay 32 until after the contacts of release magnet 42 have opened. This causes a momentary opening of the locking circuit of the fifth-pulse relay 32 and releases that relay which in turn either operates or releases selecting magnet No. 15. The fifth selecting disc will be held in its former position, however, by the stop bar until the printer clears out. The above description covers the operation of substituting the proper two-letter groups for the stunt signals.

The automatic spacing carriage return, and line feed operations will now be described. The operation of the printer when a succession of letters other than the letter "S" is being set up on the selecting magnets will be described first: Under these conditions none of the stunt contacts will operate. Assuming that the carriage has been returned to the beginning of a line, the space-control contacts 65 will be in the position indicated on the drawing. When the brush crosses segment 75 a circuit will be closed from battery through cam switch contacts 2'' and 3'', through the middle and inner space-control contacts 65, through the winding of the printing relay 40 and back contact of the clear-out relay 39 to ground. This will operate the printing relay 40. The printer will print, space and clear out as usual and the cam will be rotated one step by the space ratchet wheel. When the brush crosses segment 77 the tapes will be advanced in the usual manner.

The operation of printing the second, third and fourth letters is exactly the same. After the fifth letter is printed the space ratchet cam 64 will rotate far enough to operate the space-control contacts 65. The transmitter magnets will also operate and set up the combination for the sixth letter in the usual manner.

When the brush crosses segment 75 on its sixth revolution a circuit will be closed from battery through segment 75, cam switch contacts 2'' and 3'' and the middle and outer space-control contacts 65 and through the upper winding of the space-control relay 60 to ground. This will operate the space-control relay 60 which will lock itself through its lower winding and close a circuit through the margin contacts 41 for operating the space-lock relay 51 and clear-out relay 39. This will cause the printer to space which in turn will allow the space-

control contacts 65 to return to their normal position.

When the brush crosses segment 77 the transmitter magnets will not operate because their circuits are open at the upper back contact of the space-control relay 60. Therefore, the combination for the sixth letter previously set up on the selecting magnets will remain. When the brush crosses segment 78 the locking winding of the space-control relay 60 will be short-circuited and it will release, thus releasing the space-lock relay 51 (provided the space magnet 50 has operated by this time) and restoring the circuits to their normal condition.

When the brush revolves again it will cause the printer to print the sixth letter in the usual manner and the operation will continue until another group of five letters has been printed after which the space-control relay 60 will operate and introduce a space again in the manner just described.

A pin 66 is attached to the space ratchet wheel in such position that it will operate the margin contacts 41 at some time during the printing of the tenth group of five characters. The margin contacts 41 will remain operated until the cam is restored to its normal position.

The operation of the margin contacts 41 will have no effect until the space-control relay 60 is operated after the fifth letter of the tenth group of five is printed. When the brush crosses segment 75 after this fifth letter has been printed, the space-control relay 60 will operate as previously described and it will lock itself and close a circuit through the outer margin contact 41 for operating the margin relay 36. This relay will lock itself through the winding of the carriage return magnet 37 and through the carriage contacts 90. The margin relay 36 also closes a circuit for operating the line feed magnet 47 and opens the circuit of the distributor starting magnet 23. This allows the brush arm to come to rest against the armature of the start magnet and to remain at rest until the comparatively slow carriage return operation is completed. The carriage return magnet 37 releases a pawl which normally holds the space ratchet wheel and this allows the carriage and the space-control cam to be returned to their normal positions. When the carriage is completely restored it opens the carriage contacts 90 which releases the margin relay 36 and the carriage return magnet 37. The margin relay 36 on releasing, releases the line feed magnet 47 and closes the circuit for starting the distributor brush arm.

The above description of the automatic spacing and carriage return operations was based on the assumption that no stunt (or letter "S") signals were set up on the selecting magnets. In practice, such a signal

might occur at any part of a five letter group. The effect of such an occurrence on the automatic spacing and carriage return operations will now be described: If a stunt signal or letter "S" occurs as the first, second, third or fourth character of a five-letter group, the circuit will operate as previously described and the proper two letters will be printed to represent the stunt signal. If, however, a stunt signal, or letter "S", occurs as the fifth letter of such a group, it becomes necessary to introduce a space (or in some cases to return the carriage) between the two letters which are substituted for the stunt signal.

In order to describe this operation we may assume that four letters of a particular group have been printed and that the three tape transmitters have stepped forward and set up on the selecting magnets a combination representing the letter "S" or one of the six stunt signals. Under these conditions the slots in the selecting discs will be in alignment opposite one of the seven stunt bars.

When the brushes cross segment 75, the printing relay 40, release magnets 42, start relay 43 and start magnet 44, will be operated in succession as usual. When the release magnets 42 operate, the selected stunt contacts will close and this will operate "S" relay 61 which in turn will operate the fifth-pulse relay 32. When the brush crosses segment 77, it will operate "S" magnet 62 and release the "S" stop bar 63. This will stop the type shaft and cause the printer to print the letter "S" and to space and clear out in the usual way.

When the fifth-pulse relay 32 operates it will reverse selecting magnet No. 15, and when the printer clears out, the selecting disc controlled by magnet 15 will be released or operated as the case may be, thus setting up the combination for printing the second of the two letters representing the stunt signal.

When the space magnet 50 operates, the space-control contacts 65 will be operated by means of the cam. This will connect segment 75 to the space-control relay 60 so that when the brush revolves again the printer will space (or the carriage will be restored) as previously described in detail. The transmitter magnets will not operate during this revolution of the brush arm as their circuits are open at the back contact of the space control relay 60. The fifth-pulse relay 32 will not release during this revolution of the brush arm because the release magnets 42 are not operated when the printer performs this special spacing (or carriage return) operation. Therefore, the combination for printing the second of the two letters representing the stunt signal will still be set up on the selecting magnets, and when the brush revolves again this letter will be printed and the fifth-pulse relay 32

will be released thus restoring the circuit to its normal condition.

The arrangements illustrated in Figs. 1 and 2 accordingly provide means whereby a code message may be prepared for transmission in enciphered form and in which form the "stunt" signal combinations are represented by a combination of two letters. To decipher the incoming messages it is desirable to convert the message into the form of a perforated tape. This may be done by an operator using an ordinary keyboard perforator. In performing this operation, the operator may mentally combine the two letters representing each "stunt" signal and perforate directly the corresponding "stunt" signal. If this is done, a tape will be produced which may be inserted in transmitter A and combined with the key tapes in transmitters B and C in the usual way to produce the original message in deciphered form.

In order that the operator may not be burdened with the work of mentally combining the two letters representing each "stunt" signal, it may be desirable to use automatic means for converting these letters into "stunt" signal combinations. In this case the operator may simply perforate a tape containing the letters exactly as they appear in the cipher message and insert such tape in the transmitter A to decipher the message. In Fig. 3 is shown an arrangement whereby a tape which contains the two letter combinations for the "stunt" signals, instead of the "stunt" signal combinations themselves, may be automatically deciphered. The circuit arrangement of Fig. 3 is especially designed for deciphering messages in which the letter "S" is used to denote the stunt signals, or in other words, messages such as might be prepared by using the arrangements illustrated in Fig. 2. The arrangements of Fig. 3 may be set up as a separate outfit for deciphering purposes only, or the circuit may be combined with the arrangements of Fig. 2 in a printer set arranged for both enciphering and deciphering. Similar reference numerals have been used to denote like parts in both of the figures. In order to combine the arrangements of Fig. 3 with the printer of Fig. 2, it is only necessary to rewire the transmitter relays 1', 2', 3', 4' and 5' and the fifth-pulse relay 32 of Fig. 2 to agree with the arrangements shown in Fig. 3 and to add the key K_s which should be wired in the lead from cam switch contact 1'' to the printing relay 40 of Fig. 2. An additional pair of contacts on key K_s should also be wired to key K_s to shunt the extra contacts of the fifth-pulse relay 32 of Fig. 2, so that the fifth-pulse relay cannot open the circuit of the cipher transmitter magnet unless the key K_s is operated.

In the operation of the arrangements

shown in Fig. 3, if it is desired to print the address or other parts of the message that are not in cipher, the cipher cutoff key K_2 may be thrown. This cuts off the cipher transmitters B and C and releases all of the cipher relays 6, 7, 8, 9 and 10.

To decipher and print the enciphered part of the message, the cipher cutoff key K_2 should be restored to normal. Under these conditions, the printer will record the character formed by the combination of the three tapes.

If the operator has not substituted the "stunt" signals in perforating the message tape, key K_s should also be operated. Under these conditions the circuit will operate as follows:

The left hand contacts of the transmitter relays are wired so that if a letter "S" signal is in the tape in the message transmitter (operating relays 1' and 3'), the left hand contact of key K_s will be connected to the fifth-pulse relay 32; but if any other signal combination is set up, the left hand contact of key K_s will be connected to the printing relay 40. Assume first that a letter other than "S" is in the tape in the message transmitter. The combination representing this letter will be set up on the transmitter relays 1' to 5'. The combination of the two key tapes will be set up on the cipher relays 6 to 10 and these relays acting in conjunction with the transmitter relays will set up on the printer selecting magnets 11 to 15 the combination representing a letter of the deciphered message. When the brush crosses segment 75 a circuit will be established from battery, through the brushes, segment 75, key K_s , left hand contacts of transmitter relays 1' to 5', winding of printing relay 40 and back contact of clearout relay 39 to ground. This will operate the printing relay 40 and cause the printing of the selected letter in the usual manner. When the brush crosses segment 77, all three transmitters will be operated, thus advancing the tapes, and when the brush passes off of segment 77, the combinations for the next letter will be set up on the contacts of the three transmitters, transmitter relays, cipher relays and selecting magnets. As long as the letter "S" does not appear in the message tape, these operations will be repeated with each rotation of the brush arm. When a letter "S" signal is set up in the message transmitter, transmitter relays 1' and 3' will be operated. Under these conditions, when the brush crosses segment 75 the fifth-pulse relay 32 will be operated instead of the printing relay 40 and therefore the printer will not operate. The fifth-pulse relay 32 locks itself to battery through the contacts of release magnet 42. It also reverses selecting magnet 15 and opens the circuit of the cipher transmitter magnets 6 to 10. When the brush crosses segment 77

the message tape will be advanced, but not the key tapes. The second of the two letters representing the "stunt" signal will now be set up on the transmitter relays. The signal combination of this letter is the same as that of the "stunt" signal which it represents except that the fifth-pulse is reversed. As the fifth-pulse relay 32 is also operated at this time, the correct combination representing a letter of the deciphered message will be set up on the selecting magnets; and on the next revolution of the brush, this letter will be printed. The fifth-pulse relay 32 will be released by the operation of the release magnets 42 in the printer.

While the invention has been disclosed as embodied in certain specific arrangements which are deemed desirable, it is understood that it is capable of embodiment in many and widely varied forms without departing from the spirit of the invention as defined in the appended claims.

What is claimed is:

1. The combination of a plurality of selecting means upon which may be set up code combinations representing message characters or "stunt" signals, a printer associated with said selecting means and normally adapted to print the characters of said code combinations and to operate in accordance with said "stunt" signals, and relay means associated with said selecting means and said printer, said relay means being operative whenever a code combination representing a "stunt" signal is set up on said selecting means, and said relay means when operated preventing said printer from operating normally in accordance with said "stunt" signals and causing said printer to give a printed indication of said "stunt" signals.

2. The combination of a plurality of selecting means upon which may be set up code combinations representing message characters or "stunt" signals, a printer associated with said selecting means and normally adapted to print the characters of said code combinations and to operate in accordance with said "stunt" signals, relay means associated with said selecting means and said printer, said relay means being operative whenever a code combination representing a "stunt" signal is set up on said selecting means, said relay means when operated preventing said printer from operating normally in accordance with said "stunt" signals and causing said printer to give a printed indication of said "stunt" signals, and means operating in conjunction with said relay means to cause said printer to print said characters in groups.

3. The combination of a plurality of selecting means upon which may be set up code combinations representing message characters or "stunt" signals, a printer as-

sociated with said selecting means and normally adapted to print the characters of said code combinations and to operate in accordance with said "stunt" signals as set up on said selecting means, controlling means associated with said selecting means and said printer, and means for operatively associating said controlling means therewith, said controlling means when operated preventing said printer from operating normally in accordance with said "stunt" signals and causing said printer to give a printed indication of said "stunt" signals.

4. A message tape including code combinations representing characters of a message, a cipher tape including arbitrarily chosen code combinations, means for combining the code combinations of said tapes and setting up the resulting code combinations on a plurality of relays, said resulting code combinations including both characters and "stunt" signals, a printer associated with said ciphering arrangements and normally adapted to operate in accordance with said resulting code combinations, and controlling means associated with said printer and said ciphering arrangements and operating whenever the resulting code combinations set up by said ciphering device represent a "stunt" signal to cause said printer to give a printed indication of said "stunt" signal.

5. The combination of a plurality of selecting means upon which may be set up code combinations representing message characters and "stunt" signals, and a printer controlled by said selecting means, means associated with said printer and said selecting means whereby said printer may be caused to give a printed indication of said "stunt" signals, to space said printed letters into groups, and to automatically restore the carriage and feed the paper at the end of each printed line.

6. In a ciphering device in which the code combinations of the message are combined in effect with the code combinations of a key tape and the resulting code combinations forming the enciphered message are utilized to control a printer, the method of eliminating "stunt" signals from the printed form of said enciphered message which consists in automatically preventing said printer from operating normally whenever said resulting code combination represents a "stunt" signal, and causing said printer to print a plurality of letters whenever said resulting code combination represents a "stunt" signal.

7. In a ciphering device in which the code combinations of the message are combined in effect with the code combinations of a key tape and the resulting code combinations forming the enciphered message are utilized to control a printer, the method of eliminat-

ing "stunt" signals from the printed form of said enciphered message which consists in translating in effect the resulting code combinations which represent "stunt" signals into two letter combinations in accordance with an arbitrarily chosen code.

8. A message tape including code combinations representing characters of a message, a cipher tape including arbitrarily chosen code combinations, means for combining the code combinations of said tapes and setting up the resulting code combinations, said resulting code combinations comprising the ciphered message and including combinations representing letters and signals, and a printer associated with said ciphering arrangements, said printer being adapted to record all of said resulting code combinations in letter formation.

9. In a ciphering and deciphering device, means for setting up the code combinations of a message, said code combinations representing letters and other signals, and means

for recording all of said code combinations as set up in printed letter formation. 25

10. A message tape including code combinations representing letters, certain combinations of said letters representing signals and the other letters representing message characters, means for combining the code combinations of said first tape representing message characters with code combinations of a second tape and setting up said resulting code combinations, automatic means for transposing said combinations of letters representing signals into code combinations representing said signals and for combining said code combinations with the combinations of said second tape and setting up said resulting code combinations, and a printer controlled by said resulting code combinations. 30 35 40

In testimony whereof, I have signed my name to this specification this 19th day of July 1920.

GILBERT S. VERNAM.