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POLE CHANGER

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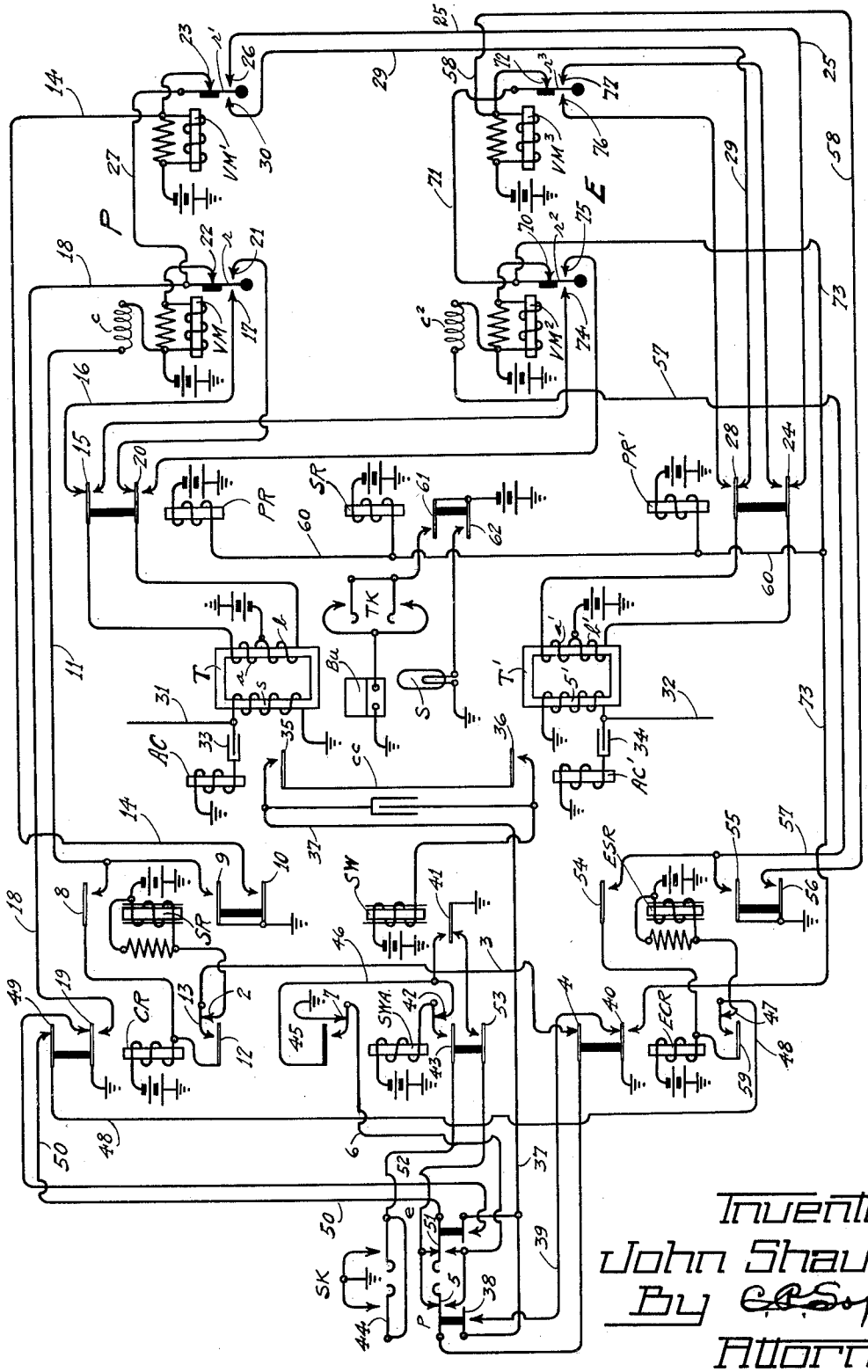

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POLE CHANGER

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My invention relates to switching circuits and has to do more particularly with circuits in which duplicate sets of apparatus are employed and in which means are provided for automatically switching from one set of apparatus to another.

In telephone systems of the class in which pole changers are used for delivering ringing current duplicate pole changer sets are employed, one of which may be termed the primary pole changer and the other the emergency pole changer. It sometimes happens that the primary pole changer becomes disabled for various reasons, such as mechanical trouble or circuit trouble and stops thus making it necessary to employ the emergency pole changer.

In the system of my invention should the primary pole changer cease operating the emergency pole changer is immediately set in operation without the intervention of any operator or attendant. Certain of the systems heretofore employed were found to be more or less impractical because the vibrating magnets supplying the lower frequencies were provided with vibrating reeds of such a size that they did not always start readily. The system of my invention has been designed to overcome this deficiency as well as others.

A feature of my invention is the provision of a key which when moved to one position places the primary pole changer in operation and which when moved to its other position disconnects the primary pole changer and causes the emergency pole changer to operate, so that the primary pole changer may be used for a certain period and when desirable the emergency pole changer can be placed in operation.

Another feature of my invention is the provision of means whereby the emergency pole changer is automatically caused to operate should the primary pole changer cease to function for any reason.

Another feature of my invention is the use of one set of transformers for both the primary and emergency pole changers and automatic means for connecting the transformers in circuit with the pole changer operating at any time.

Another feature of my invention is the provision of an additional electromagnetic coil on the vibrating magnets which furnish ringing current of the lower frequencies to initially attract the vibrating reed to positively set the reed in vibration.

Referring now in general to my invention as illustrated in the accompanying drawing I show a primary pole changer P comprising vibrating magnets VM and VM′ and their associated vibrator contacts. The pole changer E is the emergency pole changer and comprises the vibrating magnets VM^2 and VM^3 and their associated vibrator contacts. Additional vibrator units may be supplied to the number of different frequencies desired. I show a transformer T which is common to the vibrating magnets VM and VM^2 and a transformer T′ which is common to the units VM′ and VM^3 of the pole changers P and E. I also provide a pole changer switching relay PR which is associated with the units VM and VM^2 and which when operated switches the circuit of the transformer T from the primary to the emergency pole changer of the same frequency.

The pole changer switching relay PR′ performs a similar function for the transformer T′ and the associated units VM′ and VM^3.

The starting relay SR starts the vibrating magnets of the primary pole changer into operation and the control relay CR controls the operation after they are once started. An emergency starting relay ESR which is operated upon the deenergization of either one of the alternating current relays AC or AC′ starts the emergency pole changer into operation. The relays AC and AC′ are normally operated under the influence of alternating current flowing in the secondary winding of the transformers T and T′. Should either of these relays deenergize the switching relay SW is also deenergized to energize the emergency starting relay ESR. An emergency control relay ECR controls the vibrating units of the emergency pole changer E.

I also provide a switching key SK which is of the usual cam type and has two positions *p* and *e*. When the key is moved to its *p* position the primary pole changer P is set in operation and when the key SK is moved to its position *e* the emergency pole changer E is set into operation. A test key TK, bell or buzzer B*u* and a signal S are provided for supervisory purposes and are under the control of the supervisory relay SR.

I also provide an additional electromagnetic coil such as *c* for the vibrating magnet VM or c^2 for the vibrating magnet VM^2 which are to initially attract the vibrating reeds and cause them to positively operate under the influence of the coils comprising the magnets.

The vibrating reeds of the magnets furnishing current of low frequency such as 16 cycle or 30 cycle must be heavily weighted to keep them vibrating at the desired rate, and consequently a considerably greater electromagnetic force is required to initially attract the vibrating reed than is necessary to keep it in operation after it is

started. The coil *c* of the vibrator VM initially attracts the reed *r* and holds it in its operated position until the energizing circuit is closed for the control relay CR which establishes the operating circuit for the vibrator VM thru the reed *r*. The starting relay SR is slow to release and interrupts the circuit thru the coil *c* to release the reed *r* at approximately the same time the relay CR establishes the operating circuit for the vibrator. The reed *r* being in motion at the time the circuit is closed will continue to vibrate under the influence of the vibrator VM.

The detailed operation of the switching circuit of my invention is as follows. Assume that it is desired to place the primary pole changer P in operation. The switching key SK will be moved to its position *p* to close an energizing circuit for the starting relay SR which circuit can be traced from grounded battery thru the winding of starting relay SR, normally closed contact 2 of control relay CR, conductor 3, normally closed contact 4 of relay ECR, alternate contact 5 of key K, conductor 6, normally closed contact 7 of switching relay SWA to ground. The starting relay energizes and attracts its armatures 8, 9 and 10. The closure of alternate contact 9 causes the current to flow from grounded battery thru the coil *c* of vibrating magnet VM, conductor 11, alternate contact 9 of SR to ground. The flow of current causes the vibrating reed *r* of the vibrating magnet VM to be attracted and moved to engage its left hand contact as shown in the drawing where it is held. Current flowing from grounded battery thru the winding of vibrating magnet VM', conductor 14, alternate contact 10 of SR to ground causes the energization of the vibrating magnet VM' which attracts its armature or vibrating reed *r'* and causes it to engage its left hand contact 30 and to be held in its attracted position.

The closure of alternate contact 8 of starting relay SR establishes an energizing circuit for the control relay CR which circuit can be traced from grounded battery thru the winding of the control relay CR, alternate contacts 8 and 9 of SR to ground. The control relay CR opens the energizing circuit to the starting relay SR and closes a locking circuit for itself thru its alternate contact 12. The contact 2 is disengaged from the spring 13 which interrupts the energizing circuit of the relay SR which restores to normal. The holding circuit for the relay CR can be traced from grounded battery thru the winding of CR, alternate contact 12, conductor 3, normal contact 4 of ECR, alternate contact 5 of key K, conductor 6, normal contact 7 of SWA to ground.

The deenergization of SR, which is delayed due to its slow to release construction, opens the circuit for the coil *c* which releases the vibrating reed *r*. As the reed *r* reaches its extreme right position an energizing circuit for the vibrating magnet VM is established and current flows from grounded battery thru the magnet VM, normal contact 22, reed *r*, conductor 18, alternate contact 19 of control relay CR. The reed *r* will be attracted by the coil of VM thereby opening the energizing circuit which will be restored to again energize the magnet when the reed returns to engage contact 21. The reed *r* will alternately engage the contacts 17 and 21 at predetermined intervals to set up a flow of alternating current of the desired frequency. When the reed *r* engages the contact 17 current will flow from grounded battery thru the primary winding *a* of transformer T, normal contact 15 of relay PR, conductor 16, closed contact 17, reed *r*, conductor 18, alternate contact 19 of CR to ground.

When the reed *r* engages the contact 21 current is caused to flow from grounded battery thru the primary winding *b* of transformer T, normal contact 20 of PR, contact 21, reed *r*, conductor 18, alternate contact 19 of CR to ground. The flow of current thru the coil *a* and then *b* will cause alternating current to be set up in the secondary coil *s* of the transformer T. As the control relay CR energizes it closes an operating circuit for vibrator VM' at about the same time the slow to release relay SR interrupts the original circuit to release the reed *r'*. This operating circuit for the vibrating magnet VM' can be traced from grounded battery thru the winding of the magnet VM', closed contact 23, reed *r'*, conductor 27, conductor 18, alternate contact 19 of CR to ground. The reed *r'* will be caused to vibrate and alternately deenergize and energize the vibrating magnet VM'. As the reed *r'* engages the contact 26 a circuit will be established for the flow of current from battery thru primary winding *b'* of transformer T', normal contact 24 of PR', conductor 25, contact 26, reed *r'*, conductors 27 and 18, alternate contact 19 to ground. As the reed *r'* engages the contact 30 current will be caused to flow from grounded battery thru the primary winding *a'* of transformer T', normal contact 28 of PR', conductor 29, contact 30, reed *r'*, conductors 27 and 18, alternate contact 19 of CR to ground. The alternate engagement of contacts 26 and 30 by the reed *r'* and the flow of current thru the said contacts and the coils *a'* and *b'* of transformer T' will set up an alternating current of the desired frequency in the secondary coil *s'* of the transformer T'.

The secondary coils *s* and *s'* of the transformers T and T' are connected by leads 31 and 32 respectively to any apparatus which is to be supplied with current of the desired frequency. The relay AC is connected to the secondary *s* of the transformer T thru a condenser 33 and the alternating current set up in this secondary winding *s* passes thru the winding of the relay AC and energizes the same which thereupon closes its alternate contact 35. The relay AC' is connected to the secondary winding *s'* of the transformer T' thru a condenser 34 and the alternating current flowing thru the winding of the relay AC' causes its energization and the subsequent closure of contact 36. The relays AC and AC' are maintained energized as long as current is flowing thru the secondary windings *s* and *s'* of the transformers. When both the contacts 35 and 36 are closed an energizing circuit for the switching relay SW is established. The relay SW is of slow to release construction to prevent the operation of the switching relay SWA should the conductor *cc* be momentarily opened. The relay SW is energized by current flowing from grounded battery thru winding of relay SW, alternate closed contact 36 of AC', control conductor *cc*, alternate closed contact 35 of AC, conductor 37, alternate contact 38 of key K, conductor 39, normally closed contact 40 of ECR to ground. The switching relay SW closes its alternate contact 41 thereby establishing an energizing circuit for the switching relay SWA which relay is energized by current flowing from grounded battery thru the winding of relay SWA, normally closed contact 42, alternate closed contact 41 of SW to ground. The relay SWA energizes and closes a locking circuit for itself thru its alternate closed contact 43, alternate closed contact 44 of key K to ground.

The relay SWA opens its normal contact 7 and closes its alternate contact 45 to establish a holding circuit for the control relay CR. The control relay CR is maintained energized by current flowing from grounded battery thru the winding of CR, alternate contacts 12 and 13, conductor 3, normally closed contact 4 of ECR, alternate closed contact 5 of key K, conductor 6, alternate closed contact 45 of SWA, conductor 46, alternate closed contact 41 of SW to ground. It is to be understood that additional vibrators such as VM, VM', etc. can be utilized in my system and that a transformer such as T or T' and the associated AC relay will be necessary for each additional vibrator used. A contact such as 35 of AC must be provided for each additional relay such as AC and must be connected in series circuit with the contacts 35 and 36 in the common conductor *cc*.

Should any of the vibrators fail to supply alternating current to anyone of the transformers the alternating current relay associated with the secondary winding of said transformer will be deenergized and open its associated contact to interrupt the control conductor *cc*. For instance if the vibrator VM ceases to function for any reason whatsoever no alternating current will flow thru the secondary winding *s* of transformer T and the relay AC would deenergize and open its contact 35 to interrupt the control conductor *cc* and the energizing circuit for the switching relay SW which would deenergize and restore its contact 41 to normal thereby opening the energizing circuit of the control relay CR which would also restore to normal to open the operating circuit of the vibrators VM and VM', etc. of the primary pole changer P.

Immediately upon the deenergization of the switching relay SW an energizing circuit for the emergency starting relay ESR is established. This circuit can be traced from grounded battery thru the winding of the relay ESR, normally closed contact 47 of ECR, conductor 48, closed contact 49 of CR, conductor 50, normally closed contact 51 of key K, conductor 52, alternate closed contact 53 of SWA, normal contact 41 of SW to ground. The emergency starting relay ESR closes initial opening circuits for the vibrator VM^3. The energizing circuit for the vibrator VM^3 can be traced from grounded battery thru winding of VM^3, conductor 58, alternate contact 56 of ESR to ground. An energizing circuit is also established for the coil c^2 of the vibrator VM^2 which circuit can be traced from grounded battery thru the coil c^2, conductor 57, alternate closed contact 55 of ESR to ground. The coil c^2 assures the attraction and subsequent operation of the heavily weighted reed r^2 as explained in connection with the vibrator VM which furnishes alternating current of the same frequency as the vibrator VM^2. The energization of ESR also establishes an energizing circuit for the emergency control relay ECR, thru its alternate contacts 54 and 55. The relay ECR closes a locking circuit thru its alternate contact 59, conductor 48, normally closed contact 49 of CR, conductor 50, normal closed contact 51 of key K, conductor 52, alternate contact 53 of SWA, normally closed contact 53 of SWA, normally closed contact 41 of SW to ground.

Relay ECR closes its alternate contact 40 to establish energizing circuits for the relays PR, SR and PR' which circuits can be traced from grounded battery thru the windings of the relays, conductors 60 and 73, to ground at alternate closed contact 40 of ECR. The relay PR operates to close its alternate contacts 15 and 20 thereby disconnecting the primary windings *a* and *b* of the transformer T from the contacts 17 and 21 of the vibrator VM and connects the said primary windings *a* and *b* to contacts 74 and 75 of the vibrator VM^2. The pole changer switching relay PR' closes its alternate contacts 24 and 28 thereby disconnecting the primary windings *a'* and *b'* of transformer T' from the contacts 26 and 30 of vibrator VM' and connects the said primary windings *a'* and *b'* to contacts 76 and 77 of vibrator VM^3. The said transformers are thereafter supplied with current from the vibrators of the emergency pole changer E. The operating circuit for the vibrators VM^2 and VM^3 can be traced from grounded battery thru the winding of VM^3, intermittently closed contact 72, reed r^3, conductors 71 and 73 to ground at alternate contact 40 of ECR; the circuit for VM^2 being from grounded battery thru the coil of VM^2, intermittently closed contact 70, reed *r*, conductor 73, to ground at alternate closed contact 40 of ECR. The energization of supervisory relay SR causes the actuation of a signal S by current flowing from grounded battery thru alternate contact 62, the signal S to ground. This signal S informs the attendant that the primary pole changer has stopped working and that the emergency pole changer E is in operation. A test key TK is also provided with an associated buzzer *Bu* which enables a remote operator to test the system and determine which of the pole changers is in operation.

Should it be desired to initially operate the emergency pole changer E the key K will be thrown to its position *e* thereby establishing an energizing circuit for the emergency starting relay ESR which circuit can be traced from grounded battery thru the winding of ESR, normally closed contact 47 of ECR, conductor 48, normally closed contact 49 of CR, conductor 50, alternate contact 51 of key K, conductor 6, normally closed contact 7 of SWA to ground. The vibrators VM^2 and VM^3 will operate over the circuits previously traced for them as will the emergency control relay ECR and the pole changer switching relays PR and PR'.

If the emergency pole changer E, which is now the primary pole changer, ceases to operate properly the pole changer P which is now the emergency pole changer will operate in a manner evident from the foregoing explanation of the operation of the system.

While I have described my invention in certain particular embodiments, I desire it understood that modifications and alterations may be made and that I intend no limitations upon my invention other than those imposed by the scope of the appended claims.

Having described my invention, what I claim as new and desire to secure by United States Letters Patent is:

1. A switching system of the character described including a pole changer comprising a vibrator magnet having an electromagnetic coil, a vibrating reed and associated contacts, a second electromagnetic coil associated with said vibrator magnet for initially operating said vibrating reed.

2. A switching system of the character described including a pole changer comprising a vibrator magnet having an electromagnetic coil, a vibrating reed and contacts associated therewith, a second electromagnetic coil associated with said vibrator magnet for initially operating said

vibrating reed and means controlling the energization of said electromagnetic coils.

3. A switching system of the character described including a pole changer comprising a vibrator magnet having an electromagnetic coil, a vibrating reed and contacts associated therewith, a second electromagnetic coil for initially operating said vibrating reed, an electrically operated circuit for said second electromagnetic coil and relay means controlling said operating circuit.

4. A switching system of the character described including a pole changer comprising a vibrator magnet, an operating coil therefor, a vibrating reed associated therewith, an electromagnetic coil for initially operating said vibrating reed, electrically operated circuits for said electromagnetic coil and said operating coil of said vibrator magnet, a starting relay controlling the operating circuit of said electromagnetic coil and a relay controlling the operating circuit of said operating coil of said vibrator magnet.

5. A switching system of the character described including a pole changer comprising a vibrator magnet, an operating coil therefor, a vibrating reed associated therewith and operated thereby, an electromagnetic coil for initially operating said vibrating reed, electrically operated circuits for said electromagnetic coil and said operating coil of said vibrator magnet, and relay means for opening the operating circuit of said coil and closing the operating circuit of said operating coil of said vibrator magnet.

6. In a device of the class described, an electromagnetic vibrator, an operating coil therefor, a vibratory member and contacts associated therewith, said member and contacts being arranged to alternately make and break the circuit of said coil, and an electromagnetic coil and a circuit therefor for initially operating said vibratory member.

7. In a device of the class described, an electromagnetic vibrator, an operating coil therefor, a vibratory member and contacts associated therewith, said member and contacts being arranged to alternately make and break the circuit of said coil, an electromagnetic coil and a circuit therefor for initially operating said vibratory member, and means for rendering said second coil ineffective after a momentary operation thereof.

8. A switching system of the character described including a pair of pole changers, a key controlling the connection of either pole changer, an auxiliary coil associated with each pole changer for starting the operation of said pole changer, an electrical circuit for said auxiliary coils, and a relay controlling said electrical circuit and control means operating automatically to switch from one pole changer to another.

9. A system including a pair of ringing current supply devices, an operating coil for said devices and a momentarily energized starting coil for said devices, a key for rendering operative either of said supply devices, a supply circuit, means controlled by said supply circuit for disassociating one of said devices from said supply circuit and for connecting the other of said devices thereto.

10. A switching system of the character described including a primary pole changer and an auxiliary pole changer, starting means individual to said pole changers, respectively, a key for connecting either pole changer in circuit, a relay for each pole changer controlled by said key and controlling said individual starting means, a pair of transformers common to said pole changers, relays associated with said transformers and energized by current therefrom when a pole changer is operating and means controlled by said relays for automatically switching the transformer from the primary pole changer to the auxiliary pole changer incident to the disabling of the primary pole changer.

11. A switching system of the character described including a primary pole changer and an emergency pole changer, a key for selectively rendering operative either of said pole changers, a starting relay for initially operating the selected pole changer, a relay controlling the continued operation of the selected pole changer, transformers associated with said pole changers, relays, one for each of said transformers, energized by current therefrom, switching relays controlled by said last mentioned relays for switching to the emergency pole changer upon failure of said primary pole changer, an emergency starting relay for initially starting the emergency pole changer and an emergency control relay controlling the continued operation of said emergency pole changer.

12. A switching system of the character described including a primary pole changer and an emergency pole changer, each comprising vibrator magnets, a vibrating reed and an auxiliary electromagnetic coil for initially attracting said vibrating reed, electrically operated circuits for said auxiliary coils, a starting relay for each of said coils controlling the electrically operated circuit therefor, a relay controlling the continued operation of the said pole changer, transformers common to said pole changers, relays energized by current from said transformers, switching relays controlled by said transformer controlled relays for actuating an emergency starting relay for initially starting the emergency pole changer and an emergency control relay controlling the continued operation of said emergency pole changer.

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