Dec. 15, 1942. L. C. ROBERTS 2,305,496

RADIO BROADCASTING SYSTEM

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FIG. 1

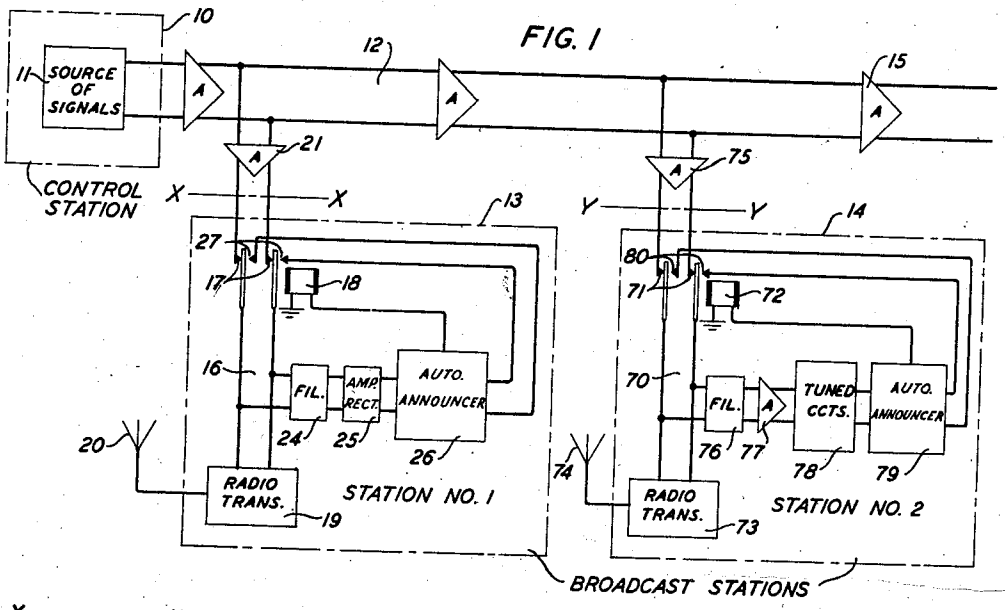
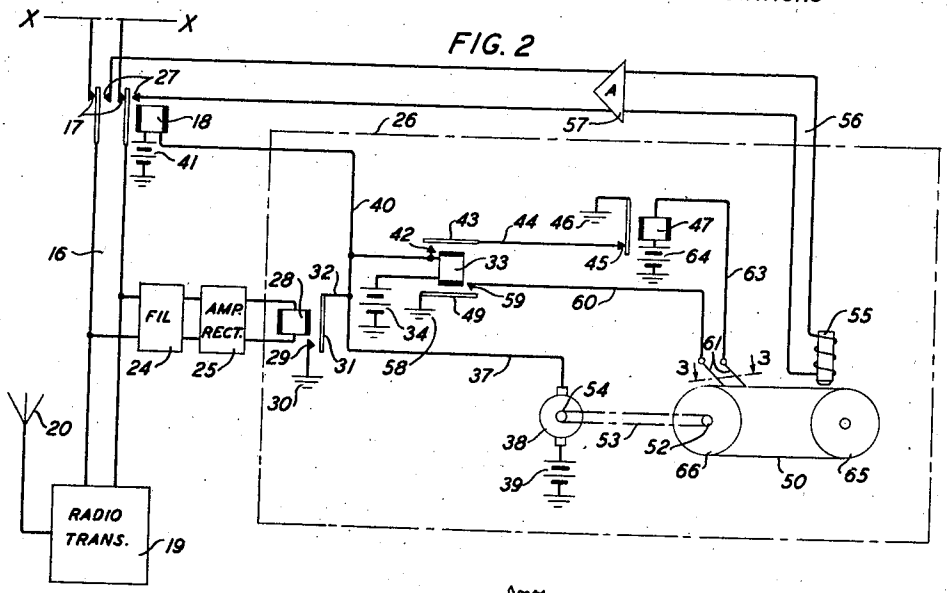



FIG. 2



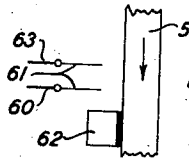




FIG. 3

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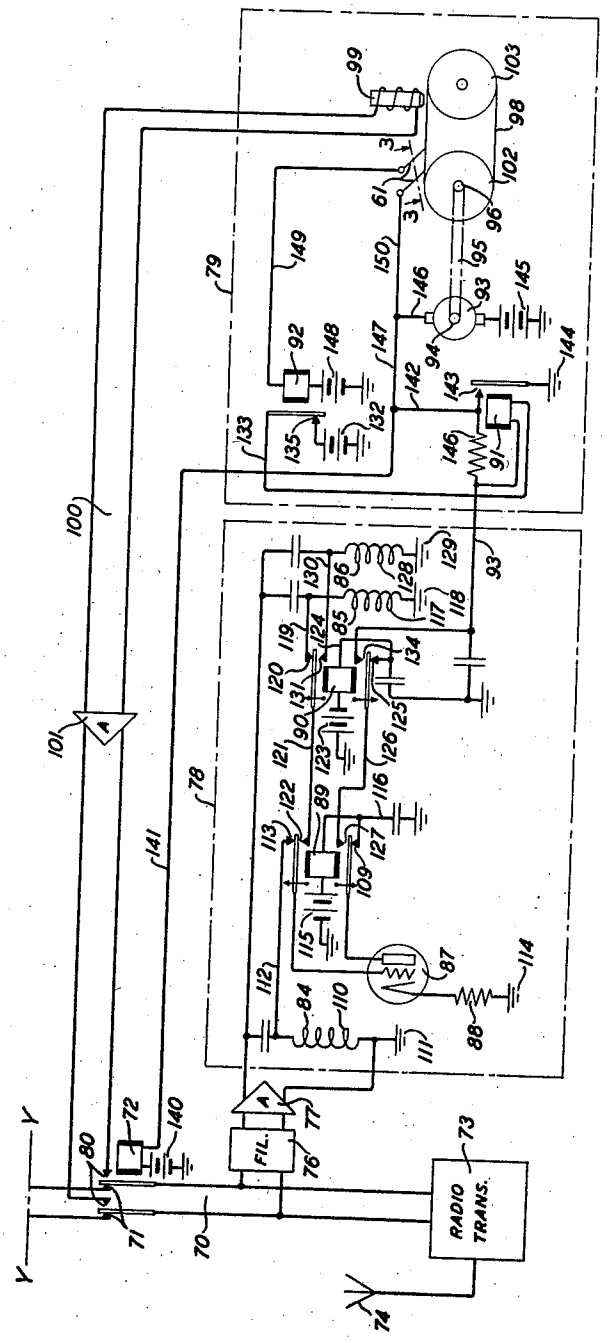
FIG. 4

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# UNITED STATES PATENT OFFICE

2,305,496

## RADIO BROADCASTING SYSTEM

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8 Claims. (Cl. 250—2)

This invention relates to a radio broadcasting system, and more particularly to arrangements for automatically broadcasting the call letters of individual stations embodied in such system, in response to a signal originating at a control station.

Heretofore, stations comprising a broadcasting system disconnected themselves individually from the system in response to an announcement, such as "This is the XYZ broadcasting system," given usually from the control point at which the common program originated. Thereafter, an attendant at the individual stations proceeded to give an oral announcement of the identifying call letters. Inasmuch as various factors including the movements of the attendants preclude all stations from simultaneously effecting the call letter broadcast, it may happen that a portion of the time allotted to the common program is consumed in the call letter broadcast. Such lost time may be more or less, depending on whether the station identification is given at quarter-hour or half-hour intervals. Consequently, a system embodying a relatively large number of stations may be called upon to reserve as much as one minute for the time differential in broadcasting its individual station call letters in order that the common program will not run over its allotted time. Such time differential is waste so far as commercial utility is concerned.

This invention contemplates an arrangement to effect automatically in a broadcasting system the simultaneous announcement of the call letters of the individual stations comprising such system, in response to a signal originating at a control station.

The main object of the invention is to minimize the time differential between the broadcast of individual station identifications in a multi-station radio system.

Another object is to effect substantially simultaneously the broadcast of the call letters of all stations embodied in a broadcasting system.

A further object is to operate on an unattended basis the individual stations embodied in a broadcasting system.

In the specific embodiment, the invention comprises a control station supply a common program to a plurality of individual broadcasting stations connected therewith by a suitable transmission line, each broadcasting station embodying a transmitter and antenna. Normally, the control station is effectively connected to the transmitter and antenna at each broadcasting station. When it is desired to send out the call letters of all broadcasting stations in the system, a suitable signal produced at the control station is applied to the connecting transmission line. This signal is simultaneously utilized at all broadcasting stations to disconnect said latter stations from the transmission line and simultaneously therewith to operate an announcer device which applies the call letter energy to the transmitter and antenna embodied in the individual broadcasting stations. After the call letter energy has been broadcast each announcer device functions to disconnect itself from the transmitter and antenna and at the same time to reconnect effectively the individual broadcasting stations to the transmission line to receive the common program.

A feature of the invention is that the call letter broadcast of the several stations of a radio system is effected on an automatic basis. Another feature ensures that the call letter broadcast takes place substantially simultaneously at all such stations. A further feature relates to minimizing the time differential between the broadcast of the call letters of several individual stations connected together in a radio transmission system. Another feature enables a relatively close check of the time allotted for the broadcast of a common program among the several individual stations operating in such system. Another feature involves the elimination of attendants at individual broadcasting stations.

The invention will be readily understood from the following description taken together with the accompanying drawings in which:

Fig. 1 is a schematic circuit diagram illustrating a radio broadcasting system including two embodiments of the invention;

Fig. 2 is a schematic circuit diagram showing one embodiment of the invention;

Fig. 3 is a partial schematic circuit diagram taken along the lines 3—3 of each of Figs. 2 and 4; and

Fig. 4 is a schematic circuit diagram illustrating another embodiment of the invention.

The same reference characters are employed to identify the same elements appearing in the several figures of the drawings.

Referring to Fig. 1 a control station 10 embodies a source 11 of signals which may comprise either intelligence produced in the familiar manner or preselected for a switching purpose which will be hereinafter explained. Actually the source 11 comprises two different signal sources, one for intelligence signals and the other for a switching signal, but for the simplification of this

description is shown as the one source 11. Spaced from source 11 and connected thereto by a transmission line 12 are individual broadcasting stations 13 and 14. A plurality of suitable amplifiers 15 may be embodied in the transmission line 12.

In Fig. 1 a transmission line 16 connects the transmission line 12 through a pair of closed contacts 17, 17 of a normally unoperated electromagnetic relay 18 to a radio transmitter 19 and associated antenna 20, both of which essentially constitute the broadcast station 13 whose circuit arrangement and operation will now be described.

In the line 16 at a point intermediate the contacts 17, 17 and the line 12 may be disposed a suitable amplifier 21. Across the line 16 at a point intermediate the contacts 17, 17 and the transmitter 19 are connected in sequence a filter 24, an amplifier-rectifier 25, and an automatic announcer apparatus 26 which is also connected to the relay 18 and a pair of open contacts 27, 27 associated therewith.

Referring to Fig. 2, which shows in detail the circuit portion of Fig. 1 below the line X—X, the apparatus 26 in the station 13 of Fig. 1 comprises a normally unoperated electromagnetic relay 28 whose open contact 29 is applied to a ground 30 and whose armature 31 extends over a lead 32 and winding of electromagnetic relay 33 to the positive terminal of a source 34 of direct potential whose negative terminal is grounded. To the winding of the relay 33 is connected a lead 37 which extends to one brush terminal of a direct current motor 38 whose other brush terminal is connected to the positive terminal of a source 39 of direct potential whose negative terminal is grounded.

To the lead 37 is connected a lead 40 which extends through the winding of the relay 18 to the positive terminal of a source 41 of direct potential whose negative terminal is grounded. Also, connected to the lead 37 is a normally open contact 42 of the relay 33 whose associated armature 43 is extended over lead 44 to normally closed contact 45 to which is connected ground potential 46, both of which are associated with electromagnetic relay 47.

A reproducing device 50 is the familiar telegraphone type comprising an endless band of magnetic material applied onto pulleys 65 and 66 of which the latter pulley has its shaft 52 connected by an endless belt 53 to the armature 54 of the motor 38. Pick-up magnet 55 positioned in proximity of the reproducing device 50 serves to apply call letter information recorded thereon over a line 56 embodying a suitable amplifier 57 to the normally open contacts 27, 27 associated with the relay 18. The call letter information of the reproducing device 50 includes the call letters of the station 13 whose identity is to be broadcast in a manner that will be subsequently explained.

Ground 58 is applied to armature 49 of relay 33 and may be extended over open contact 59, lead 60, pair of contacts 61, 61 and conducting surface 62, Fig. 3, affixed suitably to the reproducing device 50, when the latter is in the proper position as will be later explained, lead 63, winding of relay 47 to the positive terminal of a source 64 of direct potential whose negative terminal is grounded. In connection with Fig. 3, the conducting surface 62 is so affixed to the reproducing device 50, Fig. 3, as to complete the electrical circuit between the contacts 61, 61 once for each complete revolution of the reproducing device 50 in order to effect certain action which will be hereinafter pointed out.

In the operation of Figs. 1 and 2 when it is desired to broadcast call letters to identify station 13, a preselected signal, such as a 1000-cycle wave modulated with a 20-cycle wave, is supplied by the source 11 to the lines 12 and 16. Disregarding station 14 for the moment and as contacts 17, 17 are closed due to the normally unoperated condition of relay 18, this preselected signal is selected from the line 16 by the filter 24, amplified and rectified in the amplifier-rectifier 25, and thereafter impressed on the winding of relay 28. The rectified signal operates relay 28 to supply ground potential 30 over a circuit comprising contact 29 closed on armature 31 of relay 28, leads 32 and 40, winding of relay 18 to the direct current source 41. Relay 18 operates to open the contacts 17, 17 thereby disconnecting the transmitter 19 from the line 12. This terminates signaling transmission from the source 11. At the same time the operation of relay 18 closes contacts 27, 27 to connect the line 56 and pick-up magnet 55 to the transmitter 19 and associated antenna 20.

Also, at the same time ground potential 30 is supplied over a circuit comprising contact 29 closed on armature 31 of relay 28, leads 32 and 37, and motor 38 to the direct current source 39; and relay 33 is caused to operate due to an energizing circuit comprising ground potential 30, contact 29 closed on armature 31 of relay 28, lead 32, winding of relay 33 and the direct current source 34. Relay 33 locks up in a circuit comprising direct current source 34, both the winding and contact 42 closed on armature 43 of relay 33, lead 44, and closed contact 45 and ground potential 46 of relay 47. Also relay 18 is locked up in a circuit comprising source 41, winding of relay 18, lead 40, contact 42 closed on armature 43 of relay 33, lead 44 and closed contact 45 and ground potential 46 of relay 47. The operation and lock-up of relay 33 serves to close the armature 58 on the contact 59 thereby applying ground potential 58 over lead 60 to one of the contacts 61, 61 for a purpose which will be mentioned later.

As the motor 38 is now energized in the manner previously described, the pulleys 65 and 66 are rotated to pass the reproducing device 50 before the pick-up magnet 55 for the reason that the energizing circuit for the motor 38 is locked up in a circuit comprising direct current source 39, motor 38, lead 37, contact 42 closed on armature 43 of operated relay 33, lead 44, and contact 45 and ground potential 46 of relay 47. The call letter energy picked up by the magnet 55 from the reproducing device 50 is applied over line 56, amplifier 57, closed contacts 27, 27 of relay 18, line 16 to the transmitter 19 to be broadcast on the antenna 20 associated therewith.

A sufficient length of blank space is provided on the reproducing device 50 at the start of its rotation so as to enable the motor 38 to come up to such speed as is proper to enable a relatively high quality broadcast of the call letter energy picked up from the reproducing device 50. To control the speed of the motor 38 a suitable governor may be embodied therein. After the reproducing device 50 has made one complete revolution, the contacts 61, 61 complete via the conducting surface 62, Figs. 2 and 3, a circuit comprising ground 58, armature 49 closed on the contact 59 of operated relay 33, lead 60,

contacts 61, 61 and conducting surface 62 (Figs. 2 and 3), lead 63, winding of relay 47 and the positive terminal of the direct potential source 64.

This circuit causes an energization of the winding of the relay 47 which operates to open the contact 45 to interrupt the previously traced holding circuit of the motor 38 thereby stopping the movement of the reproducing device 50. At this point it is to be noted that the relay 28 is released at the conclusion of the signal being sent from the central station 10. Also, the previously traced holding circuits for the relays 18 and 33 are interrupted. The release of relay 18 closes the contacts 17, 17 to reconnect the line 12 to the transmitter 19 of the broadcast station 13. The release of relay 33 further interrupts the hereinbefore defined lock-up circuits for the motor 38 and relay 18. The control of the operation of the motor 38 is such that the above-mentioned blank portion of the recording device 50 is always stopped before the pick-up magnet 55. The release of relay 33 also interrupts the previously described engagement between the armature 49 and contact 59 to remove the ground potential 58 from one of the contacts 61, 61 thereby interrupting at this point the hereinbefore mentioned energizing circuit for the relay 47. The contacts 61, 61 are spaced relative to each other, on the conducting surface 62, Fig. 3, such that the inertia of the motor 38 causes the interruption of the energizing circuit of relay 47 at this point before the reproducing device 50 returns to a state of rest. With the reproducing device 50 in the latter state, the contacts 61, 61 are out of engagement with the conducting surface 62 as shown in Fig. 3. The automatic announcer apparatus 26 is now conditioned for the succeeding appropriate signal to effect a subsequent broadcast of the call letters of the station 13.

Referring again to Fig. 1 a transmission line 70 connects the transmission line 12 through a pair of closed contacts 71, 71 of a normally unoperated electromagnetic relay 72 to a radio transmitter 73 and associated antenna 74, both of which essentially constitute the broadcast station 14 whose circuit arrangement and operation will now be explained. In the line 70 at a point intermediate the contacts 71, 71 and the line 12 may be disposed a suitable amplifier 75. Across the line 70 at a point intermediate the contacts 71, 71 and the transmitter 73 are connected in sequence a filter 76, amplifier 77, selectively tuned circuits 78 and an automatic announcer apparatus 79 which latter apparatus is also connected to the relay 72 and open contacts 80, 80 associated with the latter.

Referring now to Fig. 4 which shows in detail the circuit portion below the line Y—Y of Fig. 1, the output of the amplifier 77 is applied across the selectively tuned circuits 78. The latter comprise essentially series tuned circuits 84, 85 and 86 arranged in parallel and connected across the input of a triode amplifier 87, normally biased by resistor 88 near its cut-off, by slow-release electromagnetic relays 89 and 90 disposed in the output thereof.

Announcer apparatus 79 connected by a lead 93 to the tuned circuits 78 is substantially identical with the announcer apparatus 26 hereinbefore described in connection with the station 13 and shown in Fig. 2. Accordingly, announcer apparatus 79 embodies essentially a direct current motor 93 whose armature 94 is connected by an endless belt 95 to a shaft 96 of a pulley 102 on which and another pulley 103 is mounted a reproducing device 98 of the telegraphone type aforementioned with respect to the reproducing device 50. Pick-up magnets 99 is connected by line 100 and amplifier 101 to the normally open contacts 80, 80 of relay 72.

In the operation of Figs. 1 and 4, when it is desired to broadcast call letters to identify station 14 a preselected signal, such as the successively familiar three tones having frequencies $f1$, $f2$ and $f3$, is applied by the source 11 to the lines 12 and 70. Disregarding station 13 for the moment and as the contacts 71, 71 of relay 72 are closed, this preselected signal is selected from the line 70 by the filter 76, amplified in amplifier 77 and thereafter impressed on the three tuned circuits 84, 85 and 86 which are individually resonant at the respective frequencies $f1$, $f2$ and $f3$.

The tone $f1$ selected by the tuned circuit 84 produces a control voltage across inductance 110 embodied therein. This voltage is impressed on the control grid of the amplifier 87 in a circuit comprising ground potential 111, inductance 110, lead 112, normally closed contact 113 of relay 89, control grid and cathode of amplifier 87, biasing resistor 88 and ground potential 114. As the amplifier was initially biased substantially at cut-off, this control voltage renders the control grid of the amplifier 87 less negative by an amount which is sufficient to occasion a flow of anode current in a circuit comprising positive terminal of source 115 of direct potential whose negative terminal is grounded, winding of relay 89, lead 116, normally closed contact 109 of relay 89, anode and cathode of amplifier 87, biasing resistor 88 and ground potential 114. The flow of anode current in such circuit serves to operate the relay 89.

The tone $f2$ selected by the tuned circuit 85 produces a control voltage across inductance 117 embodied therein. This voltage is impressed on the control grid of amplifier 87 in a circuit comprising ground potential 118, inductance 117, lead 119, normally closed contact 120 of relay 90, lead 121, closed contact 122 of operated relay 89, control grid and cathode of amplifier 87, biasing resistor 88 and ground potential 114. As the amplifier 87 was initially biased near cut-off, this control voltage renders the control grid of the amplifier 87 less negative by an amount which is adequate to cause a flow of anode current in a circuit comprising positive terminal of a source 123 direct potential whose negative terminal is grounded, winding of relay 90, lead 124, normally closed contact 125 of relay 90, lead 126, closed contact 127 of operated relay 89, anode and cathode of amplifier 87, biasing resistor 88 and ground potential 114. The flow of anode current in such circuit serves to operate the relay 90.

The tone $f3$ selected by the tuned circuit 86 produces a control voltage across inductance 128 included therein. This voltage is impressed on the control grid of the amplifier 87 in a circuit comprising ground potential 129, inductance 128, lead 130, closed contact 131 of operated relay 90, lead 121, closed contact 122 of operated relay 89, control grid and cathode of amplifier 87, biasing resistor 88, and ground potential 114. As the amplifier 87 was initially biased near cut-off this initial voltage renders the control grid of the amplifier 87 less negative by an amount which is adequate to occasion a flow of anode current in a circuit comprising positive terminal of source 132

of direct potential whose negative terminal is grounded, normally closed contact 135 of relay 92, lead 133, winding of relay 91, lead 93, closed contact 134 of operated relay 90, lead 126, closed contact 127 of operated relay 89, anode and cathode of amplifier 87, biasing resistor 88 and ground potential 114. The flow of anode current in such circuit serves to operate the relay 91 which locks up in a circuit comprising source 132, closed contact 135 of relay 92, lead 133, winding of relay 91, resistor 146, closed contact 143 of operated relay 91 and ground potential 144. Due to a slow-release feature, both relays 89 and 90 remain operated until the relay 91 is operated in the aforementioned manner.

The operation of relay 91 completes for the relay 72 an energizing circuit comprising positive terminal of source 140 of direct potential whose negative terminal is grounded, winding of relay 72, lead 141, lead 142, closed contact 143 of operated relay 91 and ground potential 144. Relay 72 operates to open contacts 71, 71 and to close contacts 80, 80. At the same time, the operation of relay 91 completes for the motor 93 an energizing circuit comprising positive terminal of source 145 of direct potential whose negative terminal is grounded, brushes of motor 93, lead 146, lead 147, lead 142, closed contact 143 of operated relay 91 and ground potential 144. Motor 93 operates to drive the pulley 102 which passes the recording device 98 before the pick-up magnet 99. The call letter energy picked up thereby is applied over line 100, amplifier 101, closed contacts 80, 80 of operated relay 72, line 70 to the transmitter 73 and associated antenna 74 shown in Fig. 1.

After the recording device 98 has made one entire revolution, the contacts 61, 61 complete via the conducting surface 62, Figs. 3 and 4, a circuit comprising source 148 of direct potential whose negative terminal is grounded, winding of relay 92, lead 149, contacts 61, 61 and conducting surface 62, leads 150, 147 and 142, closed contact 143 of operated relay 91 and ground potential 144. This occasions an energization of the winding of relay 92 which operates to open contact 135 thereby interrupting the previously traced holding circuit for relay 91. This relay returns to an unoperated condition thereby interrupting the hereinbefore described energizing circuits for the relay 72 and motor 93. Release of the relay 72 closes the contacts 71, 71 to reconnect the line 70 to the line 12 and at the same time to open the contacts 80, 80. Deenergization of the motor 93 serves to stop the movement of the recording device 98 before the pick-up magnet 99. This therefore terminates a broadcast of the call letter energy supplied by the recording device 98.

The operation of the motor 93, recording device 98 and pick-up magnet 99 embodied in the announcer apparatus 79 of Fig. 4 is substantially identical with the operation of the corresponding elements embodied in the announcer apparatus 26 of Fig. 2 to effect a high quality broadcast of the call letter information. After the relays 72, 89, 90, 91, and 92, and motor 93 are returned to their unoperated condition, the circuit arrangement shown in Fig. 4 is conditioned to receive the succeeding three tones *f1*, *f2* and *f3* to effect a subsequent broadcast of the call letters of station 14.

While Fig. 1 shows broadcasting stations 13 and 14 equipped with call letter announcing apparatus as illustrated in respective Figs. 2 and 4, it is understood that such illustration is for the purpose of facilitating this description, and in practice the broadcasting stations whose call letters are to be automatically announced simultaneously in response to signals originating in a central station should be equipped so as to respond to the same signal. This would mean that all individual broadcasting stations embodied in the one radio system are equipped with identical call letter announcer apparatus such as that shown in either Fig. 2 or Fig. 4.

It is to be understood that while the reproducing device 50 supplies the call letter energy to identify individual stations; such device could also be utilized to supply advertising or other information of a purely local character. Hence, such information could be broadcast locally without interfering with the broadcast of the common program.

What is claimed is:

1. In combination in a transmission system, a source of intelligence signals including a preselected signal, a plurality of intelligence signal transmitting stations spaced from said source, each of said stations embodying broadcasting means, circuit means to connect said source with said stations such that normally said intelligence signals are effectively applied to said broadcasting means, and means at individual stations to respond to said preselected signal such that said broadcasting means are disconnected from said source for a certain time interval during which other signals are effectively applied to said broadcasting means.

2. A radio broadcasting system comprising a control station, a plurality of broadcasting stations each of which includes an antenna, circuit means to connect effectively said control station with said broadcasting stations such that normally said control station is connected to said antennas, means at said control station to apply a preselected signal to said circuit means, and means at individual broadcasting stations to respond to said preselected signal such that said antennas are disconnected from said circuit means for a certain time interval during which call letter signals are caused to be applied effectively to said antennas of said broadcasting stations.

3. A radio broacasting system comprising a control station, a plurality of broadcasting stations each of which includes an antenna, circuit means to connect said control station with said broadcasting stations such that normally said control station is effectively applied to said antennas, means at individual broadcasting stations to disconnect said control station from said circuit means and to apply call letter signals to said antennas associated with said individual broadcasting stations and after a certain time interval to reconnect said individual broadcasting stations to said circuit means, and means at said control station to apply a preselected signal to said circuit means to actuate said disconnecting and reconnecting means at said individual broadcasting stations.

4. A radio broadcasting system comprising a control station, a plurality of broadcasting stations, each of which includes an antenna, a transmission line to connect said control and broadcasting stations such that normally said control station is effectively connected to said antennas, means at individual broadcasting stations to produce a call letter signal, means at individual broadcasting stations to disconnect said latter stations from said line and to connect

effectively said call letter producing means to said antennas associated with said latter stations such that substantially simultaneously with such connection said call letter producing means are rendered operative and after a certain time interval said call letter producing means are rendered inoperative and substantially simultaneously therewith are disconnected from said antennas and said individual broadcasting stations are reconnected to said line, and means at said control station to apply a preselected signal to said line to actuate substantially simultaneously said disconnecting and reconnecting means at said individual broadcasting stations.

5. In combination in a signal transmission system, a source of intelligence and preselected signals, at least one intelligence signal transmitting station, circuit means to connect said source and said station such that normally both said source and station are effective to transmit the intelligence signals, and means at said station to respond to the preselected signal such that both said source and station are rendered ineffective to transmit the intelligence signals for a certain time interval and said station is rendered effective, during the certain time interval, to transmit other signals to identify said station.

6. A signal transmission system comprising a plurality of stations to transmit common signals at the same time, and means at individual stations to disable said stations substantially at the same time for transmitting the common signals for a predetermined time interval and to cause the individual stations substantially simultaneously to transmit other signals during the predetermined time interval.

7. A radio broadcasting system comprising a plurality of signal transmitting stations, a central station for intelligence and preselected signals, circuit means to connect said central station to said transmitting stations so that said latter stations normally transmit the intelligence signals substantially at the same time, and means at individual signal transmitting stations controlled by the preselected signal to render said central station and said signal transmitting stations ineffective substantially at the same time to transmit the intelligence signals for a predetermined time interval and to enable the individual signal transmitting stations substantially simultaneously to transmit other signals during the predetermined time interval.

8. A radio broadcasting system comprising a plurality of stations each including an antenna, a source of intelligence and preselected signals, circuit means to connect said source to said stations such that normally said source is effectively connected to said antennas for transmitting the intelligence signals substantially at the same time, and means at individual stations controlled by the preselected signal to render both said source and stations ineffective substantially simultaneously to transmit the intelligence signals for a predetermined time interval and to cause said stations substantially at the same time to transmit other signals during the predetermined time interval.

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