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SECRET SIGNALING SYSTEM

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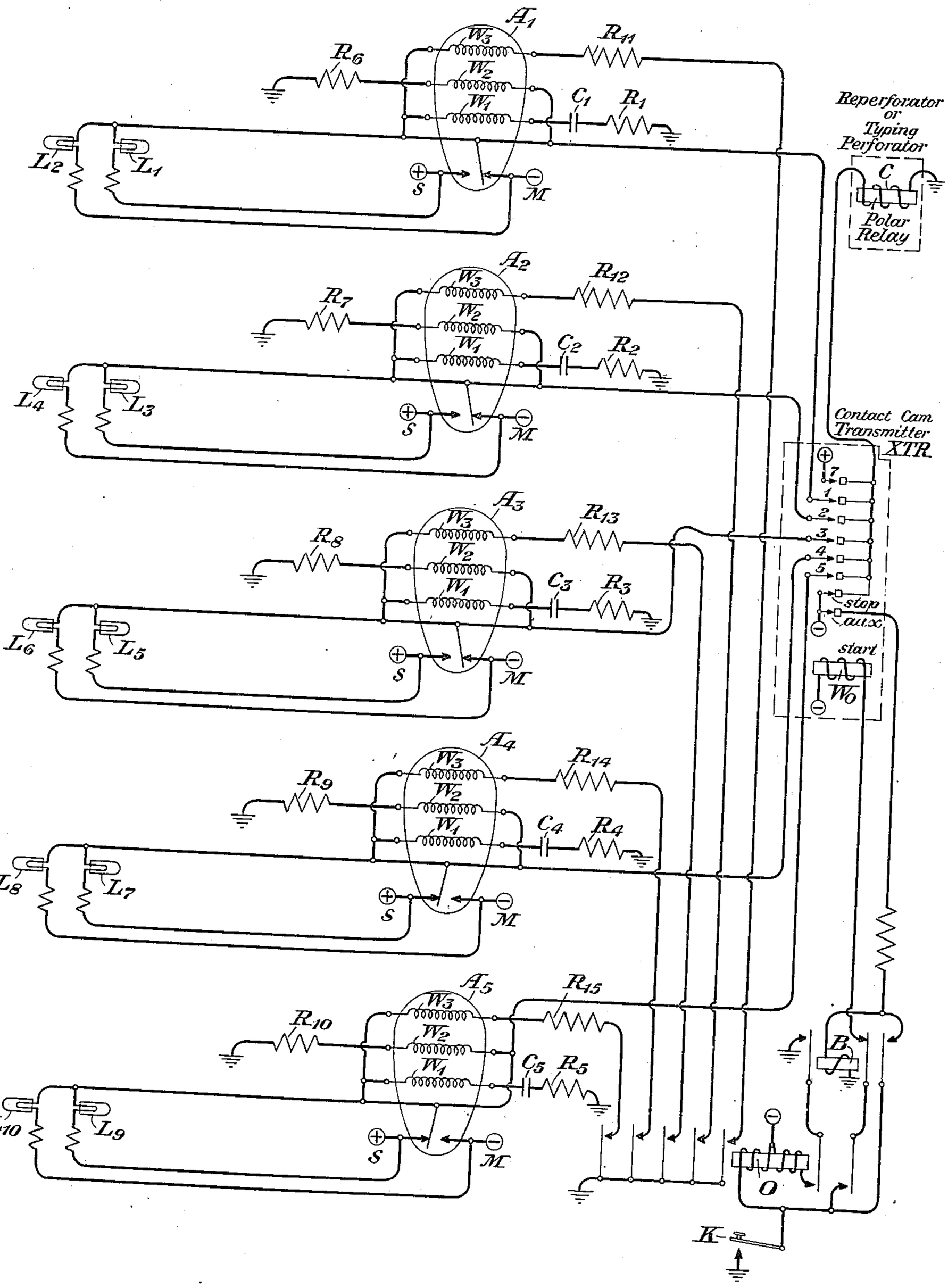

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SECRET SIGNALING SYSTEM

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This invention relates to secret signaling systems, and particularly to telegraph systems in which the messages are enciphered at the transmitting end in order to be unintelligible, and are later deciphered at the receiving end in order to be rendered intelligible.

In transmitting telegraph messages by cipher it is desirable that the cipher messages be rendered unintelligible to all except authorized receivers. In order to accomplish this, it has heretofore been the practice to combine the characters of the message—which in a teletypewriter system are made up of combinations of the elements of a five-unit code—with the various combinations of a key tape. The resultant code combinations thus make up the enciphered and unintelligible message which is transmitted to a distant station. At the distant or receiving station the code combinations of the unintelligible message are combined in effect with the code combinations of a key tape identical to that employed at the sending station, and the resultant code combinations will yield the original message in intelligible text.

Heretofore the code characters making up the key tape were prepared by picking characters by lot. It has been found, however, that this process is slow. Although these key tapes were prepared in advance, a general use of secret telegraph systems of this type would require many key tapes and therefore a more speedy method to accomplish this is desired.

According to the present invention, the key tape combination to be employed is speedily obtained from a random selection of characters. The circuit arrangement of the invention may employ the usual type of five-unit teletypewriter code from which thirty-two possible code combinations are available, and the characters of the key tape are selected at random from the various units to form a suitable combination. A series of these characters punched in the tape make up the cipher key tape such as is used in the secret telegraph systems referred to hereinabove. The same cipher key tape will be used in deciphering the enciphered message at the receiving station. The arrangements of this invention may, of course, be adapted to a code combination composed of any desired number of units, i. e. any number greater or less than the five units referred to.

The theory of operation of this invention is based upon the employment of a group of polar relays, one corresponding to each code unit, and these polar relays are arranged to vibrate simultaneously, each at a different speed, so that during a short interval the various polar relays will have passed through a plurality of combinations of different contact positions. After these polar relays are thus set into vibration, a key or other manually-operated device may be pressed in order to halt the vibration of the various polar relays. The armatures of the various polar relays will then come to rest on the contacts where they happened to be positioned at the instant when the key or other device was pressed; that is, either on their marking or spacing contacts, as the case may be at the instant of key manipulation. By means of a distributor the relay armature positions are interpreted in terms of teletypewriter signals which may be punched in tape on a reperforator for immediate use. If five polar relays are employed to vibrate freely simultaneously, they may make up any one of thirty-two possible code combinations, one of which will be selected at random upon the manipulation of the key. If the polar relays have gone through a number of cycles of operation, and the instant of stoppage is controlled manually, as is contemplated in this invention, then the combination of units chosen is taken at random. The enciphered message formed therefrom will be practically unintelligible except to the authorized receivers which are supplied with the same cipher key tape.

This invention will be better understood from the detailed description hereinafter following when read in connection with the accompanying drawing which shows one embodiment of this invention given merely for the purpose of illustration.

Referring to the drawing, five polar relays are shown which are designated A_1, A_2, A_3, A_4 and A_5. Each of these polar relays includes three windings designated W_1, W_2 and W_3, the winding W_1 being connected at one end to the armature of the relay, and at its other end to a condenser and resistor which terminates at ground, the various condensers being designated C_1, C_2, C_3, C_4 and C_5 and the corresponding resistors R_1, R_2, R_3, R_4 and R_5, as shown in the drawing. The winding W_2 of each relay is also connected at one end to its own armature, and its other end is connected to ground through another resistor, the latter resistors being designated R_6, R_7, R_8, R_9 and R_{10}. The third winding W_3 of the various polar relays is connected at one end to its own armature, and at its other end the winding is connected to one of the contacts of a relay designated O, the various resistors being desig-

nated R_{11}, R_{12}, R_{13}, R_{14} and R_{15}, each of these resistors being terminated in but one of the contacts of the relay O. The armature of each vibrating polar relay is free to move between two contacts designated S and M, the S contact being the spacing contact to which the positive terminal of a battery is connected, the negative terminal of the battery being grounded, the M or marking contact being likewise connected to a battery the positive pole of which is grounded. The M and S contacts of each vibrating polar relay are connected to a pair of lamps or other indicating devices, the lamps L_1 and L_2 being shown in the drawing as connected to the S and M contacts of relay A_1, the lamps L_3 and L_4 being similarly connected to the S and M contacts of relay A_2, the remaining lamps being similarly connected to the marking and spacing contacts of the other vibrating relays.

The armatures of the various vibrating relays A_1, A_2, A_3, A_4 and A_5 are respectively connected to the fixed respective contacts **1**, **2**, **3**, **4** and **5** of a contact cam transmitter XTR of well-known construction, the latter transmitter including also a "stop" contact, an auxiliary contact AUX, and a "start" contact designated **7**. The contact **7** is connected to a source of positive potential, which may be provided by a suitable battery, the negative terminal of which may be grounded. The starting magnet W_0 of the contact transmitter XTR is supplied with negative potential from a similar battery connected to one of its terminals, the other terminal of the starting magnet being connected to the inner contact of a relay B. The distributor arm of the contact transmitter XTR is also connected to the winding of a polar relay C, one terminal of which is grounded through suitable resistance, this polar relay being part of a reperforator of well-known type, which may be also any so-called "typing" reperforator.

The windings W_1 and W_2 of each polar relay, such as A_1, for example, are used to cause the armature of the relay to vibrate. The upper or third winding W_3 is employed to cause the armature of the relay to stop in the particular position in which it may happen to be at the instant when the third winding W_3 is energized. The various W_3 windings are normally open at the corresponding contacts of the relay O.

In the case of relay A_1, for example, the armature is positioned against its marking contact M, and hence current flows, immediately after this contact is closed, through the winding W_1 to the condenser C_1 to charge the latter condenser, the charging rate being determined by the magnitude of the resistor R_1. This current is in such a direction as to hold the armature against its contact M. As the condenser becomes fully charged, the flow of current through the winding W_1 is reduced to a practical nullity. Current also flows from the source connected to the contact M through the winding W_2 of the relay A_1, the latter current being of a magnitude which is determined by the resistor R_6. This current is of such a magnitude as to cause the armature of the relay A_1 to move away from contact M and toward contact S after the charging current for condenser C_1 has been effectively reduced. As the armature leaves contact M, the condenser C_1 will discharge through a circuit which includes both windings W_1 and W_2 and resistors R_6 and R_1. This discharge current has the effect of continuing the motion of the armature of relay A_1. When the armature of relay A_1 reaches its S contact, current will then flow from the source connected to contact S through the armature of the relay and the winding W_1 so as to again charge the condenser C_1 but in the opposite direction. As the condenser again becomes fully charged, the current through winding W_1 will be reduced to a practical nullity. The current then flowing from the source connected to contact S through the winding W_2 of relay W_1 will be in such a direction and of such a magnitude as to cause the armature of relay A_1 to return to its marking contact M. And so the armature of relay A_1 will vibrate between its two contacts at a rate which is determined by the size of the condenser C_1 and the resistors R_1 and R_6.

Similarly the armatures of each of the other relays A_2 to A_5 will vibrate continuously between their M and S contacts. The constants of the various relay circuits have been so chosen that the armatures of these various relays will vibrate at different harmonic periods, as for example, 4, 8, 12, 16 and 20 dots per second, or 5, 10, 15, 20 and 25 dots per second, or at any other predetermined rate.

When the armature of relay A_1, for example, is on its M contact, as shown in the drawing, the lamp L_1 will be illuminated, current flowing from the sources connected to the M and S contacts in series aiding. The circuit established for illuminating lamp L_1 will include the source connected to contact M, the armature of the relay A_1, the lamp L_1 (through appropriate resistance) and the contact S of relay A_1 to which an oppositely poled battery is connected. The lamp L_2, however, will be extinguished, the armature and marking contact M of relay A_1 providing a short-circuit for the lamp L_2. When the armature of relay A_1 reaches its opposite contact S, the lamp L_2 will become illuminated, the current for which is supplied by the sources connected to the M and S contacts of relay A_1 poled so as to be series aiding. The lamp L_1, however, will become extinguished because of the short-circuit then provided by the armature and spacing contact S of relay A_1. Similarly the lamps L_3 and L_4 will become alternately illuminated as the armature of the relay A_2 moves between its M and S contacts, etc.

As long as the key K remains open, the relay B will be operated, current for which is supplied by the source connected to the auxiliary contact AUX of the transmitter XTR. Moreover, as long as the key K remains open the various polar relays A_1 to A_5 will be simultaneously vibrating at different but harmonic speeds, as already pointed out, and the two lamps controlled by the armature of each relay will be alternately illuminated and extinguished. The operator may determine from the continuous flashing of the lamps that his system is working satisfactorily. But as soon as the key K becomes depressed, the various armatures of the relays A_1 to A_5 will come to rest on their previously made contacts and will remain there as long as the key K is in that position. This is because current will flow through the winding W_3 of the relay A_1, for example, the current in this case being supplied by the source connected to its contact M and traversing the winding W_3, the appropriate armature of the relay O and ground. The latter current is poled in such a direction as to maintain the armature on the contact M. Hence upon the closure of the key K the armatures of all of the polar relays A_1 to A_5 will come to rest in

such positions as to illuminate the lamps L_1, L_3, L_5, L_8 and L_{10}, while the other lamps remain extinguished.

The contact cam transmitter XTR is shown in its "stop" position in which case the relay C of the reperforator is on its marking contact and the relay B is normally operated. Upon the closure of the key K, however, the relay O will become operated, the operating current being supplied by the source connected to the terminal common to the high resistance windings of the relay O. The operation of relay O will cause the five armatures at its left to close their associated contacts and therefore ground the terminals to which the resistors R_{11} to R_{15} are connected. The closure of the outer contact at the right of relay O will cause the start magnet W_0 of the transmitter XTR to become operated, current then flowing through the winding of the start magnet W_0, and over the inner contact and armature of relay B, over the outer armature and contact at the right of relay O and over key K and ground. The contact cam transmitter XTR will now start to operate.

When the transmitter XTR operates, the distributor arm of this transmitter will then open its "stop" contact and its auxiliary contact AUX, in which case the relay B will then become released, the release being due to the removal of current from its winding upon the opening of the auxiliary contact AUX of the transmitter XTR. The release of the relay B will open the circuit of the start magnet W_0 of the transmitter XTR due to the opening of the inner contact of the relay B. If the key K remains closed, the relay B will remain released. In its released condition the relay B will lock up the relay O, the locking circuit being completed by the armature and contact at the left of relay B, current then flowing from the source connected to the right winding of relay O, through that winding, over the inner contact and armature at the right of the latter relay and the armature and contact at the left of relay B. Moreover, the various polar relays A_1 to A_5 will remain in their non-vibratory conditions, the armatures remaining on their previously made contacts. While this is happening, the "start" contact 7 of transmitter XTR is closed, thereby operating the polar relay C to spacing and thereby starting the reperforator. The distributor arm of the transmitter XTR will then close the various contacts 1 to 5 sequentially, and the positions of the armatures of the polar relays A_1 to A_5 will be registered in turn by the operation of polar relay C of the reperforator. Thus when the contact 1 of the transmitter XTR is closed, marking battery will be supplied through the armature of relay A_1 to the polar relay C; similarly marking battery will be connected to the polar relay as the distributor arm closes contacts 2 and 3, and spacing battery will be connected to the winding of the polar relay C as the distributor arm closes contacts 4 and 5 of transmitter XTR. Hence the positions of the various armatures of the polar relays A_1 to A_5 will be registered by the operation of polar relay C of the reperforator. Hence the positions of the various armatures of the polar relays A_1 to A_5 will be registered by the operation of polar relay C of the reperforator which in turn punches the tape supplied thereto in accordance with the corresponding characters.

When the key K is released, the distributor arm of the transmitter XTR may have returned to its "stop" position, as shown in the drawing. The relay B will then become reoperated, and the relay O released, as already described. If key K is opened before the distributor arm returns to its "stop" position, relay O will be held operated until the auxiliary contact AUX is closed and the relay B becomes reoperated. Furthermore, the polar relays A_1 to A_5 will again begin to vibrate and remain vibrating simultaneously at their predetermined periods only after relay O is released. It will be noted, however, that the figure punched on the tape by the reperforator may be read by the operator on the various lamps L_1 to L_{10}, already referred to. The lamps may be observed by the operator occasionally to check the random nature of the result and thereby insure satisfactory operation.

Upon the subsequent closure of the key K by the operator, the armatures of the relays A_1 to A_5 will become closed against a different combination of characters, as will be apparent to those skilled in the art. This new combination of characters will, of course, be repunched in the tape by the reperforator under the control of relay C. The random character of the apparatus is due particularly to the fact that the operator will ordinarily be unable to depress the key K at regular or predetermined intervals.

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

What is claimed is:

1. In an electrical system, the combination of a plurality of simultaneously vibrating elements operated at different periods, means for randomly stopping the vibrations of all of said elements, and means for progressively recording the positions of said elements after their stoppage.

2. In an electrical system, the combination of a plurality of vibrating elements of different periods, intermittently operated means for starting said elements in vibration and for maintaining said elements in vibration, said means including means for simultaneously stopping the vibrations of said elements, and means for sequentially registering the positions of said elements after each stoppage of said elements.

3. The combination of a plurality of vibratory elements of different frequencies operating simultaneously, means for simultaneously stopping the vibrations of all of said elements at irregular intervals, and means responsive to each stoppage of said elements for progressively indicating the positions of said elements during each interval of stoppage.

4. The combination of a plurality of polar relays, means for setting the armatures of said polar relays into simultaneous vibration at different periods, key-controlled means for stopping the vibrations of the armatures of said relays, and means for sequentially registering the positions of the armatures of said relays relative to their respective contacts at the instant of stoppage.

5. Apparatus for preparing cipher key tape for secret telegraph systems, comprising a plurality of polar relays the armatures of which are free to vibrate at different harmonic periods, a contact cam transmitter, a key-controlled circuit interconnecting said polar relays and said transmitter, means responsive to the release of said key-controlled circuit for simultaneously vibrat-

ing the armatures of said polar relays, means responsive to the operation of said key-controlled circuit to stop the vibrations of the armatures of said relays and to start said transmitter, and means responsive to the operation of said transmitter to sequentially register the positions of said armatures relative to the contacts of said armatures.

6. The combination of a plurality of relays the armatures of which vibrate simultaneously at different but harmonic periods, a plurality of indicating devices two of which are associated with each relay armature to indicate which of the two contacts of the armature is closed by said armature, a telegraph transmitter, a key-controlled circuit interconnecting said relays and said transmitter, means responsive to the operation of said key-controlled circuit for stopping the vibrations of the armatures of said relays and for operating the transmitter, and means controlled by said transmitter to register sequentially the positions of the armatures of said relays relative to the contacts of said armatures after said armatures have stopped vibrating, and means responsive to the release of said key-controlled circuit to restart said relay armatures in vibration.

7. The combination of a plurality of polar relays, means for simultaneously vibrating the armatures of said relays at different but harmonic periods, a plurality of indicating devices two of which are associated with the opposite contacts of each of the relay armatures, said indicating devices displaying the contact which is closed by the corresponding relay armature, a transmitter having a plurality of contacts one of which is connected to each of the polar relays, a reperforator controlled by the transmitter, and means for intermittently stopping the vibrations of the armatures of all of said relays and for starting said transmitter, said transmitter including means for sequentially sweeping the contacts thereof in order to register at the reperforator the various positions of the armatures of said relays.

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