Sept. 17, 1935. H. H. BEVERAGE 2,014,518

REMOTE CONTROL SYSTEM

Filed June 23, 1933 3 Sheets-Sheet 1

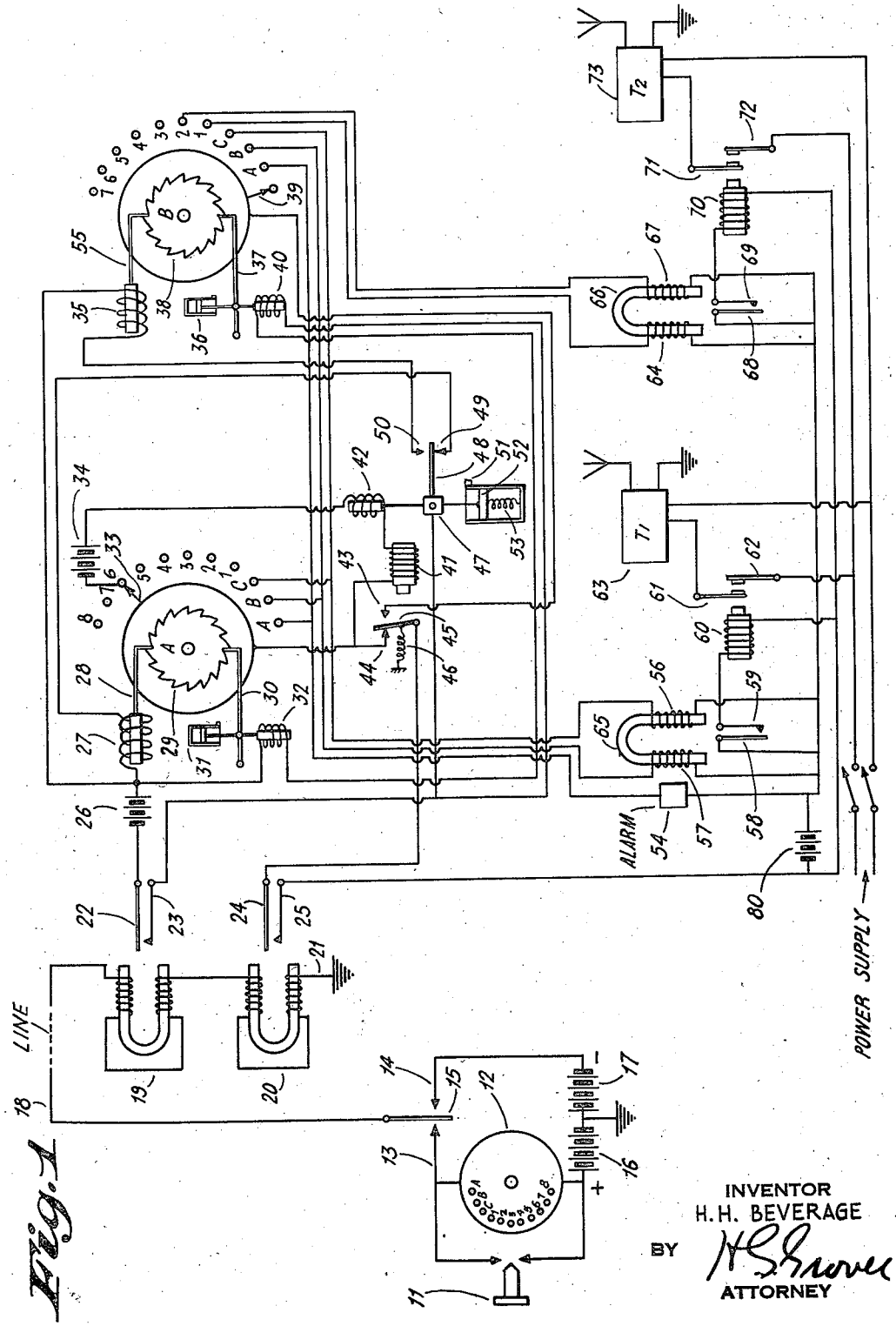


Fig. 1

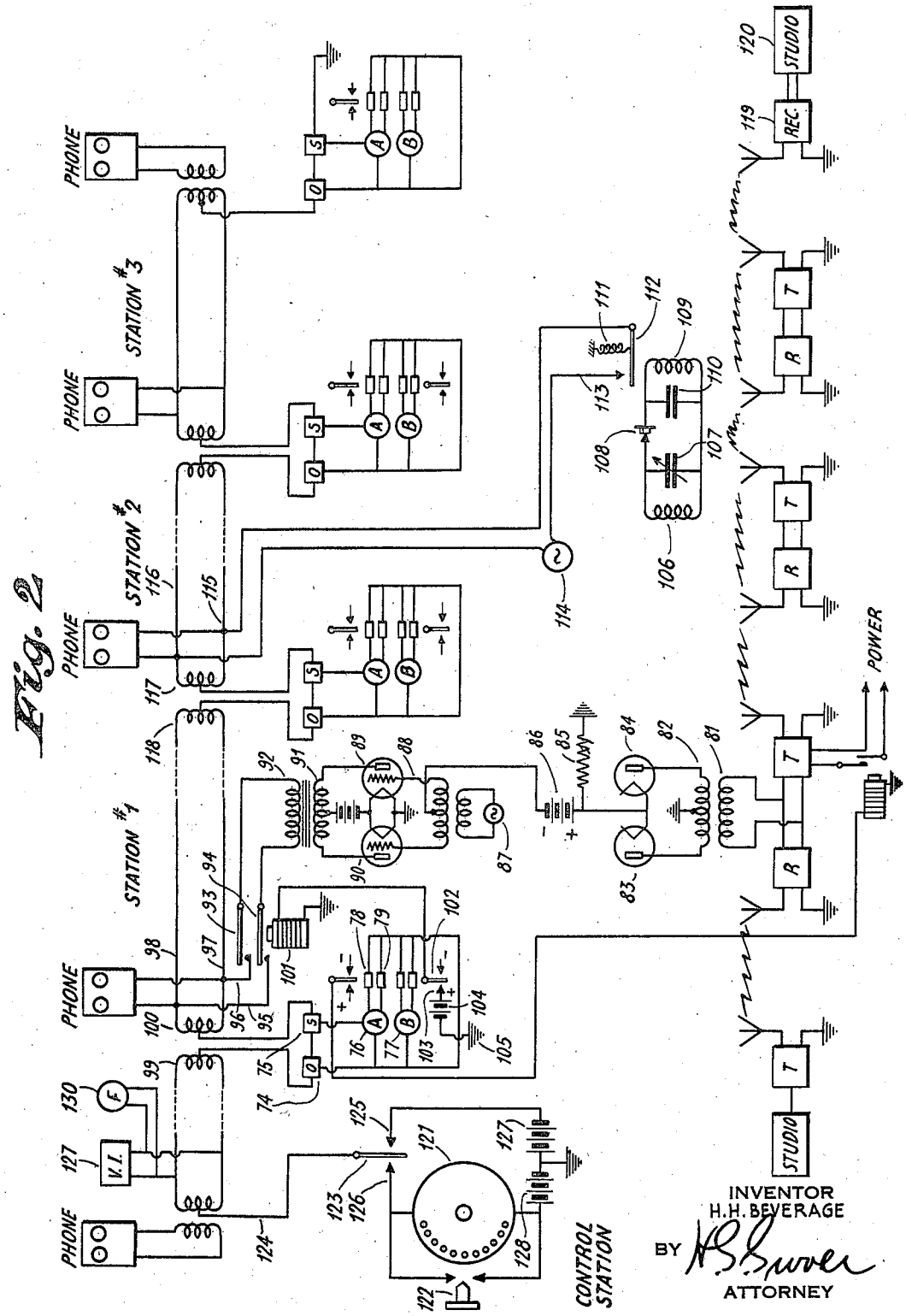
INVENTOR
H. H. BEVERAGE
BY
ATTORNEY

Sept. 17, 1935. H. H. BEVERAGE 2,014,518

REMOTE CONTROL SYSTEM

Filed June 23, 1933 3 Sheets-Sheet 2

Fig. 2



Sept. 17, 1935. H. H. BEVERAGE 2,014,518

REMOTE CONTROL SYSTEM

Filed June 23, 1933 3 Sheets-Sheet 3

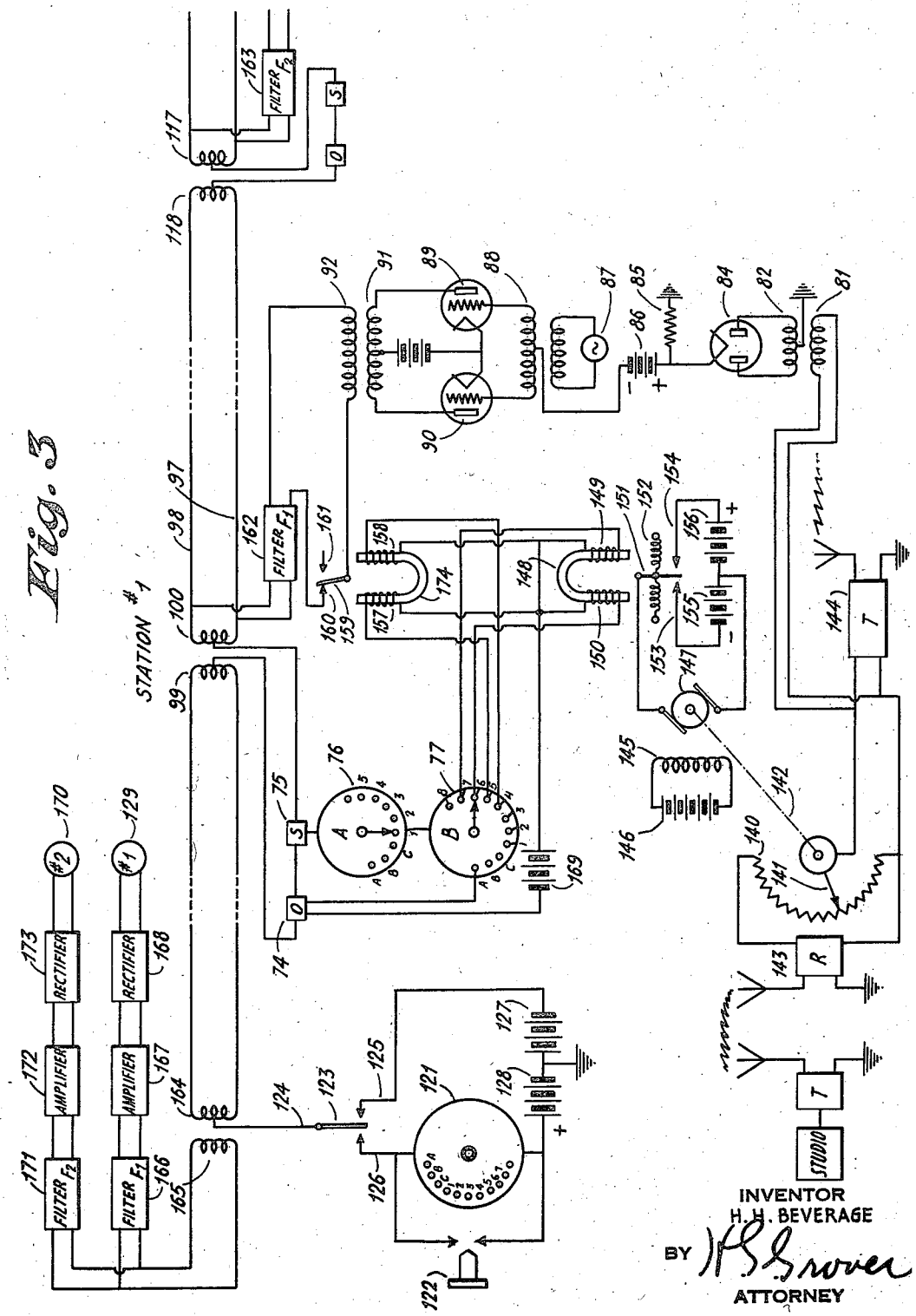


Fig. 3

Patented Sept. 17, 1935

2,014,518

UNITED STATES PATENT OFFICE

2,014,518

REMOTE CONTROL SYSTEM

Harold H. Beverage, Riverhead, N. Y., assignor to Radio Corporation of America, a corporation of Delaware

Application June 23, 1933, Serial No. 677,199

22 Claims. (Cl. 250—2)

This invention relates to a multi-station radio communication relaying system and is particularly concerned with a method of and apparatus for controlling the individual relay stations of such a radio system from a remote location.

One of the objects of the present invention is to enable the control of the apparatus at all the relay stations in the system from a remote point, and a further object is to provide means for visually indicating to the operator at the control point the proper functioning of the apparatus at each office.

In view of the difficulties encountered in the transmission over wire lines of modulation frequencies up to one million cycles, such as occurs in communication by television and high speed facsimile, it has been proposed to relay these modulations by radio. Due to the variability of the medium when frequencies involving sky waves are used, it has been found necessary to use ultra short waves, as these waves penetrate the Kennelly-Heaviside layer, and, consequently, have no sky waves. Since ground waves only are involved, the good transmission is limited to distances approaching the optical path. As these distances are on the order of 20 to 40 miles, a large number of relay stations are required to relay these high speed modulations between major cities.

One of the heavy operational charges for such a relay chain is the salaries of the personnel required to operate the relay stations. This invention provides means for operating the relay stations from a common control point by sending selective impulses over a wire line connecting the relay stations. The selective impulses might also be sent by radio. By using such an arrangement, it is possible to reduce the operating personnel to a small number required mainly for maintenance purposes. A common maintenance crew might maintain several relay stations.

In my copending application, Serial No. 667,253, filed April 21, 1933, I have disclosed a selective remote control arrangement involving two control relays which could be selectively operated. For control over a radio circuit, I have proposed in my copending application, the use of two modulation frequencies for selectively operating the two control relays, with proper safeguards against false operation by voice currents. For operation over a wire line, the control relays are polarized in such manner that one relay operates only on positive currents, while the second relay is responsive only to negative currents.

The first control relay of the copending application energizes two other relays, one a fast relay which operates a step by step switch in accordance with the number of impulses received from a dialing device; the second a slow relay unresponsive to the dial impulses, but responsive to a long impulse. The slow relay is arranged to release a latch, allowing the step by step switch to return to its initial position. Thus, the step by step switch is entirely under the control of the first control relay.

The second control relay of the copending application operates the mechanism selected by the step by step switch. This mechanism may take two general forms; first, a polarized relay that can be used for ringing a bell to call an attendant, for turning on and off any desired device such as a transmitter, etc.; second, a motor that can be made to rotate in either direction any desired amount for tuning a receiver or transmitter, for raising or lowering the gain on the modulator, etc. As step by step selector switches are available up to at least 30 points, a single selector switch is sufficient in many cases. However, in the case of the relay chain, it is necessary to provide more than 30 separate operations. Consequently, I have disclosed means in accordance with the present invention for operating two step by step switches in tandem. One of these can be a station selector, while the second can be an operation selector. For such purposes as starting up or shutting down the stations, it is preferable to have means for either selectively or simultaneously performing this operation at any or all stations. I provide means for accomplishing this result.

It is desirable to have means for remotely checking the modulation levels, radiation, and other adjustments, and for correcting these adjustments if they are found to be incorrect. I have shown in this invention means for such telemetering. I have also provided means in accordance with the present invention for indicating which station has failed if the transmitter should go off the air, enabling the control operator to switch on the spare transmitter at that point.

According to one feature of the present invention there is utilized a reversed current (or two tone) method of selectively operating two relays. One relay operates a pair of step by step switches completely, notching them up step by step through a fast notching relay, as well as returning them to normal through a slow acting latch relay. The second relay performs the selected operational function set up by the selector switches. These operations require two types of polar relays,

one type being biased to stay over on the contact last operated indefinitely, the second type being adjusted to remain centered unless the coils are energized.

Another feature of the invention is the system utilized for indicating which station fails in case a transmitter goes off the air. Further features relate to apparatus for selectively or simultaneously monitoring on any desired function such as on the modulation level or receiver output at a station. For this purpose a telemetering arrangement is used, which arrangement can also be used for measuring any other desired quantity such as antenna current. Other features comprise means for controlling certain functions, such as starting the transmitters at the relay stations so that all stations may be controlled simultaneously or individually by merely dialing the proper combination.

A better understanding of the present invention may be had by referring to the following detailed description which is accompanied by drawings wherein Figure 1 illustrates, diagrammatically, a general arrangement of a remote control system in accordance with the present invention for enabling the control of a station from a remote point; Figure 2 shows in more detail a complete system wherein a plurality of relaying stations are controlled from a central control station; and Figure 3 shows one means of adjusting the modulation level of the transmitter at a distant station.

In the drawings the equipment at the control station is shown within dotted lines, this control station being connected by means of any transmission medium such as a line to the distant station whose operational functions are controlled over the line by the attendant at the control station.

In Figure 1, dial 12 sends out a number of short impulses corresponding to the markings on the dial. Thus A is one impulse, B is two impulses, C is three impulses, I is four impulses, etc. A, B and C control operational functions which may be performed at all stations simultaneously, if desired, as will be explained later.

Before dialing, switch 15 is thrown to contact 13, connecting the dial to ground through positive battery 16. When the dial is operated, short impulses of positive current are sent over the transmission line 18 to ground 21 at the distant station through polar relays 19 and 20. Polar relay 19 is responsive to positive currents only, while relay 20 is responsive to negative currents only. Consequently, the dial impulses from the control station operate relay 19 only, causing contacts 22, 23 to close when the relay coils are energized. Current from battery 26 passes through release coils 32 and 40, but the dashpots 31 and 36 prevent the release latches 30 and 37 from operating. Current from battery 26 also passes through notching relay 27 down through contact 49 to 48 and back to battery 26 through contacts 22, 23. Step by step switch A is advanced by drag 28 a number of points corresponding with the number of dial impulses. Thus three impulses will advance the switch A three notches to point C.

It will be understood, of course, that Figure 1 shows the equipment at one distant station only. If there are ten stations, there will be a duplicate pair of step by step switches at each station, and all the relays 19 and 20 at the stations will be serially connected together. With this in mind, it will be seen that the A switches in all ten stations will be moved to point C on the foregoing operation. All switches will stay on point C until released, as will be explained later.

Now, if the operator at the control station throws switch 15 to contact 14 momentarily, an impulse of negative current passes over the line from battery 17. Polar relay 19 will not respond, but relay 20 will close its contacts 25, 24 as long as negative current comes over the line through switch 15. Current from battery 80 passes through contacts 24, 25, tongue 45 to contact 44 to switch A, thence through contact C and polar relay coil 56 of relay 65 to battery 80 again. Contacts 58 and 59 close, energizing power contactor 60 from battery 80. Heavy contacts 61 and 62 close, thus connecting #1 transmitter 63 to the power supply. The transmitters at all the distant stations are now on the air. It should be noted that polar relay 65 is so adjusted that it will stay in either the open or closed position until the opposite winding is energized. Consequently, now that all transmitters are on the air, the operator at the control station may return all step by step switches at the distant station to zero without stopping the transmitters. He does this by throwing switch 15 to contact 13 and pressing switch 11 for a few seconds. This sends positive current over the line, closing contacts 22 and 23 of relay 19, thereby energizing coils 32 and 40 and pulling down latches 30 and 37 against slow acting dashpots 31 and 36. Switches A and B (if operated) are returned to zero by a spring (not shown). The switches are now in readiness for the next operation. For example, if the operator at the control station wishes to stop all distant transmitters, he dials B, and then sends a negative impulse over the line which energizes winding 57 of relay 65, opening contacts 58 and 59, de-energizing coil 60 and opening contacts 61 and 62, thereby taking all transmitters off of the air simultaneously. If he had dialed A, the negative currents from battery 17 would have operated device 54, which could be either a bell or telegraph sounder for attracting the attention of any maintenance men at the distant station.

So far, I have described only the arrangement for simultaneous operation at all stations. I will now describe the mechanism for performing a selective operation at one station only. Suppose each distant station has two transmitters T_1 and T_2, as shown in the drawings and that all #1 transmitters are on the air, but that the operator wishes to substitute #2 transmitter for #1 transmitter at station #6 only.

The attendant at the control station will dial 6, which sends out 9 impulses and notches all step by step switches #A at the distant stations to point 6. However, point 6 is idle at all stations excepting station #6. At this station, point 6 is connected through a battery 34, coils 42 and 41 back to the switch A. When coil 42 is energized it pulls up contact 48 against the pull of spring 53. Dashpot 51 provides slow action so as to prevent the operation of contact 48 due to momentary currents present when the step by step switch is going past point 6. In this example, the dashpots prevented operation of contact 48 at stations 1 to 5 which it will be assumed had their respective circuits connected individually to one of these contacts. Contact 48 is carried on insulating bushing 47.

In a second or less, lever 48 has broken contact with 49 and made contact with 50. In the meantime, the operator is dialing "B". Relay 19 operates, but coil 27 is open at contact 49 and switch A does not move from point 6. However,

coil 35 is now connected through contact 50, and the two impulses step switch B around two notches to B. Since coil 41 is energized from battery 34, 45 is in contact with 43 and upon receipt of a negative impulse over the transmission line, current from battery 80 passes through contacts 25 and 24, 45 and 43, switch B to contact B, thence to battery 80 through coil 57. This opens contacts 58 and 59 and shuts down transmitter #1 at station #6.

To start up transmitter #2, the operator clears both switches again by sending a long positive impulse. Then he dials "6—2". From the previous description it will be obvious that switch A selected station #6 and that switch B is on point #2, and that a negative impulse over the line will energize coil 67 of polar relay 66. This closes contacts 68 and 69, energizes coil 70, closing power contacts 71 and 72, putting #2 transmitter 73 on the air at station #6 only.

It is obvious that contacts 71 and 72 are sufficient for many functions, since putting power on the transmitter suffices for energizing other contactors, which may switch the antenna from transmitter #1 to #2, turn on the filaments first, and later apply plate power after the filaments have warmed up, etc.

In Figure 1, I have shown only the control equipment at the control point and at one station. Figure 2 has been drawn to schematically show how four distant stations besides the control station, might be connected to the line. Figure 2 also shows some suggestions for telemetering and other indications.

At each distant station in Figure 2 I have shown a repeat coil in the line, indicated by 99—100 for station #1, and 117—118 at station #2. The purpose of these repeat coils is to provide a control path for the direct current without interfering with the normal operation of the line for telephone and telemetering.

The control relays are all in series with the line, as shown. At each station, the rectangle marked "S" corresponds with the selector relay 19 of Figure 1. The rectangle marked "O" is the operations relay corresponding with relay 20 of Figure 1. Likewise, circles marked "A" and "B" correspond with selector switches A and B of Figure 1. The small rectangles 78 and 79 correspond with relay coils 57 and 56 of Figure 1, for example. In general, each pair of rectangles such as 78 and 79 represents a polar relay which is adjusted to remain on either contact corresponding with the last energization of the relay coils. The relay tongue may be connected to put either positive or negative current on the device to be controlled, or may be simply "on" and "off" as desired, as shown in Figure 1. In some cases, it will be desirable to use a polar relay adjusted such that the tongue remains centered until one of the coils is energized. A centered relay would be used for operation of a motor for turning a variable condenser or volume control potentiometer (such as motor 92 of Figure 3, and motor 61 of Figure 2, illustrated in my copending application Serial No. 667,253, filed April 21, 1933, supra).

At the bottom of Figure 2, the letter "R" refers to a receiver, and the letter "T" refers to a transmitter. Signals are picked up by the receiver on one wavelength and are radiated by the transmitter on a second wavelength. The wavelengths are rotated in such a way as to prevent interference. For example, station #1 may receive 80 megacycles and radiate 85 megacycles. Station #2 receives 85 megacycles and radiates 90 megacycles. Station #3 receives 90 megacycles and radiates 80 megacycles, thus starting the cycle all over again. Four or more frequencies may be used if required for the elimination of all interference within the relay chain. Such an arrangement is described in a copending Kroger application Serial No. 611,769, filed May 17, 1932.

At station #1, Figure 2, I have shown one method of telemetering. For example, if the control operator wishes to know whether the receiver at station #1 is delivering the proper modulation level to the transmitter, he would dial 1—5, assuming that the modulation metering equipment is associated with point 5 of the selector switch B. Upon operating relay "O" with a negative pulse from battery 127, the contacts 102 and 103 close and remain closed, energizing coil 101 from battery 104. This connects transformer 92 across the line at 97 and 98 through contacts 93—96 and 94—95.

The transformer primary 81 is permanently tapped across the receiver output. Some of this energy is rectified by rectifiers 83 and 84 and the rectified current passes through resistance 85. Vacuum tubes 89 and 90 are biased to cut off by battery 86 when no current is flowing in resistance 85. Consequently, when the output from the receiver is zero, tubes 89 and 90 are biased to cutoff and oscillator 87 does not produce a tone on the line. However, if the receiver has a definite output, the rectified current through resistance 85, reduces the bias on tubes 89 and 90, allowing the tone from oscillator 87 to be repeated through tubes 89 and 90 and thence to the line through the transformer 91—92 and contacts 94—95 and 93—96. The intensity of the tone is a measure of the receiver output. This tone may be read on the volume indicator 127 at the control station. By reference to a calibration chart, the operator can determine how many volts output there is from the receiver at station #1.

If the operator finds that the receiver output is low, for example, he can dial a combination which allows him to adjust a motor driven potentiometer which raises the output from the receiver and thereby increases the modulation level on the associated transmitter. One means for accomplishing this result is shown in Fig. 3.

In Fig. 3, the corresponding elements are labeled with the same identification numbers as in Figure 2. In Fig. 3, it is assumed that the operator dialed 1—5. This operation selected station #1 on selector switch A, and point #5 on selector switch B. Upon receipt of the negative impulse from the control station, relay 74 operated and sent current from battery 169 through winding 157 of biased relay 174, throwing tongue 159 to contact 160. This passes the tone from oscillator 87 through filter 162 to the line, thence to the control station where the tone passes through filter 166, amplifier 167, rectifier 168 and registers on meter 129.

If the operator finds from the indication of meter 129 that the receiver output at station #1 is low, for example, he clears the selector switches 76 and 77, and dials 1—6. Since relay 174 is biased to stay in the last operated position indefinitely, tongue 159 remains in contact with 160 and the tone continues to pass to the line. The new dialing operation has selected station #1 on the A selector switches and point 6 on the B selector at station #1. By making contact between 123 and 125 at the control point, the operator sends a negative current over the line from battery 127

which operates relay 74 and sends current from battery 169 through point 6 of switch 77 to winding 150 of relay 148. The tongue 151 is pulled over against contact 153 and sends current from battery 155 through the armature 147 of a motor which turns the potentiometer contact 141 through shaft 142 in a clockwise direction, which raises the output level of the receiver, which in turn is registered on meter 129 at the control station. As soon as the desired level is reached, the operator breaks the contact between 123 and 125 at the control station and restores the selector switches at the distant stations to their initial position.

On the other hand, if the receiver output had been high, the operator would have dialed 1—1, in which case the winding 149 of relay 148 would have been energized, pulling tongue 151 against contact 154, thereby putting current of opposite polarity through armature 147. Since the field 145 of the motor is always supplied in one polarity by battery 146, the motor will turn in a counter clockwise direction and decrease the output from the receiver.

It should be noted that the tongue of relay 148 is centered by spring 152 and, consequently, only makes contact with 153 or 154 when the negative current is sent over the line by manipulating the contact between 123 and 125 at the control station. In some cases the spring 152 is not required, as many polarized relays can be adjusted such that the tongue will remain centered when no current flows in the windings.

It is also obvious that a reduction gear, worm gear, or friction disc may be used between motor armature 147 and potentiometer arm 141 to obtain as fine control as may be desired. It is also obvious that batteries 146, 155 and 156 may be replaced by a single battery if the relay is designed to operate a double contact such that the polarity to the motor armature is reversed in the two positions of the relay. (See Fig. 3 of my copending application, Serial No. 667,253, supra.)

At station #2, Fig. 2, I have shown a device for indicating "no radiation." Coil 106 tuned by condenser 107 is coupled to the antenna. The radio frequency picked up by coil 106 is rectified by crystal rectifier 108 and the rectified current passes through relay coil 109. The relay coil is by-passed for radio frequency by condenser 110. The rectified current holds the relay contacts 112—113 open. However, if the radiation fails for any reason, the rectified current falls to zero and spring 111 closes contacts 112—113, connecting oscillator 114 to the line at 115—116. The oscillator tone is registered at the control center on frequency meter 130, and at the same time may be utilized to ring an alarm bell at the control center by a simple rectifier-relay device, which is not shown on account of its obvious nature. Each station may be provided with an oscillator of different frequency, as, or example, 425 cycles for station #1, 595 cycles for station #2, 765 cycles for station #3, etc. (Odd harmonics of 85 cycles, corresponding with standard band pass filters used on voice frequency carrier telegraph systems.) Thus, in the case cited in Figure 2, a frequency of 595 cycles would be indicated on the frequency meter 130, informing the control operator that station #2 had failed. He would immediately dial 2—2 and start up transmitter #2 at station 2 (see Figure 1).

The monitoring filter arrangement is shown in greater detail in Fig. 3. At station #1 filter 162 is a band pass filter adjusted to pass 425 cycles, for example. At the control station filter 166 is also adjusted to pass 425 cycles. Consequently, meter 129 registers the receiver output level at station #1 only.

In like manner filter 163 at station #2 and filter 171 at the control station are adjusted to pass say 765 cycles. Consequently, meter 170 registers only the receiver output level of station #2. By using a suitable series of filters, independent and simultaneous levels at a multiplicity of relay stations may be continuously or intermittently registered at the control station.

It is obvious that all of the telemetering circuits could be set up continuously, if desired, in which case it would not be necessary to operate the dial switches to obtain telemeter readings. However, in some cases, it might be desirable to dial for the telemeter indications using portions of the same equipment for reading other indications at the remote stations, such as transmitter antenna current, for example.

It is obvious that a telemeter system indicating the conditions at all remote stations simultaneously, is a means in itself of determining which station has failed, and also serves as a check back to the control station indicating whether a given selective operation has been performed successfully by the operation of the selective switches.

It is obvious that this double selector system is extremely flexible and an almost infinite number of combinations could be worked out. However, from the description given above, many useful combinations will be obvious, and it is merely confusing to attempt to draw out too many of them.

While I have shown the use of positive and negative currents for operating the selector and operations relays, it is obvious that two tones could have been used along the line suggested in my copending application Serial No. 667,253 supra. The two tones could be operated over a radio circuit as well as a wire line, as per the above mentioned docket.

In Figure 2, there is shown an oscillator 87 at station #1. This oscillator can also perform the "no radiation" function as described for oscillator 114 at station #2. In fact, if each station has its own identifying oscillator frequency, it is possible to continuously read the modulation levels of all stations from the control center. This can be accomplished by switching on the modulation indicator devices at all stations. Then each station would send its characteristic frequency back over the line to the control center. These frequencies would be separated by band-pass filters at the control center, and the output could be indicated on separate volume indicators, one for each station. Thus, the control operator could monitor the whole system at a glance, since the volume indicators would show the receiver output or modulation level at all stations. This modification is shown in Figure 3. Instead of using amplitude variations for registering telemeter readings, frequency shift methods could be used. A suitable means for accomplishing telemetering by frequency shift methods is disclosed in my copending application, Serial No. 722,888, filed April 28, 1934.

In summarizing, the following has been shown in this specification:

1. There is disclosed a system for indicating which station fails should a transmitter go off the air.

2. There is also disclosed a system for either selective or simultaneous monitoring of any

desired function such as modulation level or receiver output. The same telemetering arrangement could be used for measuring any other desired quantity such as antenna current.

3. Means are also shown for controlling certain functions, such as starting the transmitters, such that all stations may be controlled simultaneously or individually, as desired, by merely dialing the proper combination.

This disclosure also shows a reversed current (or two tone) method of selectively operating two relays.

The biased type relay would be used for such functions as turning on and off a transmitter or receiver, for setting up a volume indicator circuit, or for any function which it is desired to set up for some length of time while the selector switches are manipulated for other operations or adjustments.

The zero center type of relay would be used for momentary operations such as controlling a motor which, in turn, adjusts a tuning device, or a potentiometer for setting the modulation levels. It would also be used for operating bells or telegraph sounders, or other devices requiring intermittent and controllable interruptions.

It is believed that this general arrangement or some modification of it, may render it practical to operate a chain of relay stations economically, whereas, otherwise the cost of personnel would render the system uneconomical.

I claim:

1. In a radio signalling system, a line, a control station and a remote station associated with said line, a first and a second selector switch at said remote station, a first transmitter and a second transmitter at said remote station, and means at said remote station responsive to signals from said control station for setting said switches, said first switch being arranged to condition said remote station for operation over said first transmitter, said second switch being operable in dependence upon said first switch for conditioning said remote station for operation over said second transmitter.

2. In a radio signalling system, a line, a control station and a remote station associated therewith, a first and a second selector switch at said remote station, a first transmitter and a second transmitter at said remote station, a signalling dial at said control station, and polar relay mechanism at said remote station responsive to dial signals from said control station for setting said switches, said first switch being arranged to condition said remote station for operation over said first transmitter and said second switch being arranged to condition said remote station for operation over said second transmitter, and means for advancing one of said switches only subsequent to the advancement of said other switch to a predetermined position.

3. In a radio signalling system, a line, a control station and a remote station associated therewith, a first and a second selector switch at said remote station, a first transmitter and a second transmitter at said remote station, keying means at said control station for transmitting signal impulses over said line, polar relay mechanism at said remote station responsive to a predetermined number of said signal impulses for setting said first selector switch a plurality of times and for conditioning said remote station to operate over said first transmitter, said relay mechanism being responsive to a different number of signal impulses for setting said first switch to a predetermined location and for subsequently setting said second selector switch and for conditioning said remote station to operate over said second transmitter.

4. In a radio signalling system, a transmission medium, a control station and a plurality of remote radio relaying stations associated with said transmission medium, each of said remote stations being arranged to receive a signal on one antenna and to transmit the signal to its next adjacent relay station on another antenna, and means at said relaying stations responsive to signals from said control station for conditioning said stations for transmission.

5. In a radio signalling system, a transmission medium, a control station and a plurality of remote radio relaying stations associated with said transmission medium, step by step selector switches at said remote relaying stations adapted to be advanced to any one of a plurality of positions, and means at said remote relaying stations responsive to signals from said control station for setting said selector switches for conditioning said relaying stations simultaneously for transmission.

6. In a radio signalling system, a transmission medium, a control station and a plurality of remote radio relaying stations associated with said transmission medium, selector switches at said remote relaying stations, a plurality of circuits associated with each of said selector switches, said switches being arranged to select any one of said plurality to the exclusion of the other circuits, and means at each of said remote relaying stations responsive to a predetermined group of signals from said control station for setting its associated selector switch for conditioning its relaying station for transmission and responsive to another signal from said control station for restoring its relaying station to normal.

7. In a radio signalling system, a transmission medium, a control station and a plurality of remote relaying stations associated with said transmission medium for relaying signals between the remote stations, two transmitters at each remote relaying station and means for conditioning from said control station any or all of said remote radio relaying stations for transmission over one or the other of the two transmitters at the respective stations.

8. In a radio signalling system, a transmission medium, a control station and a plurality of remote radio signalling stations associated with said transmission medium for relaying signals by radio between said remote stations, a radio receiver at each of said relaying stations, and means at each of said relaying stations associated with the output of its associated radio receiver for transmitting over said transmission medium a characteristic frequency whose intensity varies with the modulation level of said output, and a visual indicating device at said control station responsive to variations in said characteristic frequency for indicating said variations.

9. In a radio signalling system, a line, a control station and a remote radio relaying station associated with said line, a radio receiver at said relaying station a portion of whose output is in circuit with said line, a source of oscillations at said remote station and thermionic circuit apparatus at said relaying station responsive to the modulation level of the output of said receiver for enabling said source of oscillations to be connected to said line and a meter at said control station associated with said line and responsive

to the receipt of said oscillations for indicating the modulation level of said receiver.

10. In a radio signalling system a line, a control station and a plurality of remote radio relaying stations associated with said line, radio receivers at said relaying stations, and means at each of said relaying stations associated with the outputs of the respective receivers for transmitting over said line frequencies which are characteristic of the individual relaying station, the intensities of the frequencies varying with the modulation levels of said respective receiver devices, and indicating means at said control station responsive to the receipt of said characteristic frequencies.

11. In a radio signalling system, a transmission medium, a control station and a remote radio signalling station associated with said transmission medium, a radio receiver at said relaying station, and means at said relaying station associated with the output of said radio receiver for transmitting over said transmission medium a characteristic frequency whose intensity varies with the modulation level of said output, and an indicating device at said control station responsive to said characteristic frequency, and means at said relaying station responsive to signals from said control station for changing the volume of said receiver output.

12. In a radio signalling system, a transmission medium, a control station and a remote relaying station associated with said transmission medium, a radio transmitter and a source of oscillations for generating a characteristic frequency at said remote station, and means at said remote station responsive to failure of radiation from said transmitter for transmitting over said medium oscillations of said characteristic feaquency from said source, and an indicating device at said control station in circuit with said medium responsive to the oscillations of said characteristic frequency.

13. In a radio signalling system, a transmission medium, a control station and a remote relaying station associated with said transmission medium, a radio transmitter at said remote station, a tuned circuit and a rectifier coupled to said transmitter, a relay connected to said rectifier and adapted to be energized by rectified currents, a source of oscillations, said relay being arranged only when de-energized to connect said source to said medium, and an indicating device at said control station responsive to said oscillations in circuit with said medium.

14. In a radio signalling system, a transmission medium, a control station and a remote relaying station associated with said transmission medium, a source of oscillations at said remote station, and means at said remote station responsive to a predetermined circuit condition for transmitting over said medium oscillations of a characteristic frequency from said source, and indicating means at said control station responsive to said oscillations.

15. In a radio signalling system, a transmission medium, a control station and a remote radio relaying station associated with said transmission medium, a radio receiver at said relaying station, a source of oscillations, and means at said relaying station in circuit with the output of said radio receiver for associating said source of oscillations with said transmitting medium as a measure of the modulation level of said output, and an indicating device at said control station responsive to the oscillations from said source.

16. In a radio signalling system, a transmission medium, a control station and a remote relaying station associated with said medium, a polar relay at said remote station responsive to only a particular type of signal, means at said control station for transmitting said type of signal over said medium for actuating said relay, a first selector switch at said remote station operable to any one of a plurality of positions in response to the operation of said polar relay, means for holding said switch in any of the positions selected, a circuit including electromagnetic means connected to one of the positions selectable by said switch, said electro-magnetic means being automatically operable in response to the movement of said switch to said one position, a second selector switch similar to said first switch whose operating path is under control of said electro-magnetic means, the advance movement of said second switch being under control of said polar relay subsequent only to the closure of said operating path by said electromagnetic means.

17. A system in accordance with claim 16 characterized in this, that the closure of the operating path of said second selector switch functions to open the operating path of said first selector switch.

18. In a radio signalling system, a transmission medium, a control station, and a remote relaying station associated with said transmission medium, radio transmitting equipment and a relay at said remote station, said relay being under control of said transmitting equipment, a source of oscillations also at said remote station, said relay being responsive to the failure of said radio transmitting equipment for connecting said source to said medium.

19. A signalling system comprising a plurality of radio stations situated at intervals, a source of oscillations at each of said radio stations, each of said sources generating oscillations of a frequency which is characteristic of its associated radio station, the charactertistic frequencies being different, a transmission medium multiply associated with said radio stations, and means remotely operable for selectively associating the source of oscillations at any one radio station with said medium.

20. A signalling system comprising a plurality of radio stations situated at intervals, a source of oscillations at each of said radio stations, each of said sources generating oscillations of a frequency which is characteristic of its associated radio station, the characteristic frequencies being different, a transmission medium multiply associated with said radio stations, and means remotely operable for associating simultaneously the sources of oscillations at said plurality of radio stations with said medium.

21. A signalling system comprising a plurality of radio stations situated at intervals, a source of oscillations at each of said radio stations, each of said sources generating oscillations of a frequency which is charactristic of its associated radio station, the characteristic frequencies being different, a transmission medium multiply associated with said radio stations, and means remotely operable for associating simultaneously or selectively the sources of oscillations at said radio stations with said medium, and meters remotely located with respect to said radio stations

for indicating the existence of said oscillations on said medium.

22. In a radio signalling system, a transmission medium, a control station and a plurality of remote radio relaying stations associated with said transmission medium, each of said remote stations being arranged to receive a signal on one antenna and to transmit the signal to its next adjacent relay station on another antenna, means at said relaying stations responsive to signals from said control station for supplying to said transmission medium energy which is characteristic of a particular condition at said stations, and at least one indicating arrangement at said control station responsive to said energy.

HAROLD H. BEVERAGE.