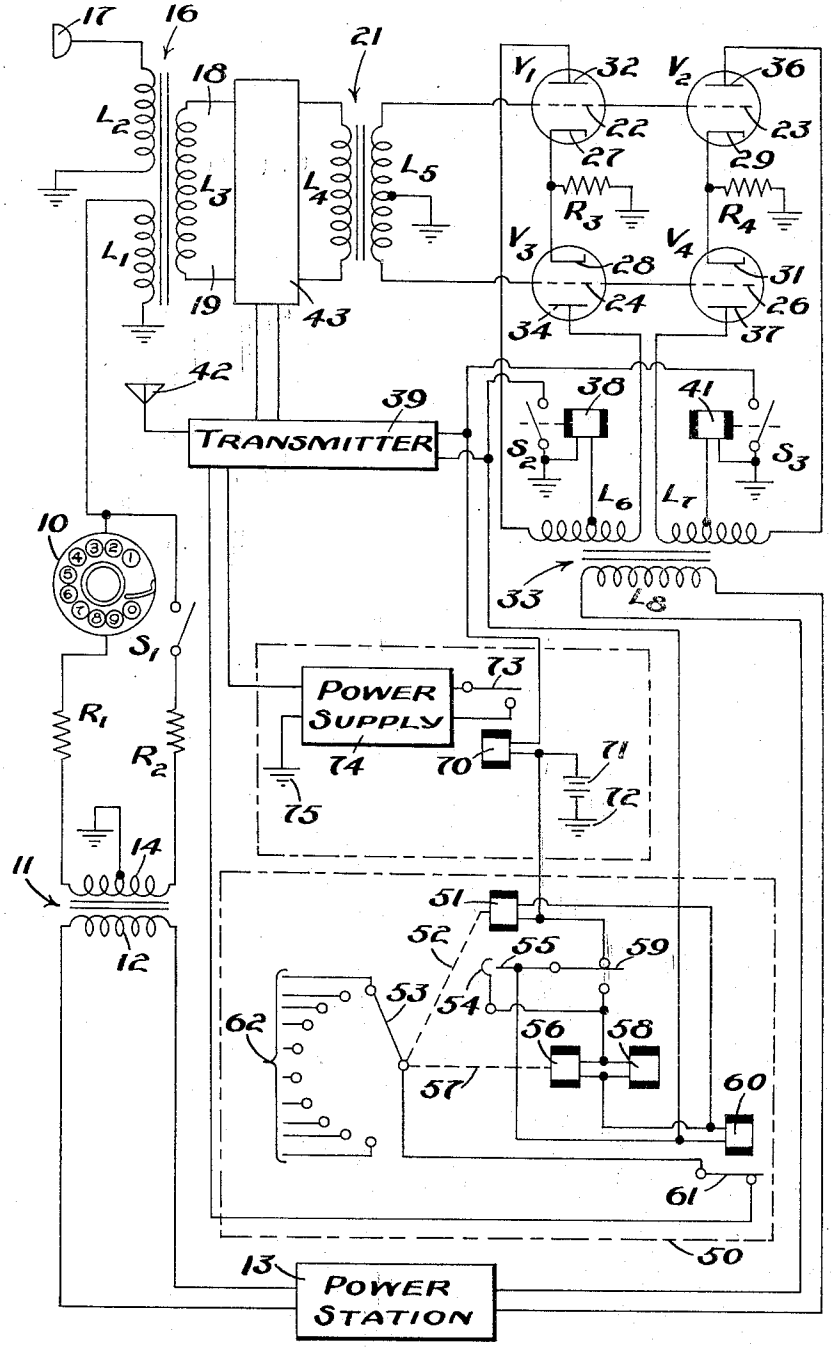
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TONE CONTROL SYSTEM FOR CONTROLLING A REMOTE STATION

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TONE CONTROL SYSTEM FOR CONTROLLING A REMOTE STATION

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This invention relates in general to a control system and in particular to means for selectively operating a pair of relays or other controlled apparatus remotely.

It is oftentimes desirable to control from a remote position, a transmitter or receiver. For example, oftentimes a radio transmitter may be located a number of miles from its control station. It is desirable to be able to turn the transmitter on remotely and in some cases, change frequencies or perform other operations from the remote control station.

It is an object of this invention therefore, to provide means for remotely controlling apparatus.

Another object of this invention is to provide means for remotely controlling either of a pair of relays.

Yet another object of this invention is to provide means for selectively operating one of two relays.

A feature of this invention is found in the provision for a phase comparison circuit which uses a reference voltage of the same phase at the remote and controlled stations so as to selectively operate either one of two relays.

Further objects, features and advantages of this invention will become apparent from the following description and claims when read in view of the drawing, in which;

The single figure illustrates schematically the remote control apparatus of this invention.

A control station is provided at which a dial **10**, as for example, a telephone dial, is connected in series with a resistor R_1 and one side **14** of a transformer **11** which has its mid-point grounded. The primary **12** of the transformer is connected to a suitable power supply, as for example, 60 cycle, 110 volts, which might come from some centrally located power station **13**. A resistor R_2 is connected to the other side of the secondary **14** and a switch S_1 is connected to resistor R_2 and to the other side of dial **10**.

The dial **10** is connected to one winding L_1 of a transformer **16**. A microphone **17** is connected to an inductance L_2 which forms a second winding of a transformer **16**. A third winding of the transformer **16**, L_3, is connected to a pair of wires **18** and **19** which join the control station with the controlled station.

The opposite ends of wires **18** and **19** are connected to a winding L_4 of a transformer **21**. The secondary L_5 of transformer **21** has its midpoint grounded and opposite ends connected to the grids **22**, **23**, **24** and **26** of tubes V_1, V_2, V_3 and V_4.

The cathodes **27** and **28** of tubes V_1 and V_3 are connected together and in series with a resistor R_3 to ground. The cathodes **29** and **31** of tubes V_2 and V_4 are connected together and to ground through a resistor R_4. The plate **32** of tube V_1 is connected to one end of a winding L_6 of a transformer **33**. The opposite side of winding L_6 is connected to the plate **34** of tube V_3.

Plate **36** of tube V_2 is connected to a second winding L_7 of transformer **33**. The opposite end of winding L_7 is connected to the plate **37** of tube V_4. The mid-point of winding L_6 is connected to a relay **38** which has its opposite side connected to ground. The relay **38** when

energized closes a switch S_2 which is connected to ground and has its open side connected to a transmitter **39**.

Likewise, winding L_7 has its mid-point connected to a relay **41** which has its opposite side connected to ground. The relay **41** actuates a switch S_3 which has its open side connected to the transmitter **39**. A third winding L_8 of the transformer **33** is connected to the power station **13**.

The transmitter **39** is connected to a suitable antenna **42**. A filter **43** is located at the controlled station and removes the voice from the wires **18** and **19** and supplies it to the transmitter **39** for modulation.

In operation, let it be assumed that it is desired to tune the transmitter **39** to a particular frequency and to transmit voice modulation after it is tuned. The dial **10** has ten or more positions of which nine might correspond to a particular frequency for the transmitter.

One of the positions might turn on the filament heaters of the electron tubes of the transmitter to prepare it for transmission. If the dial is actuated and released, a signal will be coupled through the transformers **16** and **21** to the grids of tubes V_1, V_2, V_3 and V_4. The tones transmitted by the telephone dial **10** causes tubes V_1 and V_3 to conduct for the reason that the power furnished by the power station **13** to the windings **12** and L_8 are in phase and thus tubes V_1 and V_3 have their plates and grids in phase and they will therefore conduct.

The voltage on the plates and grids of V_2 and V_4 are 180 degrees out of phase and there will be no conduction.

When tubes V_1 and V_3 conduct, the relay **38** will be energized, thus closing switch S_2 and the control information from the telephone dial **10** will be furnished to the transmitter **39**. For example, the telephone dial **10** might transmit a number of pulses corresponding to the number dialed. This will cause the switch S_2 to close the same number of times as the number dialed and the transmitter **39** will have a stepping switch or other tone resolver which can interpret the signal. A stepping switch **50** suitable for use with the transmitter is illustrated in the single figure and is connected between the relay actuated switch S_2 and the transmitter **39**.

The operation and circuitry involved in the stepping switch is as follows: Actuation of the dial **10** to the stop position is effective to close the circuit from the secondary terminal of transformer **11** through resistor R_1, the dial switch **10** and the transformer primary L_1 to ground. This energizes the grids **22** and **24** of the tubes V_1 and V_3 respectively with a voltage of the same phase as that applied to the corresponding plates. Accordingly, conduction in these tubes results and relay **38** is energized and switch S_2 is actuated to the closed position.

Closure of switch S_2 is effective to energize the release relay **51** of the stepping switch **50**. This circuit is completed from ground at switch S_2 through the contacts of switch S_2, the normally closed contact **59**, the winding of relay **51** to the positive terminal of the battery **71** and back to ground **72**. Actuation of the relay **51** mechanically drives the selector brush **53** to the home position through a mechanical linkage **52** represented by the dashed line. The closure of switch S_2 is also effective to energize slow release relay **60** and to open the normally closed contact **61**. Opening of contract **61** interrupts the circuit connection between the selector switch brush **53** and the transmitter **39** for a time interval sufficient to permit the stepping switch to come to rest at the position selected.

When the stepping switch brush **53** is driven to its home position by the linkage **52**, the brush engages the contact blade **54** and displaces this blade into engagement with the contact **55**. Closure of the contact blade **54** and contact **55** is effective to complete a circuit through stepping relay **56** and slow release relay **58** from the ground connection at switch S_2 to the positive terminal of the bat-

tery 71 and thence to the ground connection 72. Energization of slow release relay 58 actuates the normally closed contact 59 from its upper position to engagement with the lower contact. This actuation of switch 59 interrupts the circuit of the release relay 51 to prevent this relay from driving the selector switch brush to the home position upon the occurrence of succeeding pulses. A closure of the contact arm 59 against the lower contact also provides a circuit connection directly from switch S_2 through stepping relay 56 to the positive terminal of the battery 71, for actuation by succeeding pulses.

Upon the release of the dial 10 at its stop position, it will return to its normal position and produce a number of pulses corresponding to the number dialed. Release of the dial interrupts the first pulse. This interruption permits relay 38 to open switch S_2, thus de-energizing stepping relay 56. De-energization of relay 56 releases the relay armature which is connected to the stepping switch brush 53 through the linkage 63 represented by the dashed line. Release of the relay armature thus causes the stepping switch brush 53 to advance by one position. In the same manner, each succeeding pulse produced at the control station will cause the stepping switch brush 53 to advance one position until the position corresponding to the number dialed has been reached. At this point, slow release relay 60 will permit normally closed contact 61 to return to its closed position to complete the circuit from the selected one of the circuits 62 through the stepping relay brush 53 and normally closed contact 61 to the transmitter 39. The circuit 62 selected by the stepping switch brush corresponds to a particular frequency to which the transmitter is thereby tuned.

Assume that the transmitter 39 has been prepared for transmission by the dial 10 and its related circuitry. The switch S_1 may then be closed, thus causing tubes V_2 and V_4 to conduct, thus energizing relay 41 which closes switch S_3. The switch S_3 might be the transmitter on position or push-to-talk switch to put the transmitter on the air. Closure of the switch S_3 by relay 41 is effective to connect the high voltage power supply 74 to the transmitter 39. The circuit is completed from the ground connection at switch S_3 through the closed contact of switch S_3, the winding of relay 70, and the battery 71 to the ground connection 72. Energization of relay 70 closes the contact 73, which is effective to energize the high voltage power supply. When the high voltage power supply is thus energized, the high voltage output is supplied between the ground connection 75 and the input terminal of transmitter 39.

The modulation may be furnished over the microphone 17 through the wires 18 and 19 and to the transmitter through the filter 43.

In order for this apparatus to work, it is necessary that the windings 12 of transformer 11 and L_8 of transformer 33 be energized with the same phase power supply. One of the main advantages of this system is its simplicity and saving of wires. It is to be noted that only two wires 18 and 19 need to be connected between the controlled and the control station.

This invention provides a very simple means of selectively operating a pair of control relays at a remote point over a single pair of lines which might be, for example, telephone or telegraph lines that may also carry audio for voice communication. This is called a tone control system but the tone used is the power line frequency.

The two-phase detectors are the heart of this invention. They comprise, respectively, the tubes V_1, V_3, and V_2, V_4. When the 60 cycle tone applied to the telephone line causes the grid of the tubes V_1 and V_3 to be in phase with the alternating voltage on their plates, they will conduct on the positive half cycles, thus rectifying the alternating current to operate the pulsing relay 38. If the phase of the applied tone is reversed by 180°, then the right pair of tubes V_2 and V_4 will conduct instead and the relay 41 will be operated.

The main advantage of this circuit over conventional systems is its simplicity. The usual tone oscillators, selective filters, amplifiers, rectifiers and associated direct current power supplies, are replaced by the simple circuit which is operated entirely by alternating power.

The system utilizes the fact that normally 60 cycle power supply is available over a relatively large area from the same power supply. For example, the lines 18 and 19 might be rented telephone lines and the phase detecting system of this invention allows two wires to be eliminated between the control and the controlled station. This is a substantial saving in maintenance and rent of telephone or other lines.

Although this invention has been described with respect to particular embodiments thereof, it is not to be so limited as changes and modifications may be made therein which are within the full intended scope of the invention as defined by the appended claims.

I claim:

1. A tone control system for controlling a controlled station from a remote position comprising, a power station supplying power to the control and the controlled stations, a first transformer located at the control station with its primary connected to the power station, the secondary of said first transformer having its mid-point connected to ground, first and second switching means connected to opposite sides of the secondary of the first transformer, a second transformer located at the control station, a primary of the second transformer connected to the first and second switching means, a pair of communication lines connected to the secondary of said second transformer and extending from the control to the controlled stations, a third transformer located at the controlled station with its primary connected to the pair of communication lines, the midpoint of the secondary of the third transformer connected to ground, two pairs of electron tubes at the controlled station with the control grids of the first pair of electron tubes connected to one side of the secondary of said third transformer, the control grids of the second pair of electron tubes connected to the opposite side of the secondary of the third transformer, a fourth transformer located at the controlled station and having its primary connected to the power station, a first secondary of the fourth transformer with one end connected to the plate of one of the first pair of electron tubes, and the opposite end connected to the plate of one of the second pair of electron tubes, a second secondary of said fourth transformer with one end connected to the plate of the other of said first pair of electron tubes and the opposite end connected to the plate of the other of said second pair of electron tubes, a first relay connected between ground and the mid-point of the first secondary of the said fourth transformer, a second relay connected between ground and the mid-point of the second secondary of said fourth transformer, and the said first and second relays furnishing control signals.

2. A tone control system for controlling a remote station comprising, a control station having a first transformer with its primary energized by a tone voltage source and provided with a secondary winding having a center tap connected to ground, a second transformer at said control station having a grounded primary winding, means for energizing said second transformer with a tone voltage of selectable phase including a first switch means adapted to connect the primary winding of said second transformer to one terminal of said secondary winding, a second switch means adapted to connect the said primary winding of said second transformer to the other terminal of said secondary winding, means for energizing said second transformer with a signal voltage, a pair of communication lines connected across the terminals of the secondary winding of said second transformer and connecting the control station with a controlled station, filter means for separating said tone volt-

age and said signal voltage at said controlled station and having a pair of input terminals connected across said lines, a pair of signal voltage output terminals and a pair of tone voltage output terminals, a signal voltage utilization device at said controlled station, means connecting said signal voltage output terminals to said device, means for controlling said device in response to actuation of said switch means including means connecting said tone voltage output terminals across the primary winding of a third transformer, two pairs of electron tubes, the control grids of each pair connected to different terminals of the secondary winding of said third transformer, the cathodes of the first pair of electron tubes connected together, the cathodes of the second pair of electron tubes connected together, a fourth transformer with its primary energized from said tone voltage source, first and second secondary windings on the fourth transformer with the said first secondary windings having its opposite ends connected to the plates of the first pair of electron tubes, the said second secondary winding having its opposite ends connected to the plates of the second pair of electron tubes, a first control relay connected between ground and the midpoint of the said first secondary winding and a second control relay connected between the midpoint of the said second secondary winding and ground.

3. In combination a control station, a controlled station, a pair of communication lines between said stations, an alternating voltage source common to said stations, phase responsive means at said controlled station including first and second selectively conductive electron tubes and first and second selectively actuated relays, each of said tubes being provided with plate and grid electrodes and being rendered conductive for actuating the corresponding one of said relays when both of said electrodes are energized with voltages of the same phase, one of said

electrodes of one tube energized from said source with a voltage of one phase, one of said electrodes of the other tube energized from said source with a voltage of the opposite phase, the others of said electrodes of each tube being coupled to said pair of lines, a transformer at said control station energized from said source and having a secondary winding with a grounded center tap, a first selector switch at said control station connected between one terminal of said secondary winding and a grounded transformer coupling to said line for energizing the said line with a voltage of one phase, and a second selector switch at said control station connected between the other terminal of said secondary winding and a grounded transformer coupling to said line for energizing said line with a voltage of the opposite phase, the first of said selector switches being of the dial actuated type having intermittently actuated contacts for producing a selectable number of pulses, and a stepping switch in driven connection with said first selectively actuated relay at said controlled station.

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