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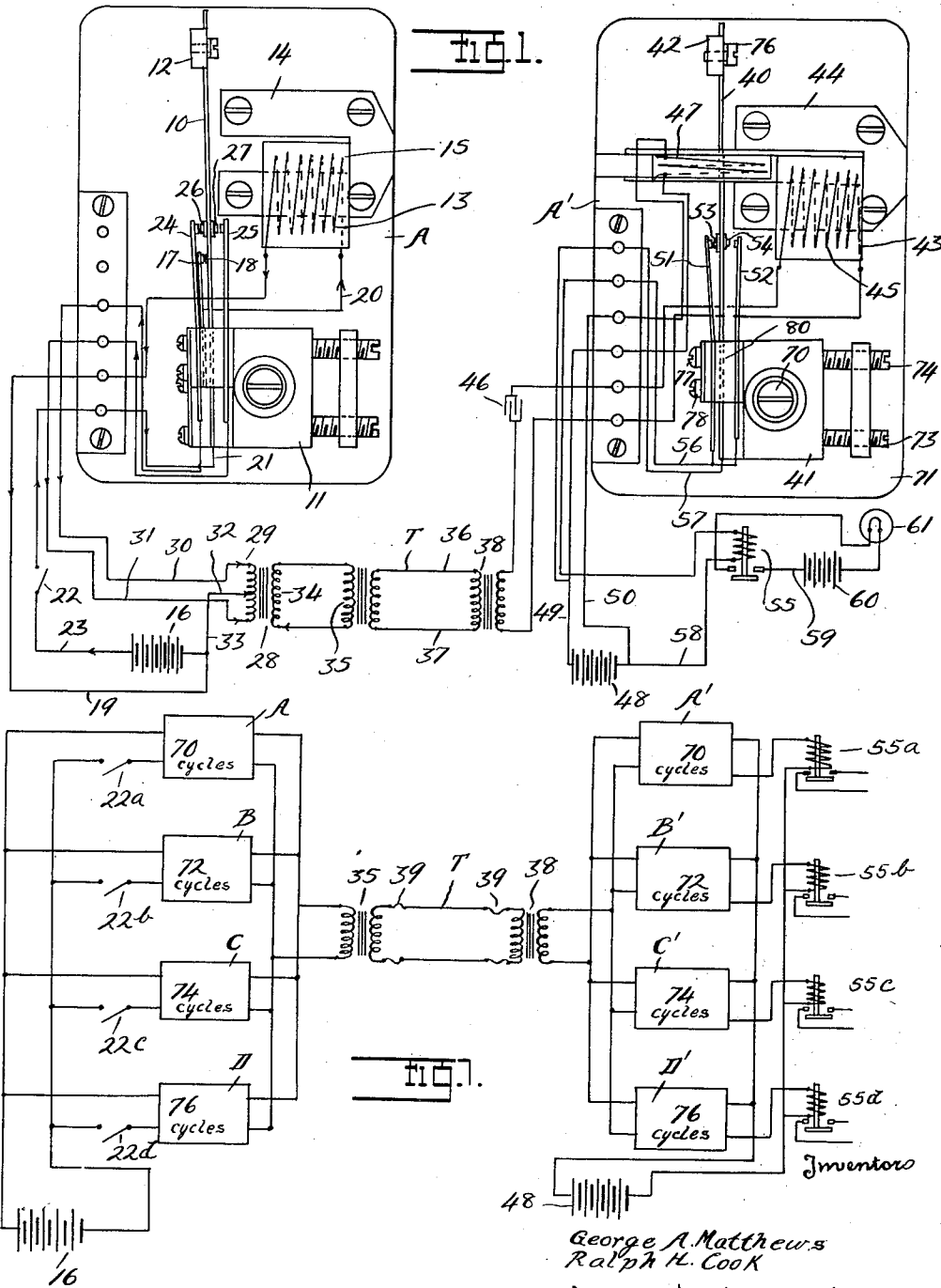
G. A. MATTHEWS ET AL

2,050,665

ELECTRICAL DEVICE

Filed May 16, 1932

3 Sheets-Sheet 1



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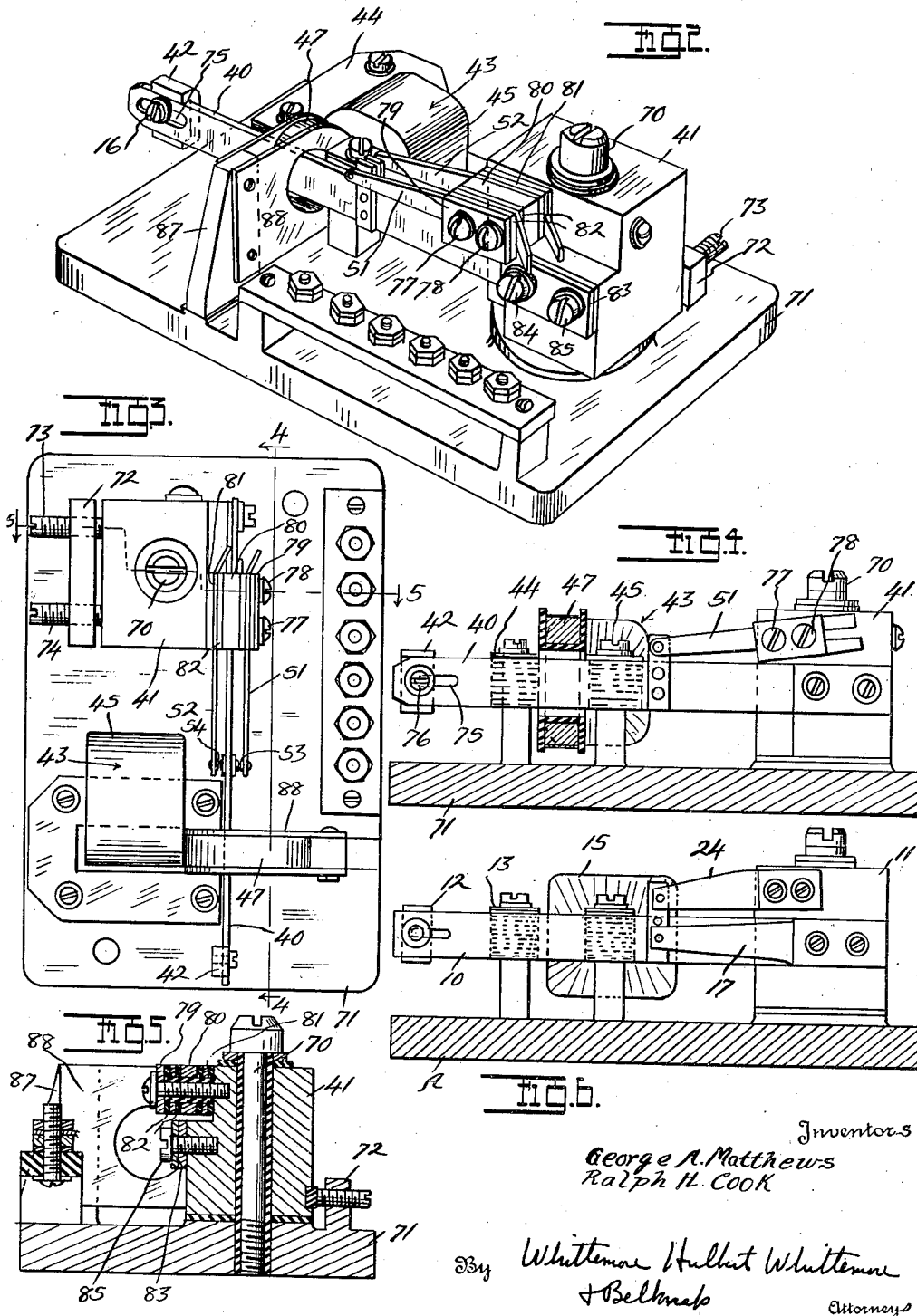
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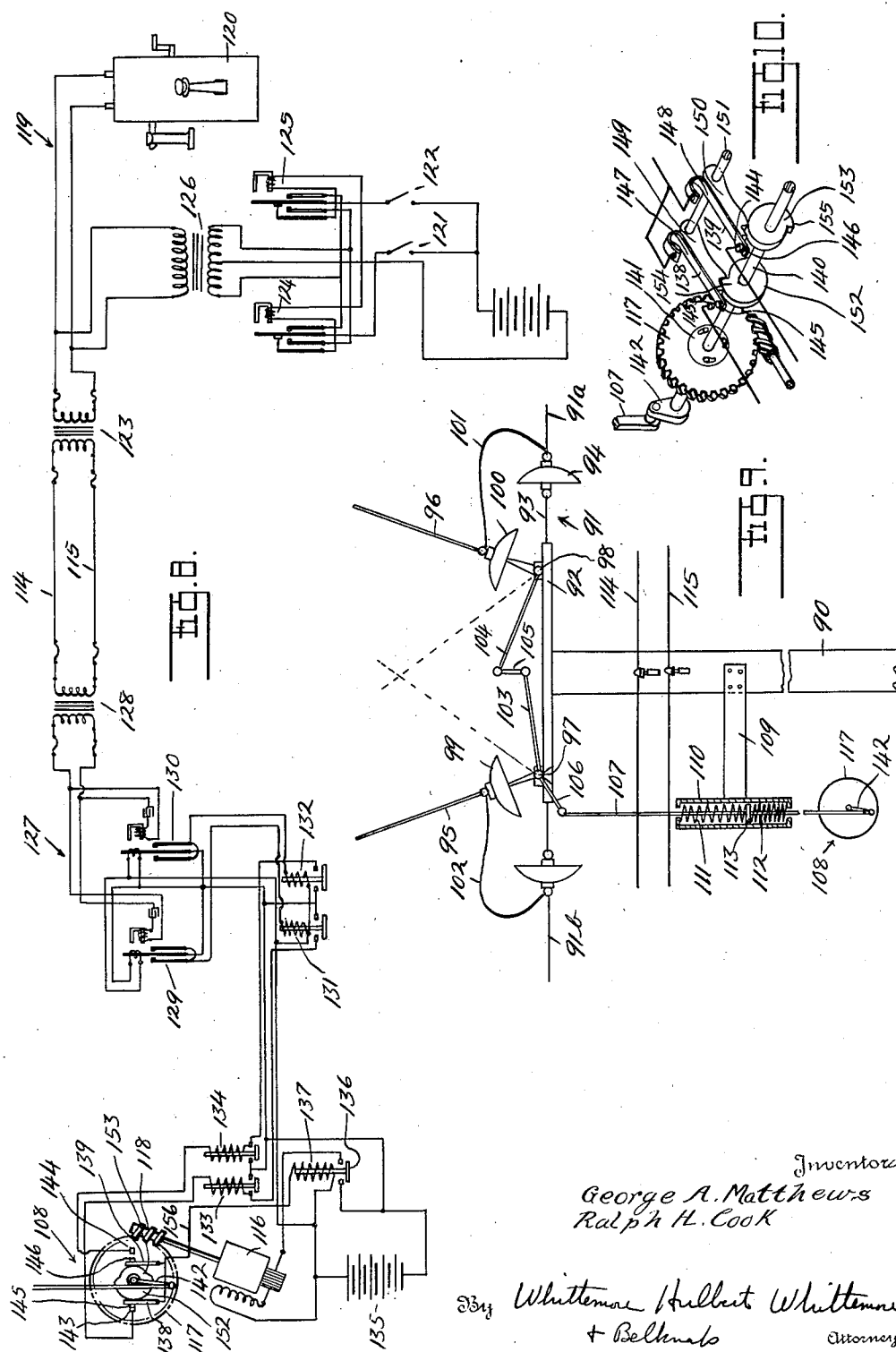
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## UNITED STATES PATENT OFFICE

2,050,665

## ELECTRICAL DEVICE

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12 Claims. (Cl. 179—78)

The invention relates to electrical systems for automatically operating alarm signals or selectively controlling apparatus from a remote point or other analogous uses.

One of the important uses for our invention is in connection with so-called supervisory control systems. Our improved system of supervisory control is in many respects far superior to any other control heretofore used. It is particularly adapted for use in electric power distributing systems where the wires for the supervisory control are carried on the same poles used for the high tension lines. Our system employs a minimum number of wires, is absolutely reliable under adverse conditions of operation and is provided with safety features which protect both the operators and the equipment from being subjected to high voltages resulting from lightning discharges or falling of high potential conductors across the control wires. However, it can be used without safety devices.

Among the objects of our invention are the following:

First, to provide selective remote operation of electrical equipment by the use of alternating current of a relatively low frequency, namely, 15 to 500 cycles per second.

Second, to provide a system in which a plurality of frequencies may be sent over a metallic, inductively or statically coupled circuit and selectively segregated at the receiving end by apparatus which is electro-mechanically tuned.

Third, to provide a system unaffected by external electrical conditions and capable of using apparatus tuned within narrow limits to exact predetermined frequencies capable of transmitting sufficient power to not be adversely affected by changes in coupling capacity or inductance.

Fourth, to provide electro-mechanically tuned apparatus of such sensitivity and selectivity as could not be obtained by electrical resonance alone.

Fifth, to provide a control system having receiving relays which are not affected by surges and lightning disturbances.

Sixth, to prevent faulty operation of the relays by falling of high tension lines on the conductors used in the control system or by other outside electrical disturbances.

Seventh, to provide a system for remote control of line switches and other apparatus so designed as to prevent accidental operation by outside electrical disturbances.

Eighth, to simplify supervisory control systems

thereby lessening the cost of installation without sacrifice of dependability.

Ninth, to make available simplified transmitting and receiving apparatus mechanically and electrically tuned to predetermined frequencies and adjustable to different frequencies. The frequency band is such that the coupling is effected without high-priced insulating devices and protective equipment.

These and other objects are attained by the improved system hereinafter more fully described and illustrated in the accompanying drawings, wherein

Figure 1 is an electrical diagram of a system embodying our invention;

Figure 2 is a perspective view of a receiver;

Figure 3 is a top plan view thereof;

Figure 4 is a section on line 4—4 of Figure 3;

Figure 5 is a transverse section on line 5—5 of Figure 3;

Figure 6 is a view similar to Figure 4 showing a transmitter instead of a receiver;

Figure 7 is a diagram illustrating a plurality of sending and receiving units connected to a common transmission line for selective operation of apparatus from a remote point;

Figure 8 is a diagram illustrating a system for operating remotely a pole top switch mechanism;

Figure 9 illustrates a pole top switch mechanism;

Figure 10 is a perspective view of a portion of the operating mechanism of Figure 9.

Referring now to the drawings, Figure 1 shows a simple hook-up of a sending and receiving apparatus embodying our invention. A represents the sending apparatus, A' the receiving apparatus, and T the transmission line connecting the two. The transmitter A comprises a steel spring or reed 10 projecting from an adjustable swivel block 11 and carrying at its outer end the adjustable weight 12. The spring is mounted is free to vibrate and for any predetermined setting of the adjustable weight 12 the spring has a definite frequency of vibration. The vibrating motion is known as isochronous motion. For vibrating the reed 10 the transmitter is provided with a laminated electromagnet 13, the U-shaped yoke 14 of which is adjustably spaced from the reed. The coil 15 of the electromagnet is connected to a battery 16 through a spring contact 17 which by bearing against a cooperating contact 18 on the reed forms an interrupter, completing the circuit when the reed 10 is in the maximum displacement away from the electromagnet and in the neutral position

and breaking the circuit when the reed is in the maximum displacement toward the magnet. The circuit above mentioned includes the conductor 19 leading from the negative of the battery 16 to one side of the coil 15, the conductor 20 leading from the other side of the coil to the spring contact 17, the conductor 21 leading from the reed 10 to the switch 22, and the conductor 23 leading from the switch to the positive of the battery 16. Thus by closing the switch 22 the electromagnet 13 is alternately energized and deenergized, thus setting the reed in vibration at a frequency corresponding to its fundamental vibration period as that may be calibrated by the weight.

Cooperating with the vibrating reed 10 are two spring contacts 24 and 25 which are carried by the swivel block 11 but insulated therefrom. These contacts are spaced so that the reed 10 alternately contacts with the same through the contact points 26 and 27 fixed on the reed. The contacts 24 and 25 are connected in circuit with the battery 16 through a transformer 28. The primary coil 29 of the transformer has one terminal thereof connected by the conductor 30 to the spring contact 24, while the other terminal is connected by conductor 31 to the spring contact 25. The negative of the battery is connected to a center tap 32 on the primary by conductor 33. Thus a circuit through the primary of the transformer is alternately completed in opposite directions by the contacting of the reed 10 with the spring contacts 24 and 25. This generates an alternating current, the frequency of which is identical with the vibration period of the reed 10.

The secondary 34 of the transformer 28 is preferably designed to produce a higher voltage, which of course is at the same frequency as the primary and this frequency may be transmitted to a remote point through any desired circuit whether this be coupled metallically, inductively or statically as is well understood in the art. As shown, the transformer 28 is connected to the transmission line through a high voltage insulating transformer 35 designed to protect the sending apparatus from any high tension current which might be impressed on the transmitting line from outside sources. The transmitting line T, as shown, a two-way circuit consisting of the conductors 36 and 37, although if desired a single conductor circuit might be used with ground connections.

At the receiving end of the apparatus the transmission line is connected through another high voltage insulating transformer 38. The receiving apparatus A' is preferably of similar design to the transmitting apparatus A in that there is a vibratory reed 40 carried by an adjustable swivel block 41 and having at its outer end the adjustable weight 42. An electromagnet 43 is arranged in an adjustably spaced relation to the vibratory reed and consists of a yoke 44 and coil 45. The coil 45 is in circuit with the secondary of the transformer 38 but a condenser 46 is placed in the circuit for the purpose of blocking off any direct current which might be imposed on the circuit as well as aiding in the tuning of the coil 45 to a fixed frequency corresponding to that which has been transmitted from the sending apparatus. The receiver is preferably arranged with a coil 47 surrounding the vibratory reed 40 in order to polarize the same. This coil is connected to a battery 48 by means of conductors 49 and 50.

Since the reed 40 is polarized it will be attracted and repelled by the frequency imposed on the electromagnet 43 and will thus tend to vibrate the reed 40 at exactly the same frequency as the incoming frequency. If the mechanical period of vibration of the reed is the same as the frequency of the current in the electromagnet, the reed will be caused to freely vibrate at its fundamental vibration period.

Mounted on the swivel block 41 are the two spring contacts 51 and 52 arranged on opposite sides of the vibrating reed and adapted to alternately contact with the contact points 53 and 54 on the reed. The spring contacts 51 and 52 are connected to a relay 55, the circuit being as follows: Conductor 56 connects both spring contacts 51 and 52 with one terminal of the relay, while conductor 57 connects the reed 40 with the positive of battery 48 and conductor 58 connects the negative of the battery to the opposite terminal of the relay. 59 represents a normally open circuit adapted to be closed by the energization of the relay 55, the circuit including a battery 60 or other suitable power source and a signalling device 61 or other suitable electrical apparatus.

In the operation of the simplified control system as above described and illustrated in Figure 1, the closing of the switch 22 at the sending station operates to energize the signal device 61 at the receiving station which may or may not be at a remote point. This operation is effected by first setting the vibratory reed 10 in operation through the electromagnet 13 and interrupter 17. The reed vibrates at a definite period and through the spring contacts 24 and 25 sets up an alternating current of a frequency corresponding exactly to the fundamental mechanical vibration. This frequency is carried through a transmission line T and is finally imposed on the electromagnet coil 45 of the receiving apparatus A'. The vibratory reed 40 of the receiving apparatus being mechanically adjusted to have the same fundamental vibration as the sending reed 10 is caused to vibrate at its fundamental period by reason of the fact that the electromagnet is electrically and magnetically tuned to the same frequency. Under these conditions the reed 10 vibrates to such an extent as to complete the circuit through the spring contacts 51 and 52 and energize the relay 55 which in turn completes the signal circuit 59.

The system as thus far described is shown in a simplified form for the purpose of readily understanding the fundamental principles underlying the invention. However, in its practical application it will ordinarily be used in conjunction with other electrical apparatus for obtaining the results desired in a supervisory control system. One of the advantages of our system is that the sending and receiving apparatus may be tuned very exactly to precise frequencies so that the receiver, for example, will not be affected by frequencies differing as little as one cycle from that to which the receiver is tuned but will operate over a wide voltage range. Thus it is possible to independently operate a plurality of different instruments of different frequency over the same transmitting line. This is illustrated more fully in Figure 7 wherein the sending units A, B, C and D are all similar to the sending unit A previously described except that they are tuned to operate at different frequencies. For example, if the unit A generates a 70 cycle alternating current, the unit B may be adjusted 71

to generate a 72 cycle current, the unit C a 74 cycle current, and the unit D a 76 cycle current. The corresponding receiving units A', B', C' and D' are also mechanically and electrically tuned to the same frequencies. Thus the units A', B', C' and D' are tuned respectively to 70, 72, 74 and 76 cycles per second. The sending battery 16 is connected to each of the respective sending units through circuits including the control switches 22a, 22b, 22c and 22d. Each of the units is also connected in parallel to the insulating transformer 35 in the same manner as previously set forth in connection with Figure 1. At the receiving end of the system the units A', B', C' and D' are connected in parallel with the insulating transformer 38. Also the receiving battery 48 is connected through the relays 55a, 55b, 55c and 55d to the respective receiving devices in the same manner as previously set forth. It will be noted also that the telephone transmission line T is provided with suitable fuses 39 in accordance with well known telephone practice.

In the operation of the multiple unit system as shown in Figure 7, the operation of the switches 22a, 22b, 22c or 22d either simultaneously or successively will generate alternating current of predetermined frequencies and impose the same upon the telephone transmission line. Each of the frequencies generated will be conveyed to each of the receiving devices A', B', C' and D' but only the frequency which corresponds to the tuned frequency of the particular receiving device will cause the vibrating reed thereof to operate. Whenever the frequency of the particular receiver is imposed thereon, however, it will cause the actuation of the corresponding relay. Thus it will be observed that by means of our invention it is possible to use a single line of conventional type for selectively operating a series of differently tuned receiving devices.

It is to be noted that control systems of the type heretofore described can be advantageously used on existing signal lines with no interference. In other words, no matter what use is made of the line it will not operate the vibratory reed devices of our invention unless the current of the precise frequency is imposed thereon. Our invention in its preferred form uses relatively low frequencies in the range 15 to 500 cycles per second. These low frequency values create small inductive and capacity values in the line impedance, thus allowing considerable variation in the length and type of line which may or may not be connected to the lines used for the signal service or remote control. The low frequency current permits the passage of the impulses through iron core transformers or static condensers, and therefore provides suitable means for high voltage insulation between the remote control equipment and the transmission line.

In the receiving apparatus as illustrated in Figure 1 it is noted that the vibratory reed 40 is polarized. There are several advantages to this polarization: First, the sensitivity of the receiving relay is increased due to the magnetizing forces of both the polarizing coil 47 and the electromagnet coil 45. Second, the air gap between the vibratory reed 40 and the electromagnet core 44 may be increased, thus preventing faulty operation due to currents of different frequency which may be imposed on the coil 45. Third, the ampere turns may be so varied in the polarizing coil 47 that the reed 40 will cease to vibrate even

when subjected to its critical frequency under certain conditions of voltage. The field due to the coil 45 will overcome the polarization effect of the coil 47, thus tending to cause the reed to vibrate at double its fundamental vibration period. However, since the reed can not mechanically vibrate at this double frequency, the ultimate effect is to stop the vibration entirely. Therefore apparatus constructed in accordance with our invention can be made responsive not only to a single frequency but also to predetermined voltages at said frequency.

In the broader aspects of our invention, however, it is not essential that the reed be polarized, it only being necessary to change the mechanical vibratory period of the reed in order to compensate for the lack of polarity. Thus in the unpolarized device the receiving reed would not be identical mechanically with the transmitting reed.

To illustrate more fully, without the polarizing coil the reed will vibrate at double the frequency of the imposed electrical frequency on the electromagnetic coil. This is due to the fact that the reed is attracted by the electromagnet twice during each cycle. On the other hand, when the polarizing coil is used, the reed is attracted and repelled once during each cycle.

While the apparatus used in our improved system may be built in various forms, we have shown in Figures 2 to 5 a preferred construction of the receiver. It is to be noted that the swivel block 41 is mounted on a cylindrical post 70 secured in turn to a base plate 71. 72 is an arm secured to the base plate in which are threadedly arranged adjusting screws 73 and 74 which bear against the swivel block 41 on opposite sides of the post 70. Thus the air gap between the reed and the electromagnet may be readily adjusted. As shown, the reed 40 is a flat spring having at its free end the longitudinal slot 75 through which extends a set screw 76 for clamping the weight 42 to the spring.

The contact springs 51 and 52 are secured to the swivel block 41 by means of the screws 77 and 78 which extend through the clamping blocks 79, 80 and 81. Suitable insulating strips 82 are inserted on opposite sides of the respective springs to insulate the same from the swivel block. The vibrating reed 40 is also insulated from the swivel base by an insulating strip 83 and is attached by means of the screws 84 and 85. 87 is a rib extending upwardly from the base to which is attached a spool 88 containing the polarizing coil 47. The coil surrounds the free end of the reed 40.

The transmitter is preferably of similar structural form to the receiver previously described except that the polarizing coil is omitted and a third spring contact 17 is provided to form the interrupter as previously described in connection with Figure 1. The transmitter is shown in section in Figure 6 and it will be observed that it is similar in general construction to the corresponding section of the receiver illustrated in Figure 4.

As heretofore stated, our improved system of supervisory control may be utilized for the operation of signals or switching devices. Figure 8 illustrates the invention applied to a system for operating remotely a pole top switch mechanism in a high tension electric transmission line.

Figure 9 represents diagrammatically the construction of the pole top switch mechanism itself.

As illustrated in Figure 9, 90 is a pole adapted to carry at the top thereof the high tension line

91 which, for example, may be designed to carry 24 k. v. a. The two portions of this line 91a and 91b are respectively secured to the cross member 92 by supporting wires 93 and suitable insulators 94. Mounted on the cross member 92 are two switch arms 95 and 96 adapted to swing about the respective pivot points 97 and 98. The switch arms carry suitable insulators 99 and 100 between the outer and inner ends thereof. The high tension line portions are connected to the outer ends of the switch arms 96 and 95 by the flexible conductors 101 and 102. A suitable linkage mechanism for opening and closing the switch is employed and as shown this comprises the arms 103 and 104 extending transversely to the switch arms 95 and 96 and connected together by the link 105. 106 is an operating arm extending from the switch arm 95 and connected to the vertical actuating rod 107 which in turn is connected to the operating mechanism 108 located at a lower portion of the pole. 109 is a supporting arm projecting laterally from the pole at a point intermediate the operating mechanism and the pole top. The arm carries a housing 110 in which are arranged coil springs 111 and 112 adapted to react in opposite directions on the cross member 113 carried by the vertical actuating rod 107. The operating mechanism 108 is shown as comprising an electric motor 116 mounted to drive a worm wheel 117 through worm 118.

Any suitable form of mechanism may be employed at this point but, as shown in Figure 10, it is preferable to have a shaft 140 to which the worm wheel 117 is connected through a suitable overrunning clutch 141. The shaft 140 carries at one end the crank 142 to which is attached the actuating rod 107. Through the shaft 140 the crank 142 is connected to limit switches 138 and 139. These switches as shown comprise the stationary contacts 143 and 144 and the respective cooperating contacts 145 and 146. The cooperating contacts are in turn formed on spring arms 147 and 148 which in turn are supported on the follower arms 149 and 150, each of which is pivotally mounted on the pivot shaft 151. 152 and 153 are cams on the shaft 140 with the high portions 154 and 155 arranged 180° apart. The followers 149 and 150 ride upon the respective cams 152 and 153 and the arrangement is such that the contacts 143 and 145 are closed when the crank is in the lowermost position and the contacts 144 and 146 are closed when the crank is in its highest position.

Beneath the high tension line 91 the pole 90 is adapted to support an overhead telephone line which preferably consists of the two conductors 114 and 115. This line may be used for ordinary telephone purposes and it may also be utilized in our system for the remote control of the pole top switch mechanism.

In the electrical diagram shown in Figure 8 the telephone line is represented by the reference characters 114 and 115. 119 represents the sending station in which there is a telephone 120, a pole top opening switch 121 and closing switch 122. The sending station is coupled to the telephone line through the insulating transformer 123. Connected to the opening switch 121 is a vibrating reed transmitter 124 of the type previously described and connected to the closing switch 122 is a vibrating reed transmitter 125 of a similar type. These two transmitting devices have reeds vibrating at different fundamental periods, thus generating in the transformer 126 alternating currents of different frequencies.

127 represents the receiving station for operating the pole top switch mechanism 108. The telephone line is coupled to the receiving station through the insulating transformer 128. 129 and 130 represent vibrating reed receivers of the type heretofore described. Receiver 129 is tuned mechanically and electromagnetically to respond to the frequencies generated by the transmitter 124 and the receiver 130 is correspondingly tuned to respond to the frequencies generated by transmitter 125. 131 is a relay operated by the vibration of the reed in receiver 129 and 132 is the corresponding relay for receiver 130. 133 and 134 represent respectively sealing-in relays for the opening and closing circuits respectively. These relays are connected to the stationary contacts 143 and 144 respectively, and the limit switches 138 and 139. The cooperating contacts 145 and 146 respectively are connected together by a conductor 156 which leads to the relay 137. The electric motor 116 is arranged in circuit with the operating battery 135 through the bridging contact 136 carried by the relay 137.

The arrangement described above and fully illustrated in Figures 8, 9 and 10 is such that upon the actuation of the receiver 129 the relay 131 is closed which in turn completes a circuit through relay 133, contacts 145 and 143 of limit switch 138 and relay 137. The closing of the relay 137 actuates the switch 136, thereby connecting the motor 116 in series with the battery 135 and starting the motor. The closing of the relay 133 completes the circuit through relay 137 independently of the relay switch 131 so that upon release of the relay 131 the motor 116 continues to operate. The motor thereupon drives the worm wheel 117 and through the overrunning clutch 141 drives the shaft 140 and crank 142 from its lowermost position to its uppermost position. The movement of the crank in turn operates the rod 107 and closes the pole top switch when the crank has reached the upper limit of its movement. The limit switch 138 through the cam 152 withdraws the contact 133 and breaks the circuit through the relay 137. The deenergization of the relay 137 opens switch 136, deenergizing motor 116.

It will be understood that in the above description the closing of the pole top switch is dependent upon the actuation of the receiver 129 which in turn is responsive only to the particular frequency generated by the transmitter 124. Thus the operation of the closing switch 121 will close the pole top switch but any other electrical energy in the telephone line will have no effect. For opening the pole top switch the operating switch 122 is actuated, energizing the transmitter 125 and generating a frequency to which the receiver 130 is tuned. As soon as the vibrating reed of receiver 130 is operated the relay 132 is closed and this in turn completes a circuit through relay 134, contacts 144 and 146 of limit switch 139 and relay 137, thereby energizing the relay 137. Thus in the same manner as previously described, the switch 136 is closed, the motor 116 set in operation and continued in operation independently of the relay 132 by reason of the sealing-in relay 134. The operation of the motor now causes the crank 142 to move from its uppermost position to its lowermost position, thus drawing downwardly on the actuating rod 107 and opening the pole top switch. The motor continues in operation until the limit switch 139 reaches the point where contacts 144 and 146 are separated by the cam 153 and thereupon the motor is deenergized.

Thus it will be observed that the mechanism disclosed in Figures 8, 9 and 10 may be used to open and close pole top switches by a controlling mechanism operated at a distant point.

5 What we claim as our invention is:

1. In an electrical device of the class described, a vibratory reed, an electric contact point on said reed and a cooperating contact arranged within the amplitude of movement of said reed, an  
10 electromagnet operatively associated with said reed and the cooperating means for simultaneously moving said reed and contact to adjust the distance between said reed and said electro-  
magnet.

2. In an electrical device of the class described, a vibratory reed, contact points on said reed, a pair of contacts on opposite sides of said reed within the amplitude of movement of the contact points thereof, an electromagnet operatively  
20 associated with said reed and means for simultaneously moving said reed and contacts to adjust the distance between said reed and said electromagnet.

3. In an electrical device of the class described, a base, an electromagnet mounted on said base, a vibratory reed having the free end operatively associated with said electromagnet, a block supporting the fixed end of said reed and pivotally  
30 mounted on said base for moving said reed to adjust the distance between the free end of said reed and said electromagnet, contact points on said reed and cooperating electric contacts carried by said block and arranged on opposite sides of said reed and means for securing said block  
35 to said base in adjusted position.

4. In an electrical device of the class described, a base, an electromagnet mounted on said base, a vibratory reed having the free end operatively associated with said electromagnet, a block supporting the fixed end of said reed and pivotally  
40 mounted on said base for moving said reed to adjust the distance between the free end of said reed and said electromagnet, electric contacts carried by said block and arranged on opposite sides of said reed, cooperating contact points on  
45 opposite sides of said reed, a bracket on said base adjacent said block and adjusting screws in said bracket engaging said block on opposite sides of the pivotal axis thereof.

5. A vibratory reed receiver comprising an electromagnet having a field coil and adjacent pole pieces, a vibratory reed extending across, on the same side of and adjacent to said pole pieces, means for energizing said electromagnet with  
55 alternating current and means rendering said reed responsive to alternating current flow in said field coil of a frequency substantially identical with natural frequency of vibration of said reed, said means comprising a polarizing coil energized with direct current surrounding a portion  
60 of said reed.

6. A vibratory reed receiver comprising a base, a U-shaped electromagnet on said base, a vibratory reed having one end secured to said base and the other end extending across the open end of said U-shaped magnet on the same side thereof and a polarizing coil surrounding the portion of said reed adjacent said magnet and having a substantial portion thereof outside of the  
70 magnetic circuit of said magnet, said polarizing coil when traversed by direct current operating to render said reed responsive to an alternating magnetic flux of the frequency to which said reed is mechanically tuned.

7. A vibratory reed receiver comprising a base,

a U-shaped magnet core on said base, an alternating current coil on said core, a vibratory reed having the free end extending across the open end of said U-shaped magnet core on the same side thereof, a block supporting the fixed  
5 end of said reed and pivotally mounted on said base for moving said reed to adjust the distance between the free end of said reed and said magnet core, a pair of electric contacts carried by said block and arranged on opposite sides of said  
10 reed, contact points on said reed, means for securing said block to said base in adjusted position, a polarizing coil surrounding a portion of said reed and having a portion of its circumference extending between the open ends of said  
15 U-shaped magnet core, means for energizing said polarizing coil with direct current, whereby said reed will vibrate at its natural frequency when alternating current of the same frequency is supplied to the coil on said core, and an electro-  
20 responsive device connected through said contacts and contact points to a current source whereby the vibration of said reed will close circuits to energize the same.

8. A supervisory control system comprising a  
25 vibrating reed transmitter, a vibrating reed receiver located at a point remote from said transmitter, said vibrating devices each comprising a magnetic core, a coil surrounding a portion of  
30 said core, a mechanically tuned reed operatively associated with said magnetic core and contacts operatively associated with said reed, said reeds being tuned to the same frequency of vibration, said transmitter having a circuit interrupter operated by said reed and connected through said  
35 coil to a source of direct current, a transformer, means operated by said reed and said contacts for alternately producing in said transformer equal and opposite direct currents of the same frequency as the vibration period of said reed thereby  
40 generating an alternating current in said transformer, a telephone line having stations at the remotely spaced points where said transmitter and receiver are located, insulating transformers at each of said stations, one of said  
45 transformers being electrically connected to said alternating current transformer of said transmitter, said receiver having the aforesaid coil thereof electrically connected to the other of said insulating transformers, a condenser in series  
50 with said receiver coil for tuning the same to the frequency of said transmitter and a polarizing coil surrounding a portion of the reed in said receiver to condition said reed for vibration at its normal frequency when the coil on said core  
55 is traversed by alternating current of the same frequency.

9. A supervisory control system comprising a vibrating reed transmitter, a vibrating reed receiver located at a point remote from said trans-  
60 mitter, said vibrating devices each comprising a magnetic core, a coil surrounding a portion of said core, a mechanically tuned reed operatively associated with said magnetic core and contacts operatively associated with said reed, said  
65 reeds being tuned to the same frequency of vibration said transmitter having a circuit interrupter operated by said reed and connected through said coil to a source of direct current, a transformer, means operated by said reed and said  
70 contacts for alternately producing in said transformer equal and opposite direct currents of the same frequency as the vibration period of said reed thereby generating an alternating current in said transformer, a two wire telephone 75

line including spaced stations adjacent said transmitter and receiver, insulating transformers at each of said stations, one of said transformers being electrically connected to said alternating current transformer of said transmitter, said receiver having the aforesaid coil thereof electrically connected to the other of said insulating transformers, a condenser in series with said receiver coil for tuning the same to the frequency of said transmitter and a polarizing coil surrounding a portion of the reed in said receiver to condition said reed for vibration at its normal frequency when the coil on said core is traversed by alternating current of the same frequency.

10. In a supervisory control system, the combination with a telephone line connecting telephone stations at spaced points, said telephone line being of the type having effective capacity and inductance which vary in accordance with conditions of use, of a vibrating reed transmitter, a vibrating reed receiver, said vibrating devices each comprising a U-shaped magnetic core, a coil surrounding a portion of said core, a reed of the same vibration frequency extending across and adjacent the open end of said U-shaped core and a pair of contacts on opposite sides of said reed, said transmitter having a circuit interrupter operated by said reed and connected through said coil to a source of direct current, a transformer connected through said contacts with a source of direct current to alternately produce equal and opposite direct currents through said transformer and generate an alternating current, said transmitter and said receiver being located at widely separated points and adjacent said telephone line, an insulating transformer electrically coupling said generating transformer with said telephone line, a second insulating transformer electrically coupling said telephone line to said receiver, a condenser connected in series with said second insulating transformer and said receiver coil for tuning the latter to the frequency of said transmitter, a polarizing coil surrounding a portion of said receiver reed adjacent said U-shaped core and connected to a

source of direct current thereby to condition said receiver reed for vibration at its normal frequency when the coil on said core is traversed by alternating currents of the same frequency, and an electro-responsive device connected through said receiver contacts to an electric current source forming a circuit adapted to be completed upon vibration of said receiver reed.

11. In a supervisory control system the combination with a telephone line connecting telephone equipment at spaced points, said telephone line having variable capacitance and inductance in accordance with conditions of use, and insulating transformers for protecting said line against high voltage, said transformers being located at points spaced apart along said line, of an electro-mechanically tuned means electrically connected to said telephone line by one of said transformers for generating an alternating current of predetermined frequency within the range of 15-500 cycles per second, an electro-mechanically tuned means electrically connected to said telephone line by another transformer at a point spaced from the transformer of said first means and responsive to said predetermined frequency and means operable upon the mechanical vibration of said last mentioned means for operating a relay to close a working circuit.

12. In an electrical device of the class described, a base, a U-shaped electro-magnet having two pole pieces fixed to said base, a block pivotally mounted on said base, a reed secured to said block having the free end thereof extending from said block across and on the same side of both of said pole pieces, a pair of spring contacts secured to said block having the free ends thereof extending from said block in the same direction as said reed and on opposite sides thereof and means for pivotally adjusting said block to vary the spacing between said reed and said pole pieces and to maintain the same relation between said reed and said spring contacts.

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