

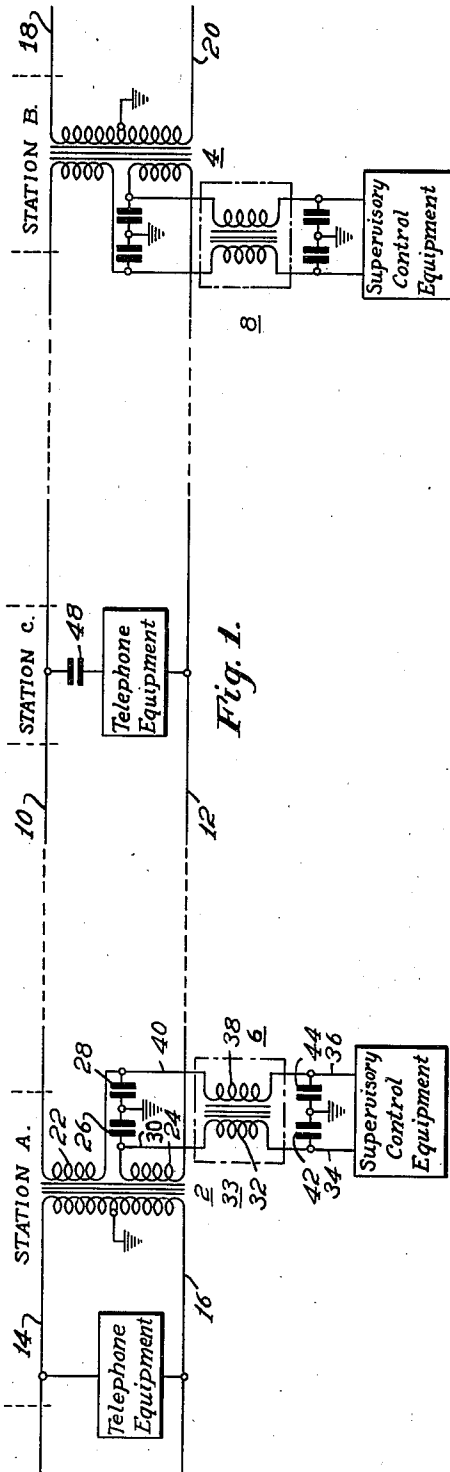
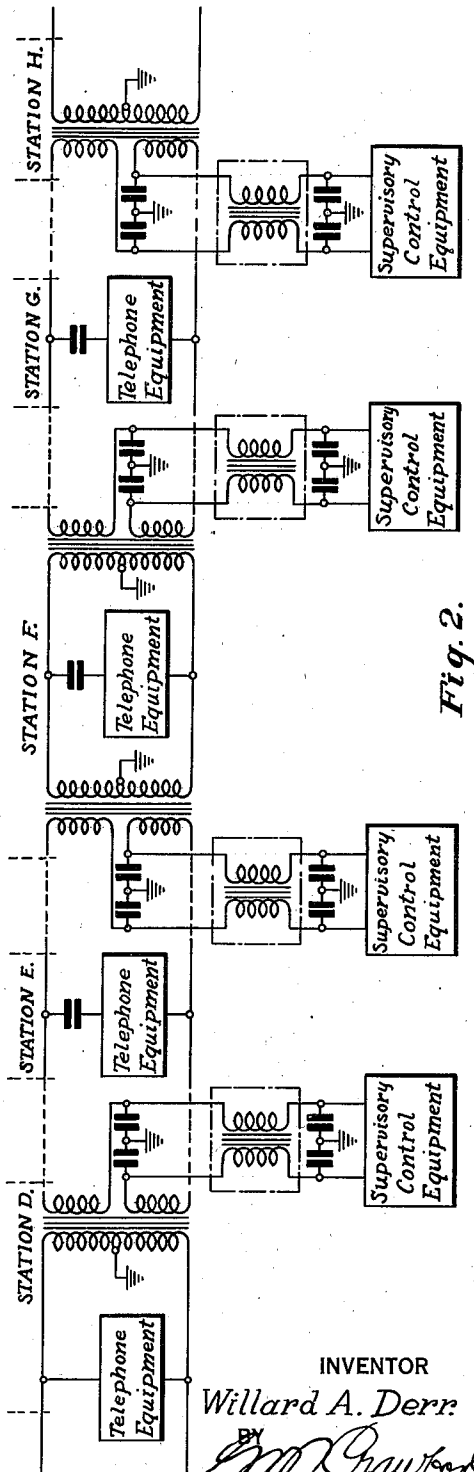
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CONTROL SYSTEM

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CONTROL SYSTEM

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My invention relates, generally, to control systems, and more particularly to supervisory control systems operated in conjunction with telephone systems.

In the operation of power systems and other systems having remotely disposed stations it is customary to interconnect the stations with a telephone system. It is also well known in the operation of systems having remotely disposed stations to control and supervise apparatus at the remotely disposed stations from a control station.

The telephone systems which interconnect such remotely disposed stations usually employ ringing currents of frequencies of from 16 to 60 cycles per second and the range of voice frequencies transmitted by the telephone system extends upward to above 5000 cycles per second. The supervisory control systems usually operate by direct current pulsing, the frequency of the pulses being approximately 6 per second.

An object of my invention is to provide a combined telephone system and supervisory control system which shall function to provide both telephone communication and supervisory control operations simultaneously over a single communication channel extending between remotely disposed stations without interference of either of the functions with the other.

Another object of the invention is to provide a supervisory control system which shall function to perform supervisory control operations between one station and adjacent stations over a telephone channel which interconnects the several stations without interference of either of the communication functions with the other.

These and other objects and advantages will be apparent from the following detailed description taken in connection with the accompanying drawing, in which:

Figure 1 is a diagrammatic representation of a combined telephone and supervisory control system embodying the principal features of my invention; and

Fig. 2 is a diagrammatic representation of a combined telephone and supervisory control system in which the supervisory control system operates between one station and the two adjacent stations on a telephone system.

In practicing the embodiment of the invention shown in Fig. 1, insulating transformers 2 and 4 are connected in the telephone channel at stations A and B between which it is desired to transmit supervisory control impulses. A supervisory control set of equipment is connected in

circuit with the line wires and the connected transformer windings at each of the stations through filter circuits 6 and 8, the filter circuits being designed to offer high impedance to voice and ringing currents and low impedance to low frequency supervisory control pulsing currents.

A set of telephone equipment may be connected at any point on the line between stations A and B as shown at station C and telephone sets may be connected similarly at stations A and B.

In the embodiment of Fig. 2, supervisory control is provided between a station F and the adjacent stations D and H and telephone sets may be provided at any of the stations D, E, F, G and H.

Considering the system more in detail, the section of the telephone circuit extending between station A and station B comprising the conductors 10 and 12 is sectionalized or segregated from the remainder of the telephone circuit comprising conductors 14 and 16 and conductors 18 and 20 by insulating transformers 2 and 4.

The winding of the transformer 2 at station A, which is connected to the conductors 10 and 12, is divided into two substantially equal parts 22 and 24, and capacitors 26 and 28 are connected in series circuit relation between the windings 22 and 24. The corresponding winding of the transformer 4 at station B is similarly divided and has similar capacitors associated with the divided winding, as indicated. Thus the telephone circuit extending between stations A and B includes the divided transformer windings at the two stations; the capacitors at the two stations and the line conductors 10 and 12 connecting the two stations.

A set of supervisory control equipment is provided at each of the stations A and B. These sets of supervisory control equipment may be such cooperating sets of equipment as are shown and fully described in the patent to Boswau No. 2,091,301, issued August 31, 1937, or any suitable sets of cooperating supervisory control equipment operating over a pair of line conductors by means of coded impulses having a frequency substantially less than the frequency of ringing and talking currents in a telephone communication system. The supervisory control equipment at the station A is connected between the windings 22 and 24 of the transformer 2 in a circuit which extends from one side of the winding 24 through a conductor 30, a winding 32 of an inductor 33, a conductor 34, the supervisory control equipment, a conductor 36, a winding 38 of the in-

ductor 33, and a conductor 40 to the transformer winding 22.

A pair of capacitors 42 and 44 is connected in series circuit between the conductors 34 and 36. A ground connection is provided for the connection between the pairs of capacitors 26 and 28 and 42 and 44, as indicated.

The connections between the supervisory control equipment at station B and the transformer 4 are identical with those at station A, as indicated in the drawing. The inductor 33 comprising the inductor coils 32 and 38 disposed on a common core is so designed as to offer high impedance to currents of the frequency normally used for ringing in a telephone communication system and voice frequency currents so that these telephone ringing and talking currents will not affect the supervisory control equipment. The condensers 26 and 28 act as a by-pass or shunting circuit for the ringing and voice frequency currents to further prevent the ringing and voice frequency currents from affecting the supervisory control equipment. The capacitors 42 and 44 also provide a shunting circuit for any ringing and voice currents that might be conducted through the windings of the inductor 33.

In the operation of the telephone system, telephone sets of equipment may be connected at stations A and B as indicated at station A directly across the telephone line conductors at any point in the telephone communication system, and the telephone system will operate through the section of telephone circuits between the stations A and B without affecting the supervisory control equipment at stations A and B, by virtue of the fact that the filter circuits 6 and 8 at stations A and B, respectively, will prevent the telephone ringing and talking currents from affecting the supervisory control equipment. When the supervisory control equipment is operated, coded impulses are transmitted between stations A and B over the line conductors 10 and 12, and these coded impulses are of such a low frequency and build up and die down so slowly that they will not be heard in the telephone equipment.

If it is desired to connect a set of telephone equipment to the section of telephone circuit extending between the stations A and B, such as at station C, a set of telephone equipment may be connected between the conductors 10 and 12 through a capacitor 48, as indicated. This connection of the telephone equipment at station C through a capacitor provides a path for the ringing and voice frequencies but prevents the drainage of supervisory control current through the telephone equipment, particularly in supervisory control systems where the line conductors are maintained energized and the coding impulses are produced by opening and closing the line circuit. The insulating transformers 2 and 4 serve the purpose of insulating the supervisory control section of line from the other telephone equipment in the system.

The capacitors 42 and 44 and 26 and 28, in addition to serving the purpose of by-passing the ringing and voice frequency currents and thus preventing them from entering the supervisory control equipment, also serve to prevent the line relays of the supervisory control equipment from releasing too quickly after the break of the coding impulses due to the residual magnetism in the inductor 33 by maintaining a potential on the line opposite to the potential induced in the

inductor 33 when the line circuit is broken at the break portion of the coding impulse.

The inductor 33 has its windings 32 and 38 so arranged as to permit passage of extraneously induced currents in the lines 10 and 12, such as might be produced by adjacent power lines or lightning surges to pass frequently to the ground connection between the capacitors 42 and 44. The ground connection between the capacitors 26 and 28 serves the similar purpose of draining extraneously induced currents from the line conductors 10 and 12. The inductor windings 32 and 38, however, are so related as to offer high impedance to the telephone ringing and voice frequencies.

In the embodiment of the invention shown in Fig. 2, apparatus is provided for utilizing the sections of telephone circuit adjacent to a station F for supervisory control operations between the station F and stations D and H. It will be seen that the telephone equipment at station F is separated from the adjacent supervisory control sections of the telephone circuit by insulating transformers, and that each of the other ends of the supervisory control sections are connected to the telephone circuit through insulating transformers. The supervisory control equipment and telephone equipment at each of the stations and the telephone equipment at intermediate stations such as station E and station G may be the same as corresponding apparatus at the corresponding stations in the system shown in Fig. 1. In the system shown in Fig. 2, it will be seen that the station F may be the control station or dispatchers station, and stations D and H may be remote stations controlled and supervised from the station F.

Thus it will be seen that I have provided a combined telephone communication system and supervisory control system which functions to provide both telephone communication and supervisory control operations simultaneously over a single communication channel extending between remotely disposed stations without interference of either of the functions with the other.

In compliance with the requirements of the patent statutes, I have shown and described herein the preferred embodiments of my invention. It is to be understood, however, that the invention is not limited to the precise construction shown and described herein, but is capable of modification by one skilled in the art, the embodiments of the invention shown herein being merely illustrative of the principal features of my invention.

I claim as my invention:

1. In a combined telephone and supervisory control system, a telephone circuit, means connecting cooperating sets of supervisory control equipment to the conductors of said telephone circuit, and circuit means disposed between each of the supervisory control sets and the telephone circuit for preventing the telephone ringing and talking currents from affecting the supervisory control equipment.

2. In a combined telephone and supervisory control system, a telephone circuit, transformer means for sectionalizing the telephone circuit, means connecting cooperating sets of supervisory control equipment to the conductors of a sectionalized section of the telephone circuit, and circuit means disposed between each of the supervisory control sets and the telephone circuit for preventing the telephone ringing and talking

currents from affecting the supervisory control equipment.

3. In a combined telephone and supervisory control system, a plurality of telephone circuit sections, an insulating transformer connected between each end of one of the sections and the adjacent section, means connecting cooperating sets of supervisory control equipment to the conductors of one section, and circuit means disposed between each of the supervisory control sets and the telephone circuit section for preventing the telephone ringing and talking currents from affecting the supervisory control equipment.

4. In a combined telephone system and supervisory control system, a telephone circuit, a telephone set connected to the circuit at one station, transformer means connected between the telephone set and each of the first adjacent sections of the telephone circuit, transformer means connected between each of the said first adjacent sections of the telephone circuit and its next adjacent section, cooperating sets of supervisory control equipment connected to the conductors of each of said first adjacent sections of the telephone circuit, and means disposed between each of said supervisory control sets and the telephone circuit for preventing the telephone ringing and talking currents from affecting the supervisory control equipment.

5. In a combined telephone and supervisory control system, a telephone circuit connecting a plurality of stations, a telephone set connected to the telephone circuit at each of a plurality of the stations, and a supervisory control system operative between two of the stations comprising transformer means connected between the section of telephone circuit which extends between the two stations and the adjacent sections of telephone circuit, cooperating sets of supervisory control equipment connected to the conductors of the telephone circuit section which extends between the two stations, and means disposed between each set of supervisory control equipment and the telephone circuit for preventing the telephone ringing and talking currents from affecting the supervisory control equipment.

6. In a combined telephone and supervisory control system, a telephone circuit connecting a plurality of stations, a telephone set connected to the telephone circuit at each of a plurality of the stations, transformer means connected between a telephone set at one of the stations and each of the adjacent sections of the telephone circuit, transformer means at each of two other stations on opposite sides of the said one station connecting the sections of telephone circuit adjacent the one station with the next adjacent section of telephone circuit, and supervisory control systems operative between the one station and the said two other stations comprising cooperating sets of supervisory control equipment connected to the conductors of each of said telephone circuit sections adjacent the said one station, and filter circuit means for preventing the telephone ringing and talking currents from affecting the supervisory control equipment disposed between each of the supervisory control sets and its associated telephone circuit.

7. In a system for operating a supervisory control system over a telephone circuit, insulating transformers connected between the section of the telephone circuit which it is desired to use for supervisory control purposes and the adjacent sections, capacitor means associated with each of the said transformers, the

telephone circuit of the supervisory control section comprising a winding of each of the transformers, the capacitor means, and the telephone circuit line conductors connected in series circuit relation, a set of supervisory control equipment connected in parallel circuit relation with each of said capacitor means, and filter circuit means disposed between each of said capacitor means and its associated supervisory control equipment for preventing the telephone currents from affecting the supervisory control equipment.

8. In a system for operating a supervisory control system over a telephone circuit, insulating transformers connected between the section of the telephone circuit which it is desired to use for supervisory control purposes and the adjacent sections, a pair of capacitor means associated with each of said transformers, the telephone circuit of the supervisory control section comprising a winding of each of the transformers, the pairs of capacitor means, and the telephone circuit line conductors connected in series circuit relation, means providing a ground connection for the connection between the capacitor means of each pair of capacitor means, a set of supervisory control equipment connected in parallel circuit relation with each pair of capacitor means, and filter circuit means disposed between each of said pair of capacitor means and its associated supervisory control equipment for preventing the telephone currents from affecting the supervisory control equipment.

9. In a system for operating a supervisory control system over a telephone circuit, insulating transformers connected between the section of the telephone circuit which it is desired to use for supervisory control purposes and the adjacent sections, the transformer windings associated with the supervisory control section being divided into two sections, a pair of capacitor means connected in series circuit relation with and between the two sections of each of the divided transformer windings, the telephone circuit of the supervisory control section comprising the divided windings of the transformers, the pairs of capacitor means, and the telephone circuit line conductors connected in series circuit relation, means providing a ground connection for the connection between the capacitor means of each pair of capacitor means, a set of supervisory control equipment connected in parallel circuit relation with each pair of capacitor means, and filter circuit means disposed between each of said pair of capacitor means and its associated supervisory control equipment for preventing the telephone currents from affecting the supervisory control equipment.

10. In a combined telephone and supervisory control system, a telephone circuit, transformer means for sectionalizing the telephone circuit, circuit means connecting cooperating sets of supervisory control equipment to the conductors of a sectionalized section of the telephone circuit, each of said circuit means comprising an inductor of such impedance as to prevent telephone currents from affecting the supervisory control equipment, and capacitor means of such impedance as to readily pass telephone current connected in shunting relation with the circuit connections to each of the supervisory control sets.

11. In a combined telephone and supervisory control system, a telephone circuit, transformer means for sectionalizing the telephone circuit, circuit means connecting cooperating sets of supervisory control equipment to a sectionalized

section of the telephone circuit, each of said circuit means comprising inductor means of such impedance as to prevent telephone currents from affecting the supervisory control equipment, and capacitor means connected in shunting relation with the circuit connections to each of the supervisory control sets on each side of said inductor means.

12. In a combined telephone and supervisory control system, a telephone circuit, a transformer connected between each end of a section of the telephone circuit which it is desired to employ for supervisory control purposes and the adjacent section, the windings of the transformers that are associated with the supervisory control section being divided into two separately connecta-

5 ble parts, a set of supervisory control equipment connected in series circuit between the two parts of the divided transformer windings, an inductor connected in circuit between each of the divided transformer winding parts and the associated supervisory control set, a pair of series connected capacitors connected in shunting relation with the supervisory control set between the inductors and the transformer winding parts, a pair of series connected capacitors connected in shunting relation with the supervisory control set between the inductors and the set, and means providing a ground connection for the connection between the capacitors of each pair of capacitors.

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