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J. T. NEISWINTER

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CALLING KEY TESTING APPARATUS

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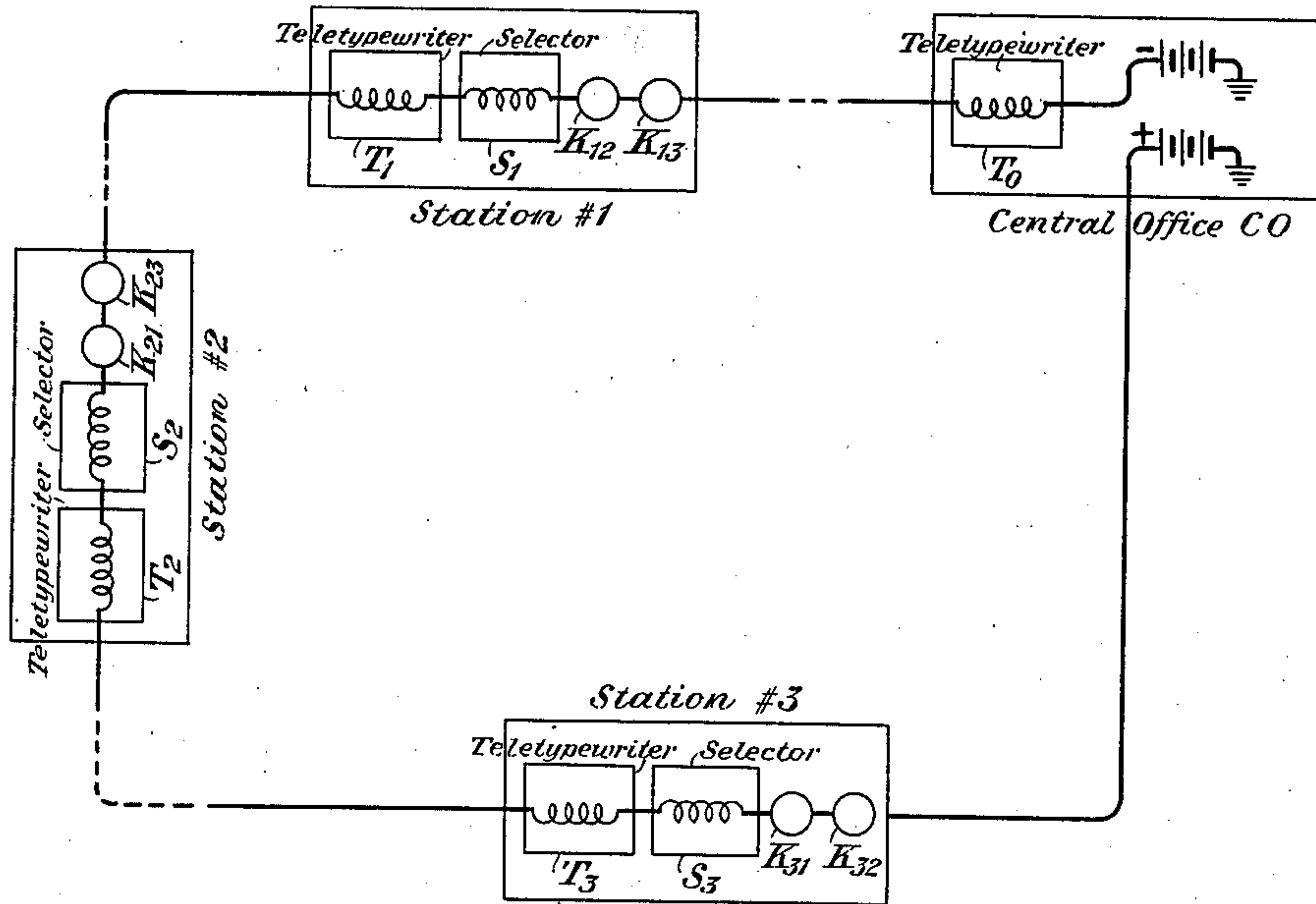


Fig. 1

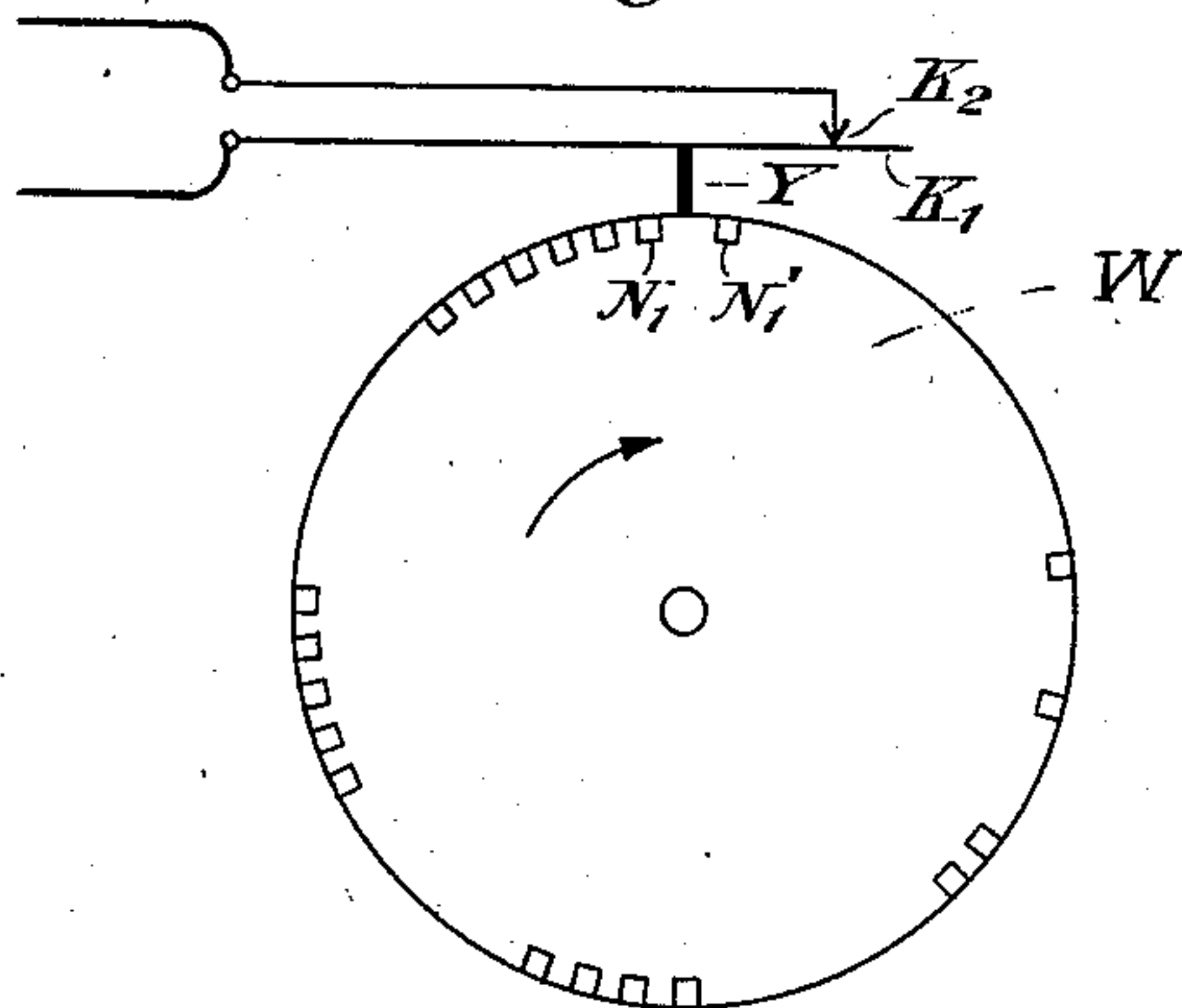


Fig. 2



Fig. 3a

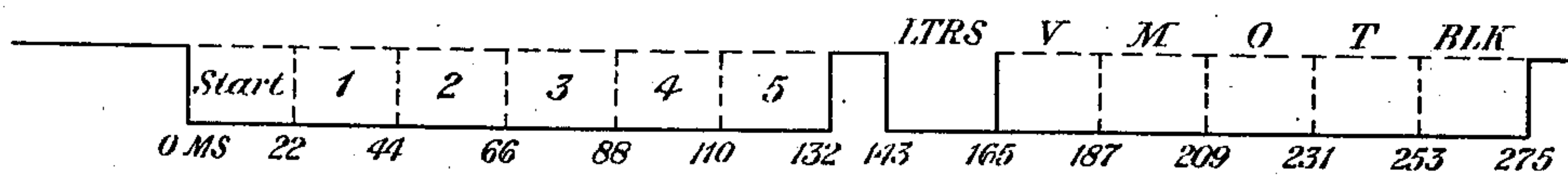


Fig. 3b

INVENTOR
J. T. Neiswinter
 BY *Jefferson Ehrlich*
 ATTORNEY

UNITED STATES PATENT OFFICE

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CALLING KEY TESTING APPARATUS

James T. Neiswinter, South Orange, N. J., assignor to American Telephone and Telegraph Company, a corporation of New York

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3 Claims. (Cl. 178—69)

This invention relates in general to signaling apparatus, and more particularly to teletypewriter apparatus. Still more particularly this invention relates to arrangements for observing the operation and performance of calling keys or switches and the like.

In existing signaling systems a key which is frequently called a "Gill selector key" is used for calling any one of a plurality of parties which may be connected to a line. This key comprises a rotatable wheel which includes a plurality of groups of notches each of which is uniformly cut along the periphery of the wheel. One of the contacts of a switch rests on an arm which rides along the periphery of the key wheel while the latter rotates and as it engages one of the notches it may be used to interrupt a signaling current. Thus the signaling current will be interrupted a predetermined number of times corresponding to the notches in the key wheel during its rotation through one complete revolution and hence a corresponding number of pulses will be generated. These pulses may be transmitted over the circuit and impressed upon a plurality of selectors, but only that selector which is designed to respond to the groups of pulses of a particular key will be actuated by those pulses for apprising, for example, the attendant at the station where the selector is located that he is being called on the circuit.

At present difficulties are experienced with keys of the Gill selector type which are in use in the field. It is difficult to determine definitely whether the trouble lies in the calling key or in the receiving selector which responds to the code of pulses set up by the key. The usual result of this condition is that considerable time is spent in readjusting or replacing keys and selectors until the trouble is ultimately cleared. This cut and try practice is, of course, time consuming and oftentimes involves the unnecessary replacement of apparatus and, moreover, does not promptly locate the source of trouble.

In this application will be described a method and apparatus for observing the operation of keys of the type above referred to so that their performance may be studied and they may be adjusted for proper operation. The apparatus used will include a teletypewriter which may be located in any one of the offices on the circuit or at the central office. The method and apparatus to be employed will yield a ready check on the operation and the mechanical adjustment of the key. The arrangements to be described may also be used for observing and checking the operation of the key even when it is used by the customer during actual

service on the circuit. The method and apparatus to be described may indicate troubles due to the customer's operation of the signal key that may not be evident during tests performed by a maintenance man.

This invention will be better understood from the detailed description hereinafter following, when read in connection with the accompanying drawing, in which Figure 1 shows one form of circuit arrangement which may be used for observing the performance of a calling key of the type already referred to; Fig. 2 shows an arrangement to explain the general principles of the calling key and its associated switch contacts; Fig. 3a illustrates an analysis of one of the pulses of the calling key; and Fig. 3b shows a chart of teletypewriter code characters that may be printed to indicate the satisfactory or unsatisfactory operation of the calling key.

Referring to Fig. 1 of the drawing, there is shown a loop circuit in which are located three customers' stations designated Nos. 1, 2 and 3. The loop circuit may terminate in a central office CO. Each station may include a pair of calling keys, a selector and a teletypewriter. The calling keys at station No. 1, for example, are designated K_{12} and K_{13} , the key K_{12} being employed to call the attendant at station No. 2 and key K_{13} the attendant at station No. 3. Likewise the keys K_{21} and K_{23} at station No. 2 may be employed to signal to stations Nos. 1 and 3, and keys K_{31} and K_{32} of station No. 3 may signal stations Nos. 1 and 2, respectively. The selectors S_1 , S_2 and S_3 at the three respective stations will each respond to but one of the codes that may be transmitted over the circuit. The selector S_1 , for example, will respond to the codes prepared by keys K_{21} and K_{31} at stations Nos. 2 and 3, respectively, the latter keys both preparing the same predetermined groups of pulses. Likewise the selector S_2 at station No. 2 will respond to the code prepared by keys K_{12} and K_{32} at stations 1 and 3, respectively, which also prepare the same groups of pulses and, finally, the selector S_3 may be operated by the groups of pulses prepared by keys K_{13} and K_{23} at stations Nos. 1 and 2, respectively. A typical group of pulses prepared by one of the keys may, for example, be 6, 5, 4, 2, 1, 1—1, where the initial group of six pulses is used to clear the various selectors and the final pulse after the dash releases the particular selector stepped and operated by the code received. It will be apparent that upon the operation of one of the selectors such as S_1 , a signal device may be operated or its associated teletypewriter T_1 may be operatively

connected to the circuit for communication with the calling station or, if desired, both of these functions may be performed at the same time.

The central office CO may include a teletypewriter T_0 for observing the performance of any of the various keys at the outlying stations. Although the circuit shown in Fig. 1 represents a direct current loop circuit, a similar arrangement may be employed for signaling between offices employing voice frequencies or higher frequencies, and repeaters (not shown) may be added to the circuit wherever required. A general description of teletypewriters that may be used in the circuit of Fig. 1 is given in Pender-McIlwain's "Electrical Engineers' Handbook" on "Communication—Electronics," third edition, pages 11-23 and 11-24.

The general outline of the rotatable wheel of the calling key and the contacts which are controlled thereby are shown in Fig. 2. Here the circular rotatable member W includes a plurality of peripheral notches according to the code 6, 5, 4, 2, 1, 1—1. Each group of notches is spaced from each succeeding group and the spacing is uniform between all groups, except that the spacing between the last notch N' and the preceding notch is considerably greater than the spacing between the various preceding groups of notches. The switch contacts are designated K_1 and K_2 . The contact K_1 is of a spring type and may be made of a material such as phosphor bronze. The contact K_1 bears against a narrow bar Y which may be inserted into each of the various notches as the wheel W of the key rotates in the direction indicated by the arrow. The pressure applied by the spring contact K_1 against bar Y acts to hold the arm Y in engagement with the outer surface of the wheel W during its rotation.

As the wheel W rotates in a clockwise direction, the arm Y in following the contour of the wheel W will move downward into the successive notches and hence open the circuit of the contacts K_1 and K_2 . The various interruptions or "opens" introduced by the notches are all intended to be of the same duration as, for example, 183 milliseconds. The spacings between the successive interruptions of any two pulses of any group of pulses are also uniform and may be, for example, 133 ms. Ofttimes failure in operating a selector is due to the fact that the interruptions or "opens" are substantially different from 183 ms. although small deviations from this standard value will ordinarily not interfere with the satisfactory operation of the apparatus as will be described hereinafter.

Fig. 3a shows a standard 183 ms. interruption or "open" produced by a calling key such as key K_{12} of Fig. 1, and directly below it Fig. 3b shows the receiving time chart of a 60 speed teletypewriter with the superimposed code characters that may be printed on a teletypewriter such as T_0 , located at the central office CO of Fig. 1. It will be understood that in 60 speed teletypewriter operation there are a starting pulse of 22 ms. and five code signals each also of 22 ms., and a final or "stop" pulse of 11 ms. for a receiving apparatus. The total time for one of these teletypewriter characters will therefore be 143 ms. Inasmuch as the 183 ms. interruption or "open" of the calling key is longer than the time for one 60 speed teletypewriter character, the teletypewriter cam (not shown), which will be released once at the beginning of the "open" and a second time at the end of the "stop" pulse (after 143 ms.), will therefore rotate through two complete revolu-

tions during the production of but one interruption or "open" of the calling key.

If the calling key interruption is of the standard value of 183 ms., the teletypewriter T_0 , for example, will print the letter V for each such interruption. Hence the teletypewriter will print a series of V's corresponding to the number of notches of the wheel W of the calling key. In actual practice there may be irregularities in the construction and operation of the key so that the "opens" of the key will be longer than 183 ms. Such longer pulses may be long enough to print the M's of the teletypewriter code. Thus certain keys may print V's and others M's and if still longer interruptions are produced, O's, T's and even "blanks" may be produced. On the other hand, if the "open" is shorter than 183 ms., the "letters" combination may be received on the teletypewriter. On some teletypewriters nothing may be printed for either the "blank" or the "letters" combination, but on other machines which are arranged to print on either "blank" or "letters" combination, the 183 ms. interruption will print characters such as arrows to designate these combinations.

The length of any interruption or "open" in general is dependent upon the adjustment of its sending contacts K_1 and K_2 and also upon the speed with which the wheel W of the key rotates. It will be understood, of course, that the wheel when released is rotated clockwise under control of its own governor from its initial position shown in Fig. 2 and thereby produces the various groups of pulses characteristic of the key operated. When the speed of the wheel W of the key is relatively slow, the interruptions will be longer than 183 ms., and on the other hand, when the speed is greater than normal, the interruptions will be less than 183 ms. The time for one revolution of the wheel may be checked at the central office CO by measuring the time interval between the first pulse which is produced when the arm Y engages the notch N_1 and the last pulse produced when the arm Y engages the notch N'_1 . This time interval can be measured, for example, on a stop watch. The "opens" may be detected by a sounder or a teletypewriter or other equivalent apparatus. The last "open" is distinguished by its appearance after the long pause that separates the final pulse from the previous pulses. Although the time so measured indicates merely an interval somewhat less than that of one complete revolution (due to the omission of the brief interval between the pulses N_1 and N'_1), this discrepancy represents but a very small fraction of a second and may in practice either be ignored or compensated in the calculations.

The time of operation of the key should be adjusted to be somewhere, for example, between 14 and 16 seconds. The period of a revolution should not be less than 14 seconds because in that case the "opens" and "closes" of the key may be so short as to fail to operate the receiving selector. If the period of operation is more than 16 seconds, the signaling time may be unnecessarily prolonged. Of these two possibilities, however, it is preferable to favor the positive operation of the selector by confining the operating time of the key closer to the 16 than to the 14 second interval.

After the key has been adjusted so that its rotating time will be within predetermined limits, then the characters that the key causes the teletypewriter to print are indicative of the adjustment of the sending contacts K_1 and K_2 of the

key. If the contacts remain open too long, O's and T's will be printed by the teletypewriter. On the other hand, if the contacts do not remain open long enough, the "letters" or "blank" combinations will be received by the teletypewriter. The danger in having the contacts not remain open long enough is that the receiving selector may fail to operate on the short "opens" while if the contacts remain open too long the "close" between two interruptions will not be long enough, i. e., the "close" will be less than 133 ms. and the selector may then fail to respond properly.

Thus after the operating time of the key has been checked and adjusted to be within prescribed limits, the key may be operated and the characters printed on the teletypewriter observed. The printing of V's and M's will indicate satisfactory operation of the key and its contacts while the reception of other teletypewriter characters will generally indicate unsatisfactory operation. O's and T's indicate interruptions which are too long and "letters" and "blanks" indicate interruptions which are too short. The number of characters printed ought to correspond to the number of notches or digits in the code of the key being tested.

It will be understood that the various constants recited hereinabove are given merely for the purpose of illustration and are not to be construed as limitations upon the inventions. Other constants of widely different character may, of course, be employed in practice within the scope of this invention.

While this invention has been shown and described in certain particular arrangements merely for the purpose of illustration, it will be understood that the general principles of this invention may be applied to other and widely

varied inventions without departing from the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. The method of determining the length of each interruption produced by a pulse producing key having a plurality of notches to provide a plurality of pulses with each operation of the key, with apparatus including a teletypewriter, which consists in operating the teletypewriter at the beginning of each interruption and then printing a teletypewriter character at the end of each interruption, the printed characters corresponding to the lengths of the interruptions.
2. In apparatus for testing a multi-notched key which produces a plurality of current interruptions of substantially uniform lengths with each operation of said key, the apparatus including a teletypewriter connected to the circuit of the key, the method of determining the duration of each interruption produced by said key which consists in operating the teletypewriter at the beginning of each interruption, and printing a teletypewriter character at the end of each interruption, each printed character corresponding to the duration of each interruption.
3. The combination of a plurality of stations between which signals may be transmitted each station including a key for producing a plurality of coded pulses of current and a selector which may respond to a predetermined coded pulse, means for observing the lengths of the various interruptions of any key while it is in service, said means including a teletypewriter which is started at the beginning of each interruption and prints a teletypewriter character at the end of each interruption, the characters printed corresponding to the lengths of the interruptions.

JAMES T. NEISWINTER.