

June 24, 1941.

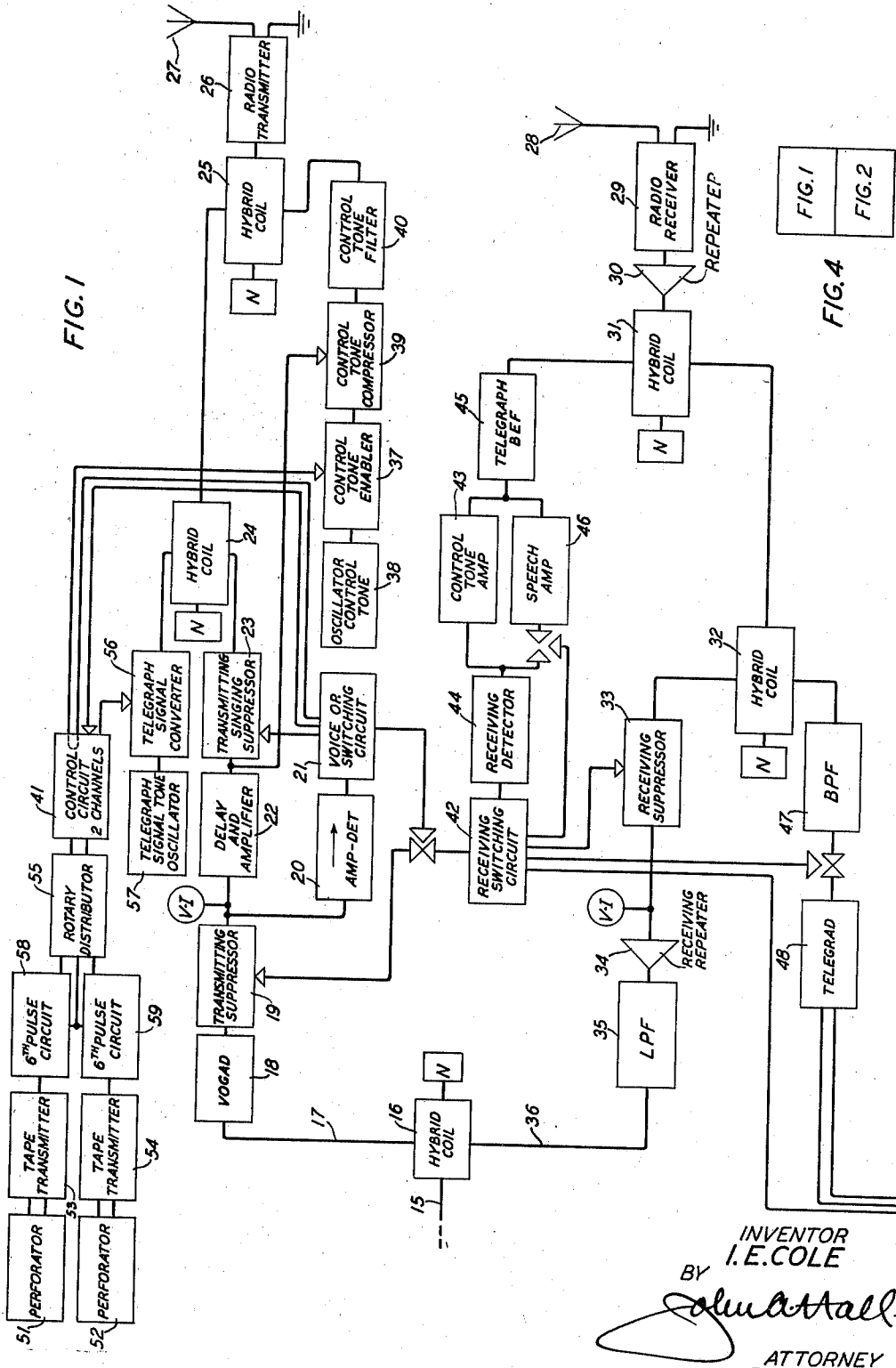
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2,246,505

CONTROL SYSTEM.

Filed Nov. 10, 1939

2 Sheets-Sheet 1



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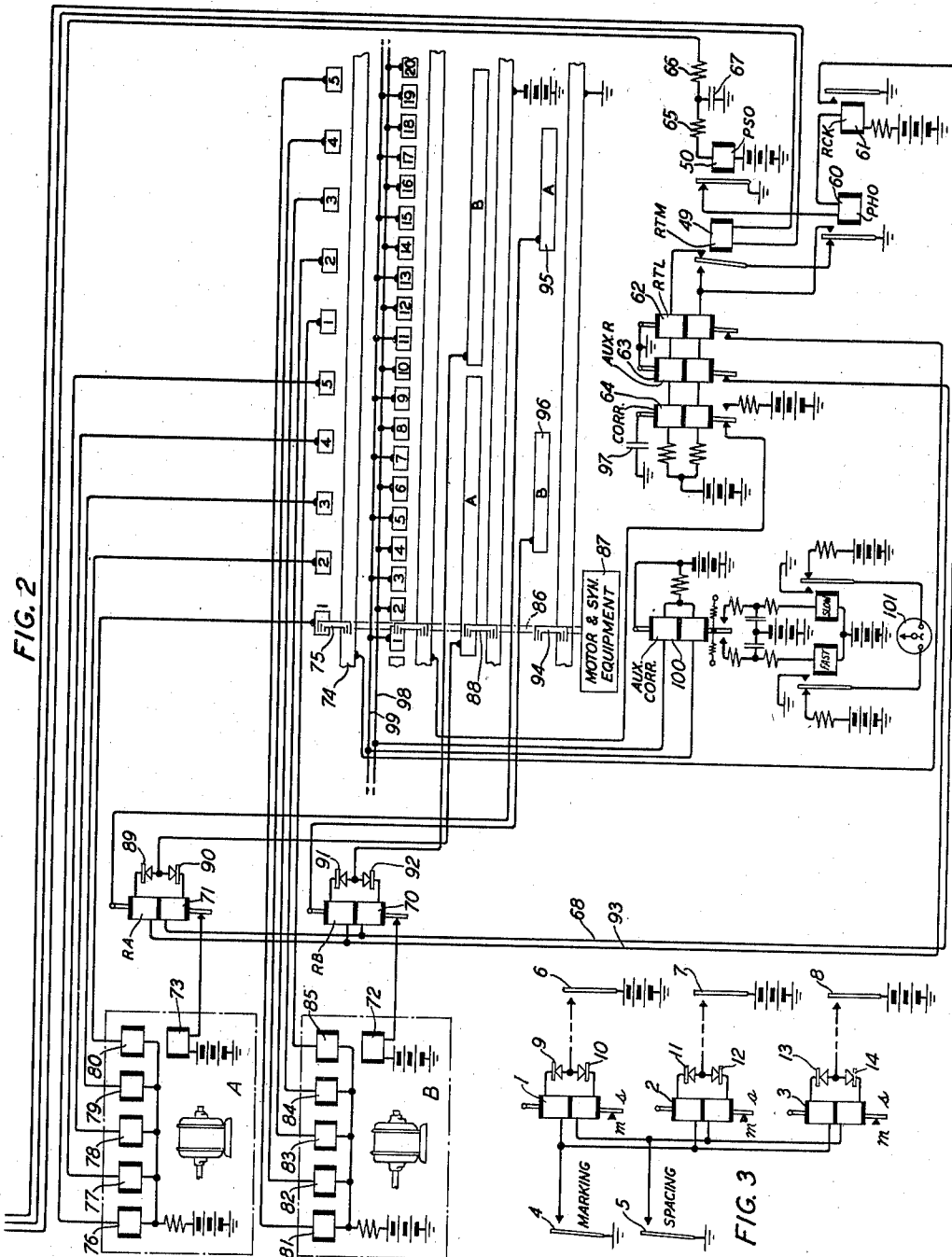
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2 Sheets-Sheet 2



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2,246,505

CONTROL SYSTEM

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2 Claims. (Cl. 178—2)

This invention relates to control systems and particularly to electrical circuits involving a plurality of circuits to be controlled by certain common conditions.

The object of the invention is to provide economical means for certain switching operations where speed and accuracy is essential. In a specific embodiment of the invention herein used by way of example the present circuit is one in which great economy has been achieved by novel means. In this circuit, which is part of the control of an interpolated telephone and telegraph system wherein the communication channel is normally conditioned for telegraphic transmission, speech currents may take command and thereupon the condition of the channel must be changed to one suitable for telephonic transmission. The switching entailed must be accurate and rapid. Heretofore very expensive polar type relays have been employed and a plurality of switching segments on a rotary distributor have been used.

I have discovered that by using the novel means herein disclosed I can reduce the number of relays and distributor segments and thereby achieve greater accuracy at far less expense and at the same time cut down on the cost of maintenance.

A feature of the invention is a plurality of relays, one for each telegraphic channel, each having a winding for driving it to marking and another winding for driving it to spacing. Each relay is provided with a switching point which may be a distributor segment for connecting battery to both its windings. There is a common grounding contact connected to all the marking windings of the relays and a common grounding contact connected to all the spacing windings of the relays.

Another feature is the use of a rectifier in the circuit of each of the relay windings which acts to prevent false operation of the relays through the multiple connections to the said common grounding contacts.

The drawings consist of two sheets which, when placed as indicated in Fig. 4, will constitute a diagram of a circuit in which the present invention is embodied.

Fig. 1 is in schematic form and Fig. 2 is in more detailed diagrammatic form. Fig. 3, shown on the same sheet with Fig. 2, is a skeletonized schematic circuit diagram showing only the essential elements of the invention.

Referring first to Fig. 3, it will be noted that three relays, 1, 2 and 3, are shown. There are

two common contact making devices, 4 and 5. The contact making device 4 is marked marking and the contact making device 5 is marked spacing. Thus, when the contact making device 4 is closed any one of the relays 1, 2 and 3 may be driven to its marking, or left-hand, contact and in the same manner, when the contact making device 5 is closed, such relays may be driven to their right-hand, or spacing, contacts. The manner in which these relays are moved is through an individual contact making device 6 corresponding to relay 1, 7 corresponding to relay 2, and 8 corresponding to relay 3. Thus, if the device 4 is closed, and the device 6 is also closed, current will flow through battery, through the device 6, the rectifier 9, the upper winding of relay 1 to the marking contact 4. The relay 2 cannot operate through a path involving the rectifier 10, the lower winding of relay 1, the lower winding of relay 2, the rectifier 12, the rectifier 11 and the upper winding of relay 2 to marking contact 4 because the rectifier 12 prevents current in such a circuit. Likewise, relay 3 will not be operated through a path including the lower winding of relay 1 and both windings of relay 3 because the rectifier 14 prevents flow of current in such a circuit. If contact making device 5 is operated instead of contact making device 4, then when any one of the contact devices 6, 7 or 8 is operated, the corresponding relay 1, 2 or 3 will be driven to its spacing contact and, due to the use of the rectifiers 9 to 14, inclusive, only that relay will operate whose individual contact making device 6, 7 or 8 is operated. Since the relays, such as 1, 2 and 3, are rather expensive devices and the rectifiers 9 to 14, inclusive, are inexpensive devices, this circuit will be considerably more economical than some other circuit which would achieve the same result through the use of additional relays instead of the rectifier devices.

As an example of how a circuit of this kind is used, the communication system shown in Figs. 1 and 2 will be described.

A speech path 15 leads to hybrid coil 16 from which a path 17 for outgoing speech leads to a vogad 18. The outgoing speech then passes through a transmitting suppressor 19 and by means of an amplifier detector 20 operates a chain of relays 21, here labeled as a "Voice operated switching circuit." This voice operated switching circuit controls a transmitting singing suppressor 23 so that the outgoing speech can pass from the transmitting suppressor 19 through the delay and amplifier 22 and the transmitting singing suppressor 23 to the hybrid coil 24. From

the hybrid coil 24 the speech reaches another hybrid coil 25 and thence goes through the radio transmitter 26 to the transmitting antenna 27. Through radio transmission, the speech will be received at some distant point and, for purposes of explanation, it will be assumed that the distant point has a receiving circuit similar in all respects to the lower part of Fig. 1 and to Fig. 2. The speech, therefore, enters antenna 28, passes through a radio receiver 29 and a repeater 30 to a hybrid coil 31. From the hybrid coil 31 the speech goes into hybrid coil 32, thence through the receiving signal suppressor 33, the receiving repeater 34, low-pass filter 35 and a path 36 to a hybrid coil, such as 16, whence it goes to the receiving subscriber over a line such as 15.

That part of the circuit between and including the radio transmitter and the radio receiver 15 is spoken of as a mutable link since it comprises a signaling channel capable of, or liable to, change from internal or external cause which may give rise to interfering energy, or, more specifically, subject to noise, fading or change of impedance.

The voice operated switching circuit 21 controls a control tone enabler 37 so that tone from a source 38 is passed through the control tone filter 40 to the hybrid coil 25 and thus enables speech. Such control is indicated by the right-hand line drawn from the top of the rectangle 21 and entering the control circuit 41, where it is indicated by a dotted line within such rectangle, thereafter leaving this point and exercising control over the control tone enabler 27. The voice operated switching circuit 21 also controls the control circuit 41, the transmitting signal suppressor 23 and a switching point leading from the receiving switching circuit 42 to the transmitting suppressor 19. Thus, when speech comes in over the path 15 and the voice operated switching circuit 21 is operated, the control, which the receiving switching circuit 42 might have over the transmitting suppressor 19, is cut off, the transmitting singing suppressor 23 is enabled, and the control tone enabler 37 is operated if the control circuit 41 has not interfered with this last control. It will be noted hereinafter that such interference is provided for under certain specified conditions.

At the receiving end the control tone coming in as modulation of a carrier wave over antenna 28 passes through hybrid coil 31 and thence through telegraph band elimination filter 45 and into a control tone amplifier and filter 43, whence through the agency of receiving detector 44 it operates the receiving switching circuit 42. The receiving switching circuit controls a normally open circuit between the telegraph band elimination filter 45 and the receiving detector 44, including a speech amplifier 46. This is provided so that when the control tone is first received, the receiving switching circuit 26 will be operated thereby and then held operated thereafter by speech currents flowing through the amplifier 46. This means that the circuits 43 and 46 are both effective and operated in conjunction with each other to hold the switching circuit chain of relays operated.

In this connection, it will be noted that when speech first comes on at the distant transmitting end, the control tone enabler 37 is operated and this allows tone of full volume to flow from the source of control tone 38 into the hybrid coil 25. After a delay, as provided by the delay and amplifier 22, the control tone compressor 39 operates to reduce the volume of control tone being trans-

mitted to the distant end. Thus, at the receiving end the first effect will be the reception of a very short interval of control tone at high amplitude followed by a reduction in this amplitude when speech comes on.

The receiving switching circuit 42 also controls the receiving suppressor 33 to open up the speech path, that is, to put the speech path in condition to freely transmit speech currents. The receiving switching circuit 42 also controls a normally closed path between the band-pass filter 47 and the telegrad 48 so that while speech is being received the telegrad 48 will be disabled. At the same time, a receiving switching circuit 42 controls the switching relay 50.

During pauses in speech, either when the subscriber at the distant end is talking into channel 15 or during the time when the subscriber on channel 15 pauses during his talk out over antenna 27, the telegraph apparatus shown in the upper part of Fig. 1 is in operation. This comprises perforators 51 and 52 working respectively into tape transmitters 53 and 54 and thence into rotary distributor 55. Rotary distributor 55 works into the control circuit 41, which in turn, exercises control over the telegraph signal converter 56. A source of telegraph signal tone is supplied to the telegraph signal converter 56 by the source 57. Under control of the control circuit, this telegraph signal tone is broken up into spurts corresponding to signals which are then sent into the hybrid coil 24 and thence out over the radio transmitter 27 where they will eventually operate the telegrad 48. At the distant end these telegraph signals in the form of spurts of alternating current are received over antenna 28 and radio receiver 29 and passed through the hybrid coils 31 and 32 to the band-pass filter 47. Thereafter the signals enter the telegrad 48 and are converted from varying strength alternating current signals to uniform strength direct current signals of practically the same length at which they were received over the antenna 28. Each marking signal will result in the operation of relay 49.

The operation of the telegrad is fully explained in the patent of Barney et al., No. 2,238,028, granted April 15, 1941.

For purposes of avoiding mutilation of telegraph signals, sixth pulse circuits 58 and 59 are provided to exercise a delay in the control which the voice operated switching circuit 21 has over the control tone enabler 37 under the condition when a telegraph code is completed within a given percentage of its total length. For a more complete description of this function reference is made to Patent No. 2,207,720, issued July 16, 1940 to Cole et al.

The direct current signals produced by the telegrad 48 operate the receiving telegraph master relay 49, it being now assumed that the voice does not have control of the circuit and that receiving switching circuit 42 is not operated. Relay 50 will be operated and, hence, relays 60 and 61 will be in the positions shown. Therefore, upon each operation of the receiving telegraph master relay 49, a circuit will be established from the armature and back contact of relay 60 through the armature and front contact of relay 49 and thence through the upper windings of the three relays 62, 63 and 64. All three relays will be driven to their marking contacts as shown. When a space signal is being received by the telegrad 48, the relay 49 will be on its back contact and thus

the lower windings of the three relays 62, 63 and 64 will be energized and thus the relays will be driven to their spacing contacts. It will be noted that when the voice currents take charge of the circuit, relay 50 will be released after an interval controlled by the two resistances 65 and 66 and the condenser 67 and thereupon the relays 60 and 61 will be operated. Relay 60 holds the three relays 62, 63 and 64 operated continuously on their spacing contacts. Relay 61 places a ground on conductor 68 to insure that relays 70 and 71 will remain on their spacing contacts so that the stepping magnets 72 and 73, respectively, cannot be energized during the time that speech has control of the circuit.

When the telegraph circuit is operating, however, the receiving telegraph line relay 62 will follow the incoming impulses and, through the continuous segment 74 and various short segments traversed by the brush 75, will distribute these impulses to the proper selector magnets 76 to 85, inclusive. The brush 75 is moved by a shaft 86 controlled by the motor and synchronous equipment 87. The shaft 86 also carries a brush 88 which connects battery to the two rectifiers 89 and 90 while the brush 75 is distributing impulses to the magnets 76 to 80, inclusive, and likewise the brush 88 connects battery to the rectifiers 91 and 92 while the brush 75 is distributing impulses to the magnets 81 to 85, inclusive. Thus, if there are any marking impulses in the codes received while brush 75 is wiping over segments connected to magnets 76 to 80, the relay 63 will close a circuit from ground through its armature and front contact to conductor 93 and thus causes the operation of relay 71 to its marking contact. In like manner, relay 70 is driven to its marking contact and these relays are of the polar variety which maintain their armatures as last placed until they are driven to the other position. Thus, when the brush 75 has completed its task of distributing impulses to the A printer, the brush 94 will make contact with segment 95 and complete a circuit from ground through the armature and contact of relay 71 to the winding of magnet 73 to cause the printing of the character stored by the magnets 76 to 80. In like manner, after the brush 75 has completed its task of distributing impulses to the B printer, the brush 94 will come in contact with segment 96 and cause the operation of magnet 72 to print the character stored by the magnets 81 to 85.

As soon as the voice currents take charge of the circuit, the relay 50, after its period of hang-over, will release and through the operation of relay 61 will place ground on conductor 68 to drive both relays 70 and 71 to their spacing contacts.

The relay 64 is a corrector relay and, during the periods when it is on its spacing contact, causes the charging of condenser 97. When relay 64 goes to its marking contact, it discharges this condenser through the segments connected to either conductor 98 or 99 or, if the shaft 88 is in exact synchronism with the shaft of the distant rotary distributor 55, then the discharge of the condenser 97 will be practically divided equally between the two conductors 98 and 99. Under this condition the relay 100 will not operate. If, however, either conductor 99 or 98 receives the full discharge of condenser 97 or a preponderance of such discharge, the relay 100 will operate to its right or left-hand contact and result in final operation of device 101 which here indicates either fast or slow operation of the shaft 88 and represents means for bringing such shaft back into synchronism with the distant rotary distributor 55.

What is claimed is:

1. A circuit arrangement including a plurality of relays each having a first winding for driving the armature of said relay to a first contact and a second winding for driving the armature of said relay to a second contact, an energizing contact individual to each relay connected to both windings of said relay, a common contact connected to the first windings of all said relays, a common contact connected to the second windings of all said relays and a rectifier in circuit with each winding of said relays, said relays being operated when their individual energizing contacts and one of said common contacts are closed.

2. A control circuit including a plurality of relays each having a winding for driving said relay to marking, and a winding for driving said relay to spacing, an individual contact for each relay for placing battery on both said windings, a common ground contact for the marking windings of all said relays, a common ground contact for the spacing winding of all said relays and a rectifier in circuit with each winding of said relays to prevent false operation of said relays through the multiple connections to said common contacts.

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