FIP8102 OR 2,112,877

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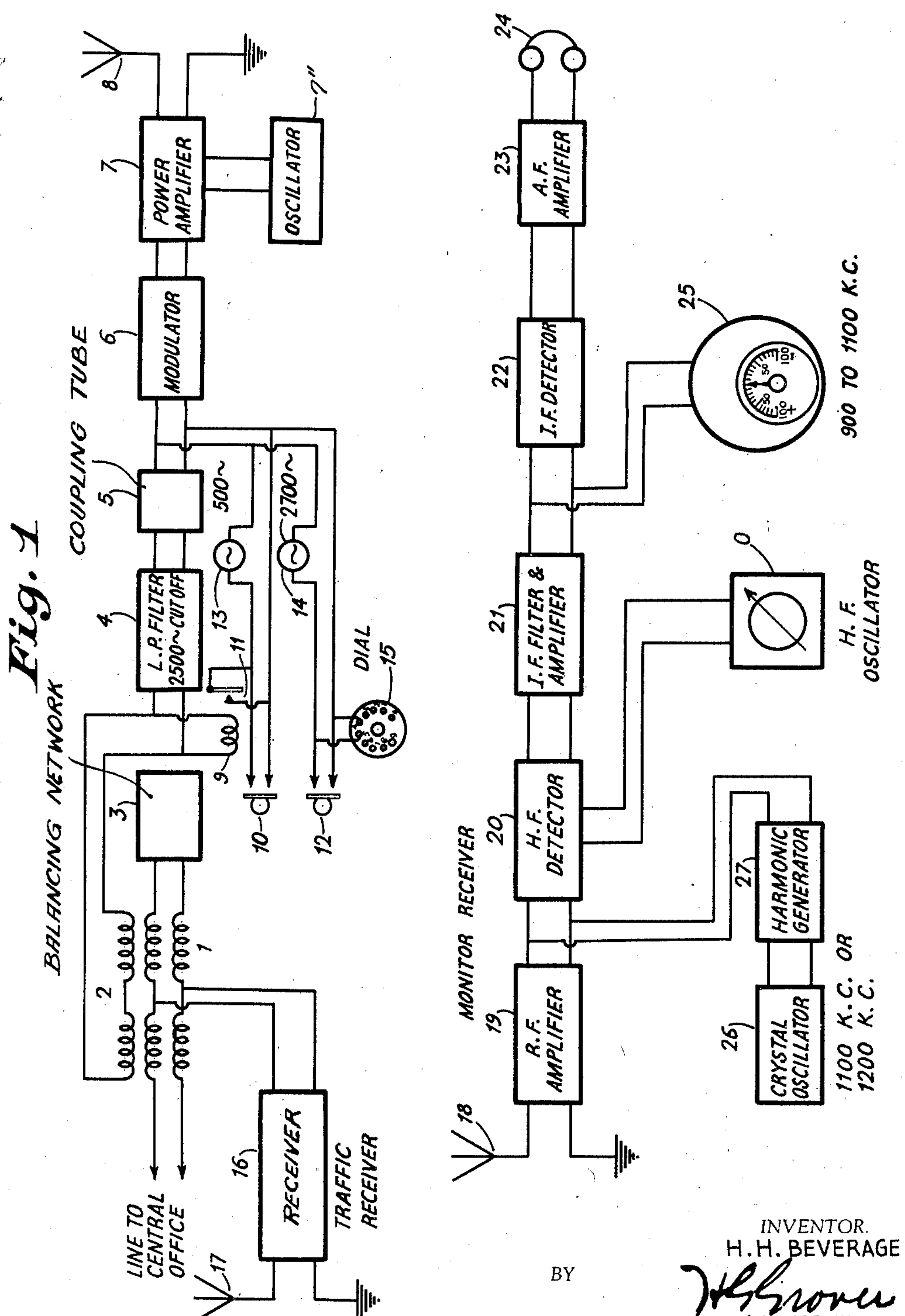
April 5, 1938. H. H. BEVERAGE 2,112,877

CENTRALIZED CONTROL

Original Filed April 21, 1933 3 Sheets-Sheet 1



INVENTOR.
H.H. BEVERAGE

BY [signature]

ATTORNEY.

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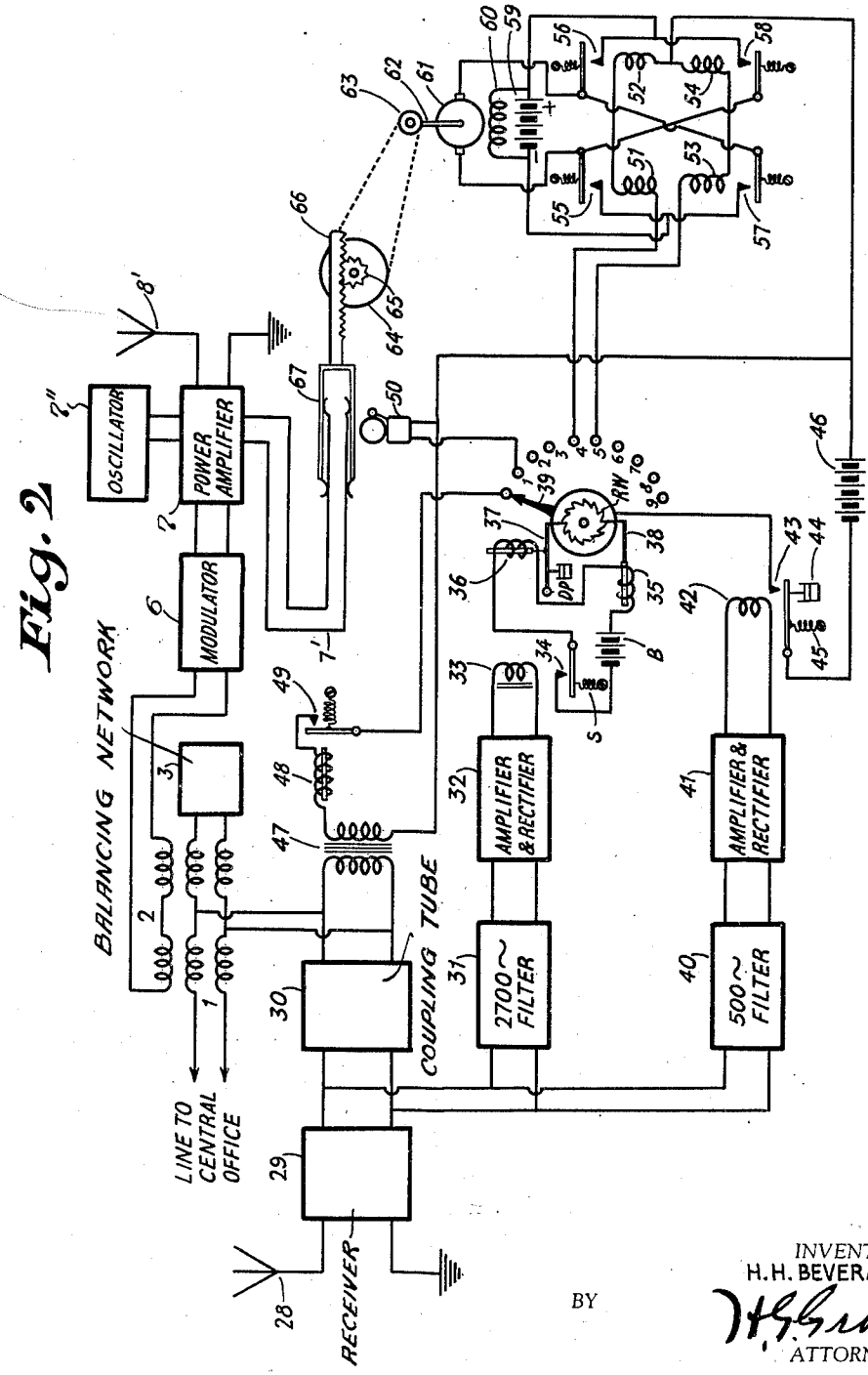
April 5, 1938. H. H. BEVERAGE 2,112,877

CENTRALIZED CONTROL

Original Filed April 21, 1933 3 Sheets-Sheet 2

Fig. 2



INVENTOR.
H.H. BEVERAGE
BY
ATTORNEY.

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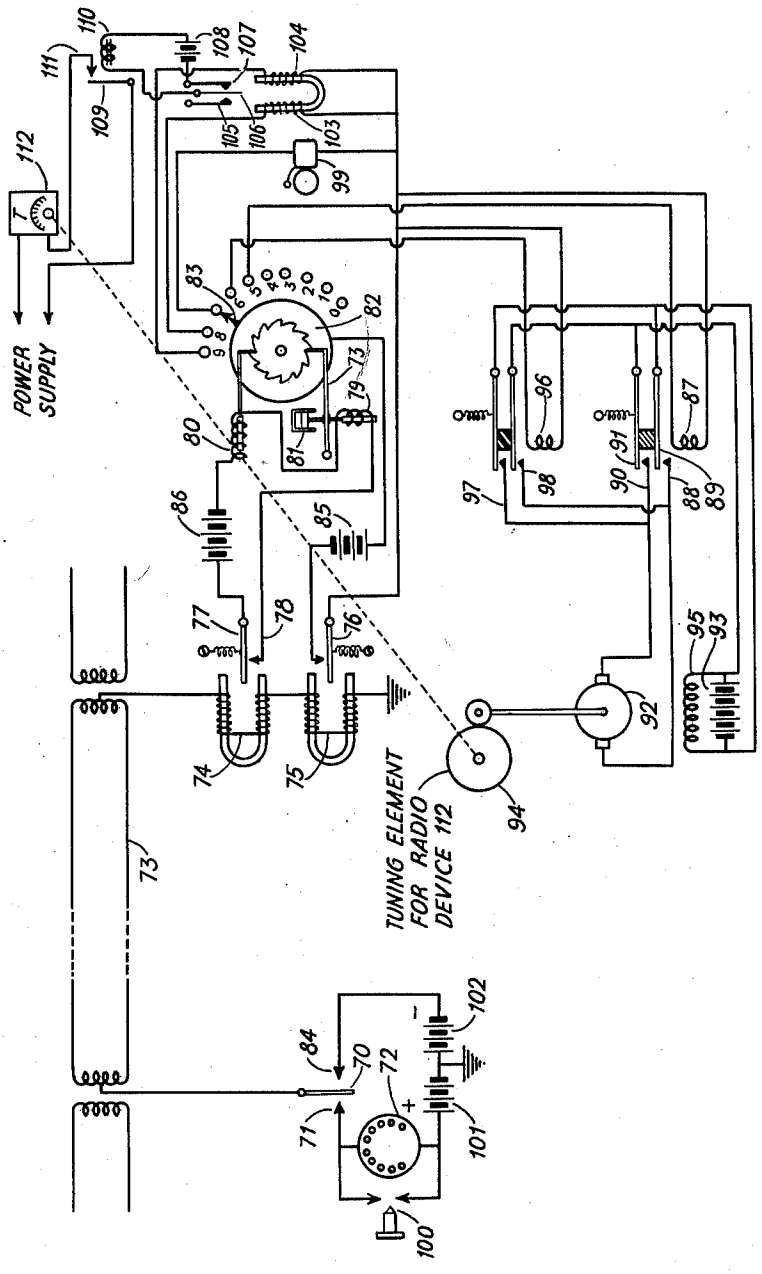
CENTRALIZED CONTROL

Original Filed April 21, 1933 3 Sheets-Sheet 3

Fig. 3



INVENTOR.
H.H. BEVERAGE

BY

ATTORNEY.

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Patented Apr. 5, 1938

2,112,877

UNITED STATES PATENT OFFICE

2,112,877

CENTRALIZED CONTROL

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

Original application April 21, 1933, Serial No. 667,253. Divided and this application August 8, 1935, Serial No. 35,260

11 Claims. (Cl. 250—2)

The invention disclosed in my U. S. application Ser. No. 667,253, Patent #2,076,361 dated April 6, 1937, relates to a novel method of and circuit arrangement for producing oscillations by means of a quartz crystal oscillator, and utilizing said oscillations as a frequency standard to produce harmonics as markers throughout the radio frequency spectrum covering the different frequencies used in the signalling system. The standard frequencies and the harmonics thereof are utilized in accordance with the present method and circuit for checking the frequency of any or all of the transmitters of the system and for producing indications of the amount by which the transmitters have deviated from their assigned frequency. This determining of the frequency of the transmitters is accomplished by a novel and simplified method and circuit which eliminates the necessity of interpolations between harmonics.

This application, which is a division of said application Ser. No. 667,253, Patent #2,076,361 dated April 6, 1937, involves a method of and circuit for controlling from a remote point any of the transmitters of the system. The object of the remote control is to eliminate the necessity of attendance at some of the transmitters. By means of the method of remote control and circuit therefor of the present invention the circuit at the remote control may be turned on or off, the attendant at the transmitter may be called, or any central station may send ring calls over the control circuits to any other central station.

A particular feature of the present invention is a novel method of and circuit for tuning any or all of the transmitters of the system back to their assigned frequency if my method of and circuit for checking the frequency of said transmitters, as described in the second preceding paragraph, shows that such transmitter or transmitters are off their assigned frequency.

In connection with the ultra short wave Inter-Island telephone system which the Mutual Telephone Company has installed in the Hawaiian Islands, I have suggested certain equipment and certain ideas for the purpose of facilitating the adjustment and the maintenance of the entire radiotelephone network from a common station. The Mutual Telephone Company were anxious to obtain a system which could be left relatively unattended at the outlying islands; they desired means for quickly checking the frequency of all of the transmitters in the system to see that they were on their proper frequencies.

I proposed obtaining frequency assignments from the Federal Radio Commission which corresponded with the harmonics of a single quartz crystal oscillator. By the use of such a device, the harmonics of the oscillator would light exactly on the assigned frequencies of the transmitters and if the transmitters were on frequency, they should beat with the proper crystal harmonic at the control station. If it should then be found that the transmitter did not beat with the crystal harmonic, it would be an indication that the transmitter was off frequency and it would then be desirable to obtain an approximate measure of how much the transmitter was off frequency and to further have some means by which the transmitters could be put back on frequency by remote control from the control station.

I propose to put the transmitters back on frequency by remote control through a system of step by step dial selectors and an on-off relay control. In order to accomplish these two functions, I propose to use two separate audio tone frequencies which may be sent out over the radio circuit by modulating one of the local transmitters. One of these tones will be used to operate the dial selector at the distant point, while the second tone would be used to operate a simple on-off relay after the proper point had been selected on the dial, thereby operating a motor, for example, which would tune the transmitter back on to its proper frequency.

In the prior art, it has been customary to use a quartz crystal oscillator as a frequency standard and to use the harmonics of this oscillator as markers throughout the radio frequency spectrum over which it was desired to make measurements. A comparatively complicated arrangement was required to interpolate between these harmonics in order to accurately determine the frequency of a station which lay between a particular pair of harmonics. A universal method of making this interpolation has been described in United States application Serial No. 535,910, filed May 8, 1931, Patent #2,070,950 dated February 16, 1937. In the present invention, it is not necessary to interpolate between harmonics and the only requirement is, that a simple means be provided for approximately determining a small frequency change close to one of the harmonics. A means for accomplishing this result is quite simple and will be described in more detail later.

In regard to the second feature of this invention, that is, the remote control idea, it has been the usual practice to have an attendant at each of the transmitting stations to maintain the

transmitter in proper adjustment on its assigned frequency. By means of the invention described herewith, continuous attendance at the transmitter is not required since the adjustments which must be most frequently made, can be made from a remote control center.

The novel features of my invention as required by law have been pointed out with particularity in the claims appended hereto.

The method of determining the frequencies and of controlling the stations of the system from any one of a plurality of remote points, and circuits for carrying out the same, will be understood by the following detailed description thereof and therefrom when read in connection with the attached drawings, in which:

Figure 1 shows diagrammatically a control station including the regular traffic receiver, a transmitter connected therewith, and the frequency checking receiver and crystal oscillator which forms a feature of the present invention;

Figure 2 shows a controlled station at a remote point; while,

Figure 3 shows a modification of the prior arrangements.

In Figure 1, I have shown the equipment required at the central control station. A monitor receiver including an aerial **18**, radio frequency amplifier **19**, demodulator **20**, of the heterodyne type, oscillator O, intermediate frequency amplifier **21**, etc., is shown. The receiver may be tuned to the frequency of any of the transmitters in the radiotelephone network. The transmitters in this network are set up with a uniform frequency spacing, such that their frequencies correspond with the harmonics of a crystal oscillator **26**. The output of the crystal oscillator is amplified and applied to a negatively biased tube in the harmonic generator **27**. I need not describe this harmonic generator in detail, as it has already been described in United States application No. 535,910, filed May 8, 1931, Patent #2,070,950 dated February 16, 1937, referred to above.

In operation, the detector **20** is tuned to a desired harmonic of 26, e. g. the frequency to which the transmitter it is desired to check is tuned. The calibrated intermediate frequency oscillator **25** is set to the frequency corresponding with the mid-band frequency of the intermediate frequency filter and amplifier **21**. Now, the local H. F. oscillator O is adjusted until it produces a beat frequency with the desired harmonic of crystal oscillator **26** equal to the mid-band frequency of the I. F. filter and amplifier **21**. The proper adjustment of oscillator O is indicated in telephones **24** by zero beat between the intermediate frequency and the calibrated oscillator **25**. The operator now turns on the receiver **19**, and may turn off **25** without disturbing the setting thereof. Now, if the monitor receiver **18**, **19**, etc. is tuned to the said one of transmitters of the network, the transmitter frequency and the crystal harmonic frequency corresponding to this transmitter frequency should and would be the same if the transmitter is on its assigned frequency. The two frequencies are applied to the high frequency detector **20**, where they are combined to produce a lower frequency, i. e., the difference frequency, and are amplified by the intermediate frequency amplifier **21**, which may, for example, be tuned to 1000 kilocycles. If the transmitter frequency and the crystal harmonic are close together, they will be detected in the intermediate frequency detector **22**, and will be amplified by audio frequency amplifier **23**, and the beat note between them will be audible in telephone **24**. The transmitter could at this point be retuned by my remote control means to its assigned frequency, thus bringing the beat note in **24** to zero. If, however, the transmitter has drifted off frequency more than 10 or 15 kilocycles, no beat will be heard in telephone **24**, and it will be necessary to put oscillator **25** into operation. This oscillator is calibrated over a range of say 900 to 1100 kilocycles. If the oscillator **25** is set at 1000 kilocycles, and the oscillations in the output of the high frequency detector **20** have been adjusted as described hereinbefore by adjusting O until the proper harmonic from crystal oscillator **26** is heard at zero beat in telephone **24**, then a simple adjustment or resetting of oscillator **25**, will give an approximate measure of the difference in frequency between the crystal harmonic and the transmitter frequency. This adjustment merely consists in raising or lowering the frequency of oscillator **25** until it is at zero beat with the transmitter. If, for example, the transmitter zero beat occurred, on setting **25**, at 980 kilocycles, then we would know that the transmitter was 1000 minus 980, or 20 kilocycles below its assigned frequency. Conversely, if the oscillator **25** had indicated 1020 kilocycles to produce zero beat with the transmitter, then the transmitter would have been 20 kilocycles above its assigned frequency.

The device described above permits the operator at the control station to ascertain in a simple and novel manner whether the transmitters of the system are on their assigned frequencies.

If a transmitter has shifted from its assigned frequency it may be brought back into tune by the novel device described hereinafter.

In Figure 1, I have also indicated the incoming line from the central office terminating in the hybrid coil **1**, with a balancing network **3**. The incoming signal from one of the distant stations would be received on antenna **17** and receiver **16** and applied to the midpoint of the hybrid coil where the energy is divided between the line to the central office and the network. The output from the receiver then divides equally between the line and the network, so that no energy is induced in winding **2**. Winding **2** is the output of the hybrid coil and carries the voice from the line to the control office over to the transmitter which is represented as including the essential elements comprising a high frequency oscillator **7''**, a modulator **6** and power amplifier **7**. The voice frequency currents are passed through a low pass filter **4** and coupling tube **5**, for reasons which will be described later. There are also two oscillators **13** and **14**, the oscillations from which may be applied to the modulator **6** for the purpose of controlling circuits at the remote station. The oscillator **14** produces a tone which is utilized at the remote station to actuate a circuit selector relay. The oscillator **13** produces a tone which is used at the remote station to actuate a control relay. The invention is not limited to the frequencies selected since, obviously, other frequencies may be used.

If the dial **15** is operated it keys the 2700 cycles oscillator **14** and sends this modulated interrupted tone out over the transmitter **6**, **7**, and **7''**. At the remote station shown in Figure 2 this modulated signal is picked up on antenna **28** and receiver **29** and the 2700 cycle tone is selected by band pass filter **31**, and is further amplified and

250. RADIANT ENERGY
Search Room

rectified at 32, and is applied to a quick acting selector control relay 33. The contacts 34 of this relay 33 are held open by a spring S but the relay will close in accordance with the impulses sent out from the control station by means of the dial. Closing the contact 34 of this relay connects two relays 35 and 36 with the energy source B. Thus the relay 33 actuates the two other relays 35 and 36. Relay 36 is a holding relay which actuates the holding pawl 37 and its operation is made slow by means of a dashpot DP. Relay 35 is rapid acting. When an impulse at 2700 cycles comes in the relay 33 closes its contact 34 in response to said impulse resulting from operation of dial 15. Relay 35 is energized and operates and pulls the drag 38 and moves the ratchet wheel RW in a clockwise direction one notch. The ratchet wheel RW is then held in position by the latch or pawl 37. If a second impulse of 2700 cycles is then received, the ratchet wheel switch is notched up one more point. It is obvious that the ratchet wheel switch will be advanced a number of points corresponding with the number of impulses at 2700 cycles sent over the circuit by the dial 15 at the control station, and, that the switch 39 will be held stationary on the final notch by the latch or pawl 37.

Now, if the oscillator 13 of Figure 1 is energized by closing switch 10, a 500 cycle tone is sent over the radio circuit where it is selected by band pass filter 40 and is amplified and rectified at 41 and operates control relay 42. This relay is also slow acting on account of dashpot 44. This may not be necessary in some cases, but the slow action of relay 42 is a means of assuring that the relay will not be operated by momentary voice currents which might come through the filter 40 when the circuit is being used for conversations. After the 500 cycle tone has been on for a period sufficient to close the contacts 43 of relay 42, current will flow from battery 46 through the selector switch arm 39 to whatever mechanism may be associated with the particular contact on the selector switch which has previously been dialed. For example, if the operator at the control station dials #1 a single pulse of 2700 cycles would go out from 8, be received at 28, and pass through 31 and 32 to actuate 33 to move the ratchet wheel RW one step so that contact 39 comes to rest on contact #1 to close the circuit including 46 and bell 50 at this point. Then when switch 10 of Figure 1 is operated to send out a 500 cycle pulse long enough to close contact 43, the circuit through 50, 46 will be closed and the bell 50, which might be placed in the living quarters of the attendant, for example, will ring. This serves to call the attendant to the transmitter room in case of necessity. If the control operator wishes to correct the frequency of the transmitter, he may dial #4. This may send out four 2700 cycle pulses, which will be received by 28. These pulses will advance the wheel RW forward four steps so that 39 would come to rest on contact #4 to close at this point the circuit through source 46 and relay windings 51 and 52. Now, if the operator presses switch 10, a 500 cycle note will be sent out and 42 will be energized to close 43 and current from battery 46 will energize relay windings 51 and 52 to close contacts 55 and 56. When the contacts 55 and 56 of these two relays close, they put the armature of the motor 61 across the battery 59 and the motor then revolves in one direction, such as, for example, the direction necessary to raise the frequency of the transmitter. It should be noted that the field of this motor, shown at 60, is permanently connected across the battery 59.

If the operator at the control station had desired to lower the frequency of the distant transmitter, he would have dialed #5 and then the operation of the on-off relay 42 would have operated relays 53 and 54. This would have closed contacts 57 and 58, putting the armature of the motor 61 across the battery 59 with the polarity reversed so that the motor would operate in the reverse direction and lower the frequency of the transmitter.

It is obvious that the rotation of the motor 60, 61 may produce or cause frequency control in many ways, such as by operating a variable condenser or a variable inductance, etc. The particular arrangement used in the Hawaiian Islands, however, is the long line control method and for the purpose of adjusting the frequency, a trombone tube 67, connected by line 7' to power amplifier 7, has been connected with a rack 66 and a pinion 65. Rotary motion of wheel 64 will decrease or increase the electrical length of the long line 67 and raise or lower the frequency of the power amplifier 7. The wheel 64 may be driven by the motor in any manner. I have shown the wheel 64 as being driven by a belt, which in turn is driven by a pulley on the shaft 62 of the motor.

After an operation has been completed, as, for example, adjusting the frequency of the transmitter, or calling the attendant by ringing the bell 50, the selector switch can be returned to the zero point by pressing the switch 12 of Figure 1. This sends out a continuous 2700 cycle tone which energizes 33 continuously and holds relay contact 34 closed. This enables the slow acting relay 36 to operate so that it finally pulls up latch or pawl 37 and allows a spring, not shown, to return the wheel RW and contact arm 39 to the zero point of the selector device. The selector switch is now in readiness for dialing any other combination that may be desired.

Since the operation of the whole system depends upon the position of the selector switch contact arm 39, it would be highly undesirable for this switch to be operated by stray currents. Since the relay 33 must be quick acting, it is not possible to protect it against operation by momentary voice currents with a dashpot as was done in the case of relay 42. To avoid this difficulty, I propose to use a low pass filter 4 at the control station, which cuts off everything above 2500 cycles, so that no voice currents will exist at 2700 cycles, which might get through the band pass filter and operate the selector relay at the remote station. The coupling tube 5 being a one-way device, prevents potentials originating in 13 and 14 from acting through 4 on the voice currents in channel 2, 1.

Incidentally, in connection with the operation of the slow relay 42, of Figure 2, it should be pointed out that the relay is forced to close slowly on account of the dashpot 44, but it must open quickly in order that it may return to its starting point. This switch is opened by the tension on the spring 45.

I have also shown means which will enable the operator, at one central office, to ring over the radio circuit to the operator at a remote station. The ringing current from the central office, connected with the control station of Figure 1, sends ringing current over the line which operates relay 9 of Figure 1 to close contact 11. This relay is slow opening, so that as long as the winding of

relay 9 is energized by ringing current, the contacts 11 will remain closed, thus sending a long continuous dash of 500 cycle modulation out over the air.

At the remote station shown in Figure 2, the ratchet wheel RW will not have been moved and it will be resting in a position such that 39 is on the zero point. The long dash of 500 cycle modulation will energize the winding of the slow acting relay 42 and close 43, thereby completing a circuit through 46 and energizing buzzer 48 with energy from battery 46. The contacts 49 under the magnetic action of 48 will then open and close intermittently as in the case of an ordinary buzzer. The armature of this buzzer should be loaded mechanically so that it will vibrate at a period of, say, 16 cycles per second, corresponding with the normal ringing currents. The output from this buzzer passes through transformer 47 onto the midpoints of the hybrid coil 1 and thence to the central office at the remote station, where it signals the operator in the normal manner. In order to keep this buzzer current from exciting the band pass filters 31 and 40 and thereby causing false operation of the relays, I have shown a coupling tube 30 which isolates the filters from the ringing current. It is obvious that the operator at the control station would have rung long enough for the relays to operate at the remote station, but the relays could be adjusted such that if the operator rings for three or four seconds, the relays will operate and at the same time will still give the desired protection against false operation by momentary voice currents.

At the remote point of Figure 2 four different operations may be carried out, as described hereinbefore in connection with Figure 2.

1. The attendant can be called by sending out a single 2700 cycle impulse and a 500 cycle dash.

2. The circuit for raising the frequency of the transmitter 8' at the remote point may be prepared by sending out four 2700 cycle impulses to actuate the ratchet wheel and close the circuits through 51, 52 so that the 500 cycle tone may be sent out to tune the transmitter.

3. The circuit for lowering the frequency of 8' may be completed by sending out five 2700 cycle impulses before the 500 cycle tuning impulses are sent out.

4. Ringing current may be sent out to all remote stations from the control station by sending from the control station ringing current to close 11.

It is obvious that several other functions could be added. For example, the first operation of calling the attendant could be arranged for starting up the transmitter, while operation two might be arranged for stopping the transmitter. A sixth operation could be used for increasing the gain of the audio frequency energy supplied to the modulator, while a seventh operation could be arranged for decreasing the gain of the audio frequency supplied to the modulator. I have not shown these functions, as the means for carrying them out is perfectly obvious and it would unnecessarily complicate an understanding of the diagram if these functions were shown in detail.

While I have shown a remote control means applied to a radio circuit, it would be possible to apply the same mechanism for operation over a land line. I have shown such a modification in Figure 3. In this case, instead of using two frequencies, I propose to use currents of two polarities, for example, if the switch 70 is thrown to make contact with contact 71, and the dial 72 is operated, it will send positive impulses over line 73, which will energize relays 74 and 75 at the receiving end. These relays may both be quick acting. Relay 74 must be quick acting. However, these relays are polarized and the positive impulses will not operate the tongue 76 of relay 75, but will operate the tongue 77 of relay 74, thus causing the tongue to make contact with contact 78. This connects battery 86 and energizes both relays 79 and 80, but since relay 79 is slow closing on account of the dashpot 81, only relay 80 will operate on the impulses from the dial 72. These impulses will notch up step by step selector relay ratchet wheel 82 in accordance with the number of impulses dialed at the control end of the line. For example, if the operator dials 5 the selector switch ratchet wheel 82 will rotate and 83 will make contact with point 5. Now, if the switch 70 is swung over to contact 84, a negative impulse will be sent over the line. This negative impulse does not operate polar relay 74, but it will operate polar relay 75, thereby passing current from the battery 85, up through the selector switch and arm 83 to point 5, then down to relay 87. When relay 87 is energized, it closes contacts 88, 89 and 90, 91, thus connecting the armature of motor 92 across the battery 93, causing it to turn dial 94 in one direction. On the other hand, if the operator had dialed #6, the same sequence of events would have operated relay 96, causing the motor to be energized through contacts 97 and 98, and turn the dial 94 in the opposite direction. Motion of the dial 94 may be utilized to tune signaling circuits or for other purposes. When it is desired to return the selector switch to zero, the switch 70 will be thrown to contact 71 and a long impulse of positive current will be sent out by operating switch 100, thereby closing polar relay 74 and energizing slow relay 79, pulling down latch 73, and allowing the selector switch and ratchet wheel 82 to be pulled back to its zero position by a spring not shown.

The field winding 95 of the motor at the remote point is energized by the source 93. The positive and negative pulses dialed from the control point dial 72 are supplied from batteries 101 and 102, respectively.

The system, of course, may also be used to control a transmitter, that is, turn the transmitter on and off and tune the same from a remote point. For example, if the operator at the control station dials #9 on dial 72, relay 74 notches the selector switch 82 up nine steps so that the contact 83 comes to rest on point 9. Then, when switch 70 is thrown to the right to complete a circuit through the negative battery 102, 75 is energized and the tongue 76 thereof is pulled against its spring bias to close its contact and can complete a circuit through battery 85, selector switch point 9 to polar relay or winding 104. When the winding 104 is energized the tongue 106 connected with the armature of said relay is moved to the right to bear on contact 107. This completes a circuit from the power supply not shown to the transmitter 112 which in this manner may be rendered operative. The polar relay including the elements 105, 106 and 107 is so adjusted that the tongue 106 remains on contact 107 until the operator at the control point dials #8 after the switch 70 has again been moved to the left hand position so that positive impulses of current passing over the control line energize the winding or relay 74 to close contact 78 and step the ratchet wheel up

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to a point at which the contact 83 bears on point #8. This closes a circuit through winding 103 of the polar relay. The armature 106 is drawn to the left to bear on contact 105, thus deenergizing the winding 110 of the power circuit contactor relay. Deenergizing winding 110 permits contact 109 to open, thereby breaking the energizing circuit to the transmitter, which becomes inoperative. The transmitter 112 may be replaced by a receiver. The receiver or transmitter in 112 may be tuned by the element 94 to the desired frequency, as set out hereinbefore.

In conclusion, therefore, it may be noted that I have provided a novel means for checking the frequency of a plurality of transmitting stations. This checking operation may be done with a single monitoring circuit, thus eliminating the necessity of separate frequency checkers at each transmitter. The present invention also provides means which eliminates the necessity of keeping an attendant on duty at many of the stations since the apparatus at said stations may be controlled to the extent indicated above by my novel control scheme.

What is claimed is:

1. The method of operating a transmitting station, which includes a step by step selecting device, an operating relay having a circuit adapted to be conditioned by said selecting device and a tuning relay controlled by said operating relay from a remote point which includes the steps of, producing carrier frequency energy, modulating said carrier frequency energy by different discrete tone frequencies, radiating said modulated carrier frequency to said remote point, receiving said carrier frequency at said remote point, demodulating said carrier frequency to obtain said discrete tone frequencies filtering said tone frequencies to isolate the same, and utilizing one of said tone frequencies to actuate said step by step selecting device to condition said operating relay circuit and the other of said tone frequencies to actuate said operating relay to control said tuning relay.

2. A transmitting system for transmitting signals and controlling potentials comprising, transmitting means, a voice frequency signal channel and a plurality of tone frequency channels, modulating means interposed between said tone frequency channels and said transmitting system, and a low pass filter interposed between said voice frequency signal channel and said modulating means to cut off the voice frequencies at a desired point to prevent interference with the tone frequencies.

3. The combination of a signalling system comprising, a transmission channel, means for sending telephony signals over said channel, means for sending controlling potentials of tone frequency over said channel, and an operating device responsive to one of said control potentials on said channel, said operating device including a relay which closes slowly in response to said one tone frequency and opens quickly to prevent its operation by telephony signals during normal signalling operations.

4. A signalling system comprising, a transmitting station, a control station, a central station, said transmitting station and said central station being connected by tone lines, means at said control station for sending out a carrier wave modulated by tone frequencies, receiving means at said transmitting station for receiving said modulated carrier wave, said receiving means being coupled to said tone lines, a filter circuit connected with said receiver, said filter circuit being adapted to pass one of said tone frequencies, a selector switch, a plurality of circuits associated therewith, one of said circuits including an interrupting device adapted when energized to produce audible oscillations, a coupling between said interruptor device and said tone lines whereby said interruptor when actuated produces oscillations which may be sent over said tone lines to said central station, an energizing circuit connected with said interruptor, a slow relay adapted when energized to close said energizing circuit to send a continuous audible oscillation over said tone line, a filter circuit interposed between said receiver and said slow relay, and means for preventing said oscillations produced by said interruptor from reacting on either of said filter circuits to operate said selector switch or said slow relay comprising a thermionic coupling tube interposed between said interruptor mechanism and said receiver whereby false operation of said selector switch or slow relay is prevented.

5. Means for controlling a plurality of circuits from a remote point comprising, a control station, a tone line connecting said control station to said remote point, a plurality of direct current sources having opposed terminals grounded, switching means for alternately connecting the free terminals of said direct current sources to said tone line to reverse the polarity of the current impressed from said sources on said tone line, two polarized relays at said remote point, each of said relays having a winding connected with said tone line, one of said relays being responsive to current of one polarity, the other of said relays being responsive to current of the other polarity, a step by step selector device connected to one of said relays and adapted when actuated to complete the desired one of said circuits upon the closing of said second relay, and means connected with said selector device and with said first relay for returning said selector device to zero point when said first relay is operated for a definite length of time.

6. A signalling system comprising, means for receiving signal carrying oscillations, a voice frequency transmission line connected therewith, a high frequency transmitter, a plurality of sources of tone frequencies, means for impressing any of said tone frequencies on said transmitter and for controlling the impression of one of said tone frequencies on said transmitter by currents sent over said voice frequency line, and means for preventing undesired currents sent over said line from affecting said transmitter including a filter circuit interposed between said voice frequency line and said transmitter.

7. In a radio signalling system, a control station and a remote relaying station connected together by a transmission medium, a relay at said remote station responsive to only one kind of signal, means at said control station for sending said one kind of signal over said medium for operating said relay, a step by step selector switch at said remote station operable to any one of a plurality of positions under the control of the action of said relay, and slow operating mechanism for holding said switch in the position to which it has been moved after said relay has ceased functioning, said slow operating mechanism being responsive to the continued actuation of said relay for at least a predetermined interval

of time for releasing said selector switch and restoring same to normal.

8. The combination with a signalling system comprising a high frequency transmission channel and a voice frequency transmission channel, and means connecting said channels, of means for sending high frequency waves modulated by signals of voice frequency over said high frequency transmission channel, means for sending voice frequency currents over said voice frequency channel, means connected with said high frequency channel for sending controlling potentials of tone frequency over said high frequency channel, and means for preventing said controlling potentials of tone frequency from entering said voice frequency transmission channel comprising a coupling tube interposed in said means connecting said channels.

9. In a communication system, a transmitter including a source of carrier wave energy, a voice frequency channel connected through modulating means to said transmitter, sources of normally inoperative controlling potentials of tone frequency connected with said modulating means, whereby signals from said voice frequency channel or said sources may be impressed on said carrier wave energy for transmission, a remote station comprising signal receiving and demodulating means, a second voice frequency channel connected to said demodulating means, means associated with said first named voice frequency channel and one of said sources of controlling potentials to make the same operative for impressing a tone frequency on said wave energy, means connected with the output of said demodulating means and responsive to rectified controlling potentials of tone frequency for producing a signalling current and impressing the same on said second named voice frequency channel, and means interposed between said last named means and the output of said demodulator for preventing said signalling current from mixing with the rectified potentials of tone frequency in said output.

10. A system as recited in claim 9 wherein said last named means is a coupling tube in said connection between said second voice frequency channel and said demodulating means.

11. In a communication system, a transmitter including a source of carrier wave energy, a voice frequency channel connected through modulating means to said transmitter, sources of normally inoperative controlling potentials each of tone frequency, connected with said modulating means whereby signals from said channel or said sources may be impressed on said wave energy for transmission, a remote station comprising signal receiving and demodulating means, a conditioning relay connected to said demodulating means and responsive to potentials characteristic of one of said controlling potentials for conditioning a signalling circuit, a second voice frequency channel coupled to said demodulating means, a coupling between said signalling circuit and said last named voice frequency channel, means connected with the output of said demodulating means and responsive to another of said controlling potentials of tone frequency for rendering said signalling circuit operative to send signals over said second voice frequency channel and means interposed between the output of said demodulator and said signalling circuit for preventing said signals from reaching said output and mixing with potentials of tone frequency therein.

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