

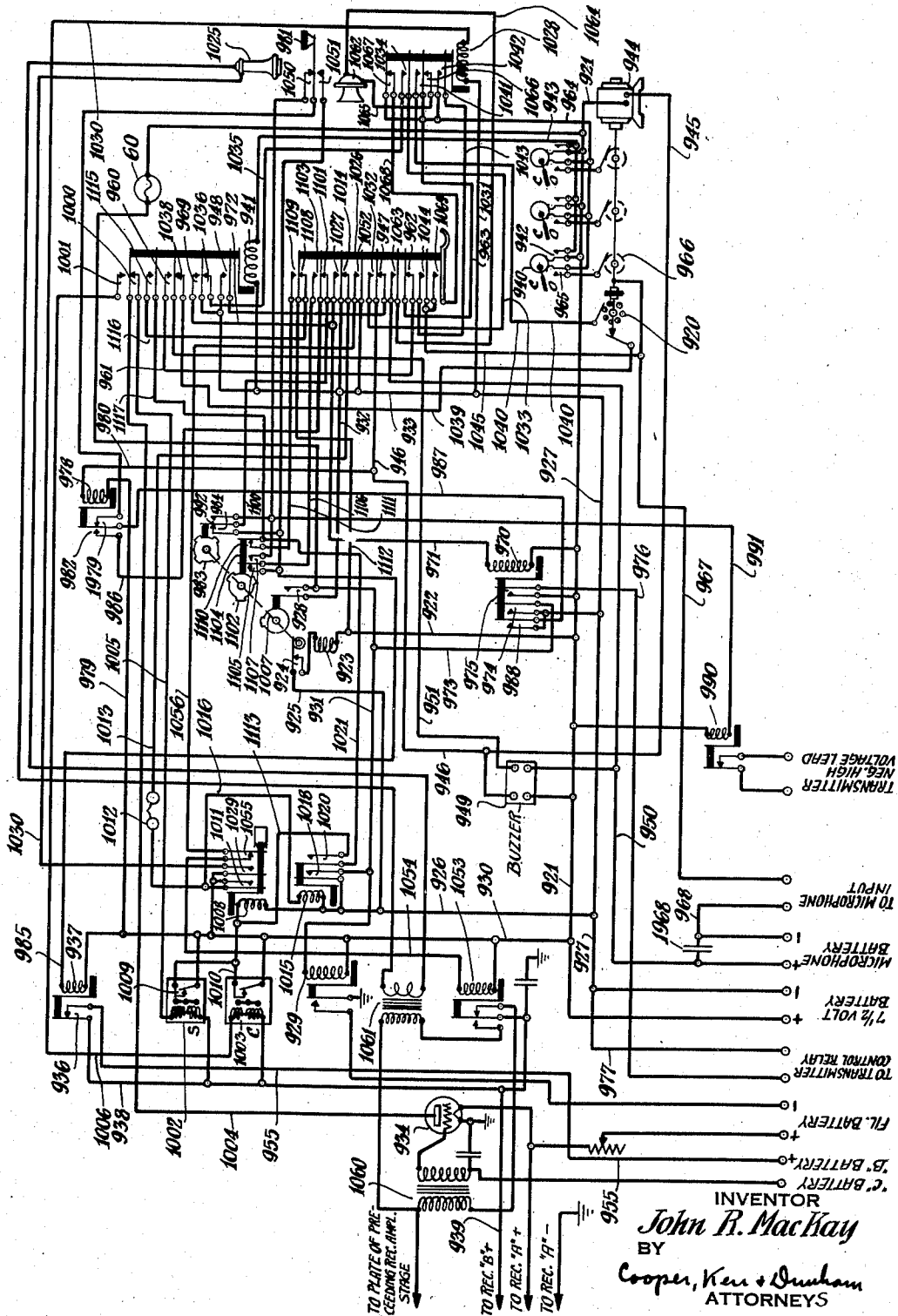
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COMMUNICATING SYSTEM

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COMMUNICATING SYSTEM

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This invention relates to communicating systems. More particularly it relates to telephone systems and from a still more specific aspect it relates to radio telephone systems. This application is a division of my copending application, Serial No. 11,783, filed March 19, 1935, for Communicating system, which was itself a division of my copending application, Serial No. 730,127, filed June 11, 1934, for Communicating system.

One of the objects of the invention is to provide a two-way radio telephone system in which the user at the calling station operates a call switch and the user at the called station receives a signal, as the ringing of a bell, thereupon lifts his telephone receiver from its hook, and thereby the user at the calling station is given a signal, as by means of a bell, indicating that his call has been put through, and the user at the calling station thereupon removes his telephone receiver from its hook, and two-way telephone conversation may then proceed as in the case of an ordinary communication over two land line telephones which have been properly connected.

A further object of the invention is to provide a radio telephone system in which the major portion of the apparatus employed is not energized at all times but only periodically at such desired intervals as will conserve the energy required to energize or activate such apparatus.

Further objects are to provide new combinations of instrumentalities and new sub-combinations thereof whereby the communication system is comparatively inexpensive to build and operate, comparatively simple in operation from the standpoint of the intelligence required to use it, and thoroughly reliable in its operation. Other objects and advantages will appear as a preferred form of the invention is hereinafter disclosed.

The drawing illustrates an embodiment of what is considered to be a preferred form of the invention, and shows a wiring diagram of apparatus and connections at one of a number of stations between any two of which radio telephone communication is to be established and maintained. Except for certain features as will hereinafter appear, the apparatus and connections used at each of the various stations of this system is identical to that used at any of the other stations; the system shown represents, as stated, one of a plurality of stations, and in accordance with the system any of the stations can selectively call any desired one of the other stations. In the arrangement shown, only one carrier frequency is employed for the entire system for all

purposes. For convenience, therefore, the several stations will be identified as stations A, B, C, etc., and in the following description the drawing will be taken to represent each of the stations in turn, as will be explained.

Each station of the system includes radio receiving apparatus and radio transmitting apparatus. The receiving apparatus is adapted to receive radio telephone signals and convert them to sound frequency speech-representing currents, and the transmitting apparatus is adapted to have its filament and plate supply rendered operative upon energization of a transmitter control relay so as to emit a desired carrier frequency and also properly to modulate it when telephone conversation takes place in the manner later to be described. The receiving apparatus is also adapted to receive modulated calling signals, and the transmitting apparatus is also adapted to transmit such signals, as more particularly explained hereinafter. It will be understood that it is immaterial what particular type of radio receiving apparatus and radio transmitting apparatus are employed with the system and circuits shown; it will be understood, by those familiar with the art, that there are many types of receiving and transmitting apparatus suitable for the purposes explained and readily adapted for use with the apparatus hereinafter more fully described. The receiving and transmitting apparatus are therefore not shown in the drawing.

Each station includes an intermittently operating or cycling mechanism having for one purpose the conservation of apparatus and of energy required. For that and other purposes as hereinafter explained, a motor 923 is provided for continuously rotating certain cams 983, 1007, and 1102. While this motor may assume a variety of different forms, I prefer at present to employ a motor of the magnetic type, such as that described and claimed in United States Patent No. 1,985,357 for Electric motor apparatus, granted December 25, 1934, upon the application of Charles F. Wallace.

The system is such that each station is adapted to transmit a carrier, for calling purposes, which may be modulated both by a buzzer modulating device, for example, and also by a circuit interrupter. Upon receiving a call from another station, each station is adapted to transmit a reply carrier which has similarly imposed on it a two-fold modulation. It may also be explained that each station is provided with selective relay means responsive to the reception of calling or reply-calling carriers which are modulated and

coded (as by a circuit interrupter) in the manner described.

It will be understood that for the purpose of conserving energy and the life of the apparatus, the radio receiving and transmitting apparatus (not shown) are normally de-energized,—i. e., filament or heater current being not supplied to the vacuum tubes thereof—except as hereinafter described.

Each station is provided with a motor-driven circuit interrupter 920 which is coded in common to all of the stations and which has for one purpose to eliminate the effect of interference by sustained or otherwise interfering signals, prolonged static, etc. Here it may be stated that this common circuit interrupter 920 is not in circuit when any of the other code interrupters employed in the system is in circuit.

The receiving apparatus at each station embodies two selective relays 1002 and 1003. One of these relays, 1003, is common to the code of all stations of the system and is responsive to the coding imparted by any of the circuit interrupters 920, and the other of the selective relays, 1002, is responsive to the particular code corresponding to that station and by which it is selectively called. Furthermore, the Wallace motor 923 at each station operates continuously, i. e., its circuit is never interrupted, and it not only periodically energizes the radio receiving apparatus at its station in the manner described in my above-mentioned copending applications, but also periodically interrupts transmission from that station and renders the radio receiving apparatus at that station operative during the intervals during which the transmission is interrupted; the purpose of this being to enable a calling station to receive the return signal transmitted from the called station.

The circuit of the Wallace motor is as follows: from the positive side of the 7½ volt battery, through the conductors 921, 922, through the winding 923 of the Wallace motor, through the automatically operating switch 924 forming a part of the Wallace motor, through the conductors 925, 926, and 927 back to the negative side of the 7½ volt battery. The cam switch 928 operated by the Wallace motor periodically closes the circuit of the relay 929 as follows: from the positive side of the 7½ volt battery, through the conductor 930, through the relay 929, through the conductor 931, through the cam operated switch 928, through the conductors 932, 933, 927 back to the negative side of the 7½ volt battery.

Energization of the relay 929 energizes the filaments of the tube 934 and the tubes of the radio receiving apparatus (not shown). The plate circuit of the radio receiving apparatus is normally closed, its circuit being as follows: from the positive side of the plate supply or B battery, through the conductor 955, through the contacts 936 (closed except when the relay 937 is energized) of relay 937, through the conductors 938, 939, to the B plus terminal of the radio receiving apparatus.

With the foregoing explanation, the circuits and operations will now be described under the assumption that the drawing represents station A and that the user at that station desires to call one of the other stations, say station B.

The user at station A throws his call switch 940 to calling position thereby energizing the relay 941 in the following circuit: from the positive side of the 7½ volt battery, through the conductor 921, through the contacts 942 of switch

940, through the conductor 943, through the relay 941, through the conductors 933 and 927, back to the negative side of the 7½ volt battery. Energization of the relay 941 causes energization of the motor 944 in the following circuit: from the positive side of the 7½ volt battery, through the conductor 921, through the motor 944, through the conductors 945, 946, through the contacts 947 (now closed) of hook switch 1026, through the contacts 948 (now closed) of relay 941, through the conductors 933, 927, back to the negative side of the 7½ volt battery.

Energization of the relay 941 closes the primary circuit of the buzzer modulating device 949 as follows: from the positive side of the 7½ volt battery, through the conductor 921, through the primary of the buzzer modulating device 949, through the conductor 946, through the contacts 947 (now closed) of hook switch 1026, through the contacts 948 (now closed) of relay 941, through the conductors 933, 927 back to the negative side of the 7½ volt battery.

Energization of the relay 941 also closes the secondary circuit of the buzzer modulating device 949 as follows: from the positive side of the microphone battery, through the conductor 950, through the secondary of the buzzer modulating device 949, through the conductor 951, through the contacts 960 (now closed) of the relay 941, through the conductor 961, through the contacts 962 (now closed) of hook switch 1026, through the conductors 963, 964, through the contacts 965 of the call switch 940, through the circuit interrupting device 966, through the conductor 967 to one side of the microphone input, whose other side is connected through the conductor 968 and by-pass condenser 968 to the positive side of the microphone battery.

Energization of the relay 941 closes its contacts 1115 so as to render the relay 1003 energized independently of the action of the relay 1003 after the initial "call back" signal has been received from station B, the circuit being as follows: from the positive side of the 7½ volt battery, through the conductors 921, 922, 1112, through the contacts 1108 (now closed) of the hook switch 1026, through the conductor 1116, through the contacts 1115 (now closed) of the relay 941, through the conductors 1117, 1021, through the contacts 1020 (now open) of the relay 1015, through the conductor 1113, through the relay 1003, through the conductors 926, 927 back to the negative side of the 7½ volt battery.

Energization of the relay 941 causes energization of the relay 970 in the following circuit: from the positive side of the 7½ volt battery, through the conductor 921, through the relay 970, through the conductors 971, 972, through the contacts 969 (now closed) of relay 941, through the conductors 933, 927, back to the negative side of the 7½ volt battery.

Energization of the relay 970 causes energization of the relay 929 in the following circuit: from the positive side of the 7½ volt battery, through the conductors 921, 930, through the relay 929, through the conductors 931, 973, through the contacts 974 (now closed) of relay 970, through the conductor 927 back to the negative side of the 7½ volt battery.

Energization of the relay 970 energizes the transmitter control relay in the following circuit: from the positive side of the 7½ volt battery, through the conductor 921, through the contacts 975 (now closed) of relay 970, through the conductor 976, through the transmitter control re-

lay, through the conductor 977, to the negative side of the $7\frac{1}{2}$ volt battery.

Energization of the relay 941 causes energization of the relay 978 in the following circuit: from the positive side of the $7\frac{1}{2}$ volt battery, through the conductors 921, 930, 979, through the relay 978, through the conductors 980, 946, through the contacts 947 (now closed) of hook switch 1026, through the contacts 948 (now closed) of the relay 941, through the conductors 933, 927, back to the negative side of the $7\frac{1}{2}$ volt battery.

Energization of the relay 978 causes its contacts 979 to open and thereby to cut out a key 981 hereinafter described. Energization of the relay 978 causes its contacts 982 to close and to establish automatic control, by the additional cam 983, of the transmitting and reception periods in view of the fact that a single carrier frequency is employed for both transmission and reception. The cam 983 which is continuously rotated by the Wallace motor has a plurality of high spots, with intervening low spots of greater angular extent. Each of the high spots of this cam 983 causes the contacts 984 to be opened to deenergize the relay 937 whose circuit is as follows: from the positive side of the $7\frac{1}{2}$ volt battery, through the conductors 921, 930, through the relay 937, through the conductor 985, through the contacts 984 (open when the high spot of the cam 983 is operative), through the conductor 1100, through the contacts 1101 (now closed) of the hook switch 1026, through the conductor 986, through the contacts 982 (now closed) of the relay 978, through the conductor 987, through the contacts 988 (now closed) of the relay 970, through the conductor 927, back to the negative side of the $7\frac{1}{2}$ volt battery. When the contacts 984 are closed, i. e., when the low spots of the cam 983 are opposite the cam operated switch, the relay 937 is energized so that the plate or B battery supply is disconnected from the radio receiver and from the tube 934.

When the high spots of the cam 983 are opposite the cam operated switch, the radio transmitting apparatus is rendered inoperative, or its operation suspended, by energization of the relay 990 in the following circuit: from the positive side of the $7\frac{1}{2}$ volt battery, through the conductor 921, through the relay 990, through the conductor 991, through the contacts 992 (closed whenever a high spot of cam 983 is opposite the cam operated switch), through the conductor 1100, through the contacts 1101 (now closed) of the hook switch 1026, through the conductor 986, through the contacts 982 (now closed) of relay 978, through the conductor 987, through the contacts 988 (now closed) of relay 970, through the conductor 927, back to the negative side of the $7\frac{1}{2}$ volt battery. When any of the low spots of the cam 983 is opposite the cam operated switch, the relay 990 is deenergized and the radio transmitting apparatus is operative. The relay 990 when energized opens the negative high voltage lead to the radio transmitter, thus preventing emission of a carrier.

Energization of the relay 941 causes its contacts 1000 to open and its contacts 1001 to close, to break the circuit of the relay 1002 and to establish a circuit through the relay 1003. The circuit of the relay 1002 is as follows: from the plate of the tube 934, through the conductor 1004, through the contacts 1000 (now open) of relay 941, through the conductor 1005, through the relay 1002, through the conductor 938,

through the contacts 936 of relay 937, through the conductor 955, to the positive side of the plate supply or B battery. The circuit of the relay 1003 is as follows: from the plate of the tube 934, through the conductor 1004, through the contacts 1001 (now closed) of the relay 941, through the conductor 1006, through the relay 1003, through the conductor 938, through the contacts 936 of the relay 937, through the conductor 955, to the positive side of the B battery.

The time interval of energization of the control relay 990 by each high spot of the cam 983 is shorter than the time interval of operation of the cam switch 928 by the high spot of the cam 1007. The purpose of this is to guard against the receiver at a desired called station being inoperative co-incidentally with the interval during which the transmitter at the calling station is inoperative.

By the operations thus far described at station A, i. e., the calling station, there is being transmitted from station A, a coded buzzer-modulated carrier. Furthermore, this transmission is periodically interrupted and during such relatively brief intervals of interruption of transmission, the radio receiving apparatus at the calling station (A) is rendered operative to await the return signal from the called station, in this instance the station B. In addition, the selective relay 1003 at station A has been rendered available to await the return signal from the called station.

Passing now to the called station, that is, station B, it will now be assumed that the drawing represents that station.

The coded modulated carrier transmitted from station A is received at station B when the high spot of the cam 1007 at station B is opposite the cam-operated switch 928. It will be recalled that the cam-operated switch 928, when closed, causes energization of the relay 929 to cause the filaments of the radio receiving apparatus and the filament of the tube 934 to be energized. When the coded modulated carrier is so received at station B, the increase of plate current of the tube 934 at station B causes the selective relay 1002 at station B to be energized. This last mentioned relay at station B is one that is mechanically tuned to respond to the code imparted by the circuit interrupter 956 at the calling station.

When the relay 1002 at station B is energized it closes its contacts 1009 to establish the following circuit through the relay 1008; from the positive side of the $7\frac{1}{2}$ volt battery, through the conductor 930, through the contacts 1009 (now closed) of relay 1002, through the conductor 1010, through the relay 1008, through the conductor 926, back to the negative side of the $7\frac{1}{2}$ volt battery. Energization of the relay 1008 causes its contacts 1011 to close to energize the relay 1015 in the following circuit: from the positive side of the $7\frac{1}{2}$ volt battery, through the conductor 930, through the contacts 1011 (now closed) of the relay 1008, through the conductor 1016, through the relay 1015, through the conductors 926, 927, back to the negative side of the $7\frac{1}{2}$ volt battery.

Energization of the relay 1015 causes all of its sets of contacts to close and the closure of the contacts 1018 establishes the following circuit through the relay 929; from the positive side of the $7\frac{1}{2}$ volt battery, through the conductor 930, through the relay 929, through the contacts 1018 (now closed) of the relay 1015, through the con-

ductors 926, 927, back to the negative side of the $7\frac{1}{2}$ volt battery.

The relay 1008 is a slow release relay, that is, when it has been energized and has closed its contacts, the contacts will be maintained closed, even when the relay 1002 or the relay 1033 is deenergized, for an interval of time somewhat longer than that during which transmission is periodically interrupted at the calling station by the high spots of the cam 933 at that station, but the interval during which the relay 1008 so maintains its contacts closed is shorter than the "high spot" intervals of the cam 1102, as will hereinafter be described. By virtue of this provision, so long as the transmission from the calling station is taking place, notwithstanding that there are comparatively short interruptions of such transmission, the relay 1008 at station B will maintain its contacts closed, even during the short intervals when the transmission from station A is being periodically interrupted. Closure of the contacts 1011 of the relay 1008 causes continued energization of the relay 1015. Maintained closure of the contacts 1012 of the relay 1015 causes energization of the relay 929 to be maintained and thereby the filaments of the radio receiving apparatus at station B and the filaments of the tube 934 at that station are maintained energized at this time independently of any operation of the cam 1007 at station B.

Upon the above described energization of the relay 1008 at station B the bell 1012 at that station is caused to ring by virtue of its energization in the following circuit: from the positive side of the $7\frac{1}{2}$ volt battery, through the conductor 930, through the contacts 1011 (now closed) of the relay 1008, through the bell 1012, through the conductor 1013, through the contacts 1014 (now closed) of hook switch 1026, through the conductors 933, 927, back to the negative side of the $7\frac{1}{2}$ volt battery.

When the user at station B hears his bell 1012 he removes his head piece 1025 from the hook of the hook switch 1026. This removal of the head piece from the hook of the hook switch causes the contacts 1014 to be automatically opened whereby the circuit of the bell 1012 is broken and the bell stops ringing. Removal of the head piece 1025 from the hook of the hook switch causes the contacts 1027 to be automatically closed establishing the following energizing circuit through the relay 970: from the positive side of the $7\frac{1}{2}$ volt battery, through the conductor 921, through the relay 970, through the conductor 971, through the contacts 1027 (now closed) of the hook switch 1026, through the conductors 933, 927, back to the negative side of the $7\frac{1}{2}$ volt battery.

Energization of the relay 970 causes all of its contacts to close and closure of the contacts 975 causes the transmitter control relay to be energized at station B.

Energization of the relay 1008 at station B causes the relay 1028 to be energized through the following circuit: from the positive side of the $7\frac{1}{2}$ volt battery, through the conductor 930, through the contacts 1029 (now closed) of the relay 1008, through the conductor 1030, through the relay 1028 through the conductors 1031, 927, back to the negative side of the $7\frac{1}{2}$ volt battery.

Energization of the relay 1028 at station B closes the following circuit through the primary of the buzzer modulating device 949 at that station: from the positive side of the $7\frac{1}{2}$ volt battery, through the conductor 921, through the

primary of the buzzer modulating device 949, through the conductor 946, through the contacts 1032 (now closed) of the hook switch 1026, through the conductor 1033, through the contacts 1034 (now closed) of the relay 1028, through the conductor 1035, through the contacts 1036 (now closed) of the relay 941, through the conductors 933, 927, back to the negative side of the $7\frac{1}{2}$ volt battery.

Energization of the relay 1028 at station B also closes the following circuit through the secondary of the buzzer modulating device 949 at that station: from the positive side of the microphone battery, through the conductor 950, through the secondary of the buzzer modulating device 949, through the conductor 951, through the contacts 1038 (now closed) of the relay 941, through the conductor 1039, through the circuit interrupting device 920, through the conductor 1040, through the contacts 1041 (now closed) of the relay 1028, through the contacts 1042 (now closed) of the relay 1028, through the conductor 1043, through the contacts 1044 (now closed) of the hook switch 1026, through the conductors 1045, 967, to one side of the microphone input whose other side is connected through the conductor 968 and the condenser 1968 to the positive side of the microphone battery.

Energization of the relay 970 at station B establishes the following circuit through the relay 929: from the positive side of the $7\frac{1}{2}$ volt battery, through the conductor 930, through the relay 929, through the conductors 931, 973, through the contacts 974 (now closed) of the relay 970, through the conductor 927, back to the negative side of the $7\frac{1}{2}$ volt battery. Maintained energization of the filament control relay 929 in the circuit last traced, maintains current on the filaments of the tubes of the radio receiving apparatus and the filament of the tube 934 at station B.

The following circuit through the relay 978 at station B is established due to the removal of the head piece 1025 from its hook and due to energization of the relay 1028; from the positive side of the $7\frac{1}{2}$ volt battery, through the conductors 930, 979, through the relay 978, through the conductors 980, 946, through the contacts 1032 (now closed) of the hook switch 1026, through the conductor 1033, through the contacts 1034 (now closed) of the relay 1028, through the conductor 1035, through the contacts 1036 (now closed) of relay 941, through the conductors 933, 927, back to the negative side of the $7\frac{1}{2}$ volt battery. Removal of the receiver 1025 from the hook of the hook switch 1026 opens the contacts 1101 thereof and closes its contacts 1103 to render the cam 983 ineffective and to place the cam switch 1104, which is operated by the cam 1102, in circuit so as to make the transmitting and receptive periods at station B in accordance with the program imposed by cam 1102, the circuit being as follows: during transmission periods at station B; from the positive side of the $7\frac{1}{2}$ volt battery, through the conductors 921, 930, through the relay 937, through the conductor 985, through the contacts 1105 (now closed) of the cam switch 1104, through the conductor 1106, through the contacts 1103 (now closed) of the hook switch 1026, through the conductor 986, through the contacts 982 (now closed) of the relay 978, through the conductor 987, through the contacts 988 (now closed) of the relay 970, through the conductor 927, back to the negative side of the $7\frac{1}{2}$ volt battery.

During receptive periods at the called station, i. e., station B, the transmitter at that station is rendered inoperative by energization of the relay 990 by the contacts 1107 of the cam switch 1104 in the following circuit: from the positive side of the 7½ volt battery, through the conductor 921, through the relay 990, through the conductor 991, through the contacts 1107 (now closed) of the cam switch 1104, through the conductor 1106, through the contacts 1103 (now closed) of the hook switch 1026, through the conductor 986, through the contacts 982 (now closed) of the relay 978, through the conductor 987, through the contacts 988 (now closed) of the relay 970, through the conductor 927, back to the negative side of the 7½ volt battery.

Removal of the receiver 1025 from the hook switch 1026 also causes contacts 1108 of the hook switch to open and contacts 1109 to close, thus placing the contacts 1110 of the cam switch 1104 in circuit to maintain energization of the relay 1008 during transmission periods so as to prevent removal of modulation from the carrier of station B due to deenergization of the relay 1008 by shutting down of the receiver at station B during transmission periods, the maintaining circuit of the relay 1008 being as follows: from the positive side of the 7½ volt battery, through the conductor 921, through the conductor 922, through the conductor 1112, through the contacts 1109 (now closed) of the hook switch 1026, through the conductor 1111, through the contacts 1110 (closed during transmission) of the cam switch 1104, through the conductor 1021, through the contacts 1020 (now closed) of the relay 1015, through the conductor 1113, through the relay 1008, through the conductors 926, 927, back to the negative side of the 7½ volt battery.

Energization of the relay 978 at station B renders the key 981 ineffective and renders control by the cam 1102 effective.

By the foregoing operations at station B, that station is now transmitting an interrupted modulated carrier (the modulation being interrupted by the interrupting device 920) during the intervals in which the low spots of the cam 1102 are opposite the adjacent cam switch, and during the intervals when the high spots of the cam 1102 are opposite the adjacent cam switch 1104, the radio transmitting apparatus at station B is rendered inoperative and the radio receiving apparatus at that station is rendered operative; it being also now understood that during the interval in which the low spots of the cam 1102 are opposite the adjacent cam switch 1104 the radio receiving apparatus at station B has its "B" supply turned off so that otherwise resultant damage to the receiving apparatus is avoided.

Station B, in response to the call from station A and the removal of the head piece 1025 from its hook at station B is now transmitting back to station A a buzzer modulated carrier interrupted by the circuit interrupting device 920, such transmission taking place during the low spot intervals of the cam 1102 at station B. During the high spot intervals of the cam 1102 at station B, the radio receiving apparatus at that station is in receptive condition.

Returning now to station A, i. e., the calling station, we shall now again assume that the drawing represents that station.

When the modulated carrier from station B is received at station A the modulated plate current of the tube 934 causes energization of the relay 1003 at station A.

Energization of the relay 1003 at station A causes energization of the relay 1008, which in turn causes energization of the relay 1015 and the relays 1008 and 1015, in cooperation as previously described, place the bell 1012 in operation and maintain its operation.

The user at station A upon hearing his bell 1012 is thereby informed that station B has received his call and that the user at that station has removed his head piece from its hook. The user at station A now removes his head piece 1025 from the hook of the hook switch 1026. Removal of the head piece 1025 from the hook switch at station A automatically opens the contacts 947 of the hook switch and thereby breaks the circuit of the primary of the modulating device 949 at station A. Removal of the head piece 1025 from the hook switch at station A opens the contacts 962 of that hook switch and thereby breaks the circuit of the secondary of the buzzer modulating device 949 at station A. Opening of the contacts 947 of the hook switch 1026 by removal of the head piece 1025 at station A also breaks the circuit of the motor 944 at station A. Opening of the contacts 947 of the hook switch 1026 at station A also deenergizes the relay 978 so as to render the cam 983 ineffective to control transmission and reception and so as to transfer such control to the key 981 at station A. The contacts 1050 of the key 981 perform the same general function as is performed by the contacts 992 except that whereas the latter are cam-operated the former (1050) are manually controlled. The contacts 1051 of the key 981 exercise the same control as was exercised by the contacts 984 except that the latter are cam-operated whereas the contacts 1051 are manually controlled. The key 981 is biased to, or normally in, a position in which the contacts 1050 are closed and the contacts 1051 are open. By manual depression of the key 981, the contacts 1050 are opened and the contacts 1051 are closed. If the key 981 at station A is in the position shown, station A is not transmitting at all. If at this time the user at station A happened unnecessarily to press the key 981, an unmodulated carrier would be transmitted from station A. At this particular time it is unimportant whether station A is transmitting an unmodulated carrier or not transmitting at all; the important consideration being that station A is not transmitting at this time a coded modulated carrier.

Returning now to the called station, that is, station B and again assuming that the drawing represents that station, the relay 1002 at station B now becomes deenergized, causing the relays 1008 and 1015 to become deenergized during the low spot interval of the cam 1102 at station B. Deenergization of the relay 1008 at station B causes the relay 1028 at station B to become deenergized and thereby cause the following operations to take place at station B.

Deenergization of the relay 1028 at station B causes the contacts 1034 to open and thereby deenergize the relay 978 at station B and also the primary circuit of the buzzer modulating device 949 at that station. Deenergization of the relay 1028 at station B causes its contacts 1041 to open thereby breaking the secondary circuit of the buzzer modulating device 949 at station B. Opening of the contacts 1034 of the relay 1028 by deenergization of the latter also breaks the circuit of the motor 944 at station B.

Deenergization of the relay 1008 at station B, and the fact that the contacts 1052 of the hook

switch 1026 at station B are now closed, causes the following energizing circuit to be established through the relay 1053 at station B: from the positive side of the $7\frac{1}{2}$ volt battery, through the conductor 930, through the relay 1053, through the conductor 1054, through the contacts 1055 (now closed) of the relay 1008, through the conductor 1056, through the contacts 1052 (now closed) of the hook switch 1026, through the conductors 933 and 927, back to the negative side of the $7\frac{1}{2}$ volt battery.

Energization of the relay 1053 disconnects the primary of the input transformer 1060 of the tube 934 from the radio receiver at station B and connects the output of this radio receiving apparatus to the primary of the transformer 1061, across the secondary of which the head piece 1025 is directly connected. The microphone transmitter 1062 at station B is now effectively connected in the following circuit: from the positive side of the microphone battery, through the conductor 950, through the contacts 1063 (now closed) of the hook switch 1026, through the conductor 1064, through the microphone transmitter 1062, through the conductor 1065, through the contacts 1066 (now closed) of the relay 1028, through the contacts 1067 (now closed) of the same relay, through the conductor 1068, through the contacts 1069 (now closed) of the hook switch 1026, through the conductors 1045, 967, to one side of the microphone input whose other side is connected through the conductor 968 to the negative side of the microphone battery.

Station B is now in condition for speech reception when the key 981 is in the position shown, and is in condition for speech transmission when the key 981 is manually depressed by the user at station B.

Returning now to station A (i. e., again assuming that the drawing represents station A) and having in mind that the modulation has been removed from the carrier transmitted from station B, the relay 1003 at station A becomes deenergized, causing the relays 1008 and 1015 at station A to become deenergized.

Deenergization of the relay 1008 at station A causes the relay 1053 at that station to become energized which results in connecting the primary of the transformer 1061 at that station to the output of the radio receiving apparatus thereof and in rendering the tube 934 ineffective. Effective connection of the microphone transmitter 1062 at station A in series with the microphone battery and the microphone input at that station, is established by deenergization of the relay 1028 by deenergization of the relay 1008 and the opening of its contacts 1029. Station A is now in condition to transmit speech when the key 981 is manually depressed and to receive speech when the key 981 is released, i. e., in the position shown.

When either user at stations A and B desires to talk he depresses his key 981 and when he is not talking he permits the key to stay in the position shown in the drawing, or to return to that position.

After conversation has ceased, the head pieces 1025 at both stations are returned to the hooks of their hook switches and the user at station A throws his call switch 940 to the "off" position. These operations restore stations A and B to their normal periodic monitoring condition.

The operations whereby any of the four stations of this system may call any desired one

of the other three stations will, it is believed, be understood in view of the foregoing description. It will be understood that the system may be extended to more than four stations if desired.

While not essential, I prefer to provide a pilot light at each station to indicate when the call switch at that station has been operated at its calling position and to indicate the operation of the motor 923 at that station. The pilot light 60 is shown connected in parallel with the winding of the relay 929, and being energized with that winding, the pilot light 60 will light when any call switch is moved to calling position and also when the receiver-energizing contacts of the cycling mechanism are closed by that mechanism at the station. The pilot light blinks or flashes in response to periodic closure of those contacts, thus providing a visual monitoring of the apparatus.

While the functions performed by the key 981 may be automatically performed by any one of various known types of speech-operated relays, which may have its winding energized by the speech amplifier or otherwise, I have, for simplicity in illustration, chosen to show the manually operated key 981.

The buzzer modulating device shown at 949 may be of the type comprising a transformer, in the primary circuit of which, a microphone transmitter button is connected in series to act as an interrupter; the microphone transmitter button being mounted on a reed so as to impart a mechanical resonance characteristic to it, the reed being mechanically operated as an armature by the core of the transformer. Such a device is generally similar to the well-known induction coil having an interrupter in its primary circuit actuated by the core upon which the primary and secondary windings are wound. The secondary winding of the transformer constitutes the output of the device. Such devices are readily available and are known as "microphone hummers". It will be understood, of course, that other forms of devices may be substituted for this particular type of tone generator, as for example, audio frequency oscillators, etc.

The mechanically tuned relay shown at 1002 and 1003 may be of the type shown in Figs. 10 and 11 of Australian Patent No. 23,313/35, for Improvements in or relating to wave signalling systems, accepted July 1, 1936, and in Figs. 10 and 11 of British Patent No. 459,235 for Improvements in or relating to radio wave signalling systems, granted April 1, 1937 (each of said patents being issued to Wallace & Tiernan Products, Inc.). It will be understood that the entire apparatus shown in Fig. 10 of each of the patents just cited, is such as may be included within the casing or box shown at 1002 or 1003. Other forms of mechanically or electrically tuned or selective devices may be used in lieu of the particular mechanically tuned device shown in Figs. 10 and 11 of the cited patents.

In accordance with the provisions of the patent statutes, I have herein described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiments thereof, but I desire to have it understood that the apparatus disclosed is only illustrative and that the invention can be carried out by other means. Also, while it is designed to use the various features and elements in the combinations and relations described, some of these may be altered and others omitted and some of the features of each modi-

fication may be embodied in the others without interfering with the more general results outlined, and the invention extends to such use within the scope of the appended claims.

I claim:

1. In a station of a wave signalling system, wave receiving means and control devices for effecting energization of the same, wave transmitting means and control devices for effecting energization of the same, call switch means, and means controlled by the call switch means and including periodically operated contact devices in circuit with the receiver control devices and periodically operated contact devices in circuit with the transmitter control devices, for repeatedly and at respectively successive intervals effecting operation of the wave transmitting means and of the wave receiving means.

2. The combination of claim 1 including also a signalling device, an energizing circuit therefor controlled by the receiving means, means for arresting the periodically operated contact devices, and common control means for operating said arresting means and for opening the energizing circuit of the signalling device.

3. In a wave signalling system, in combination, a plurality of stations each including wave transmitting means and wave receiving means, a plurality of selectable circuit interrupting devices at each station for effecting modulation of the carrier set up by the transmitting means, at different frequencies respectively corresponding to the other stations, a circuit interrupting device at each station for effecting modulation of the carrier set up by the transmitting means at another predetermined frequency common to all stations, means at each station controllable by the receiving means for operating a signalling device to indicate reception of waves, said means including alternatively connectible selective relay devices, one of said relay devices being responsive only to the modulation frequency corresponding to the station and the second of said relay devices being responsive only to the aforesaid common modulation frequency, means for connecting said first relay device to listen for calls from other stations at times when the hereinafter-recited call switch means has not been operated, call switch means at each station for bringing one of the selectable circuit interrupting devices into controlling relation with the transmitting means and for bringing the second relay device under control of the receiving means in place of the first relay device and independent call-replying circuit-controlling devices at each station for bringing the common frequency circuit interrupting device into controlling relation with the transmitter.

4. In a station of a wave signalling system, wave transmitting apparatus, wave receiving apparatus, switch means for controlling the transmitting and receiving apparatus, and means responsive to an operation of said switch means for repeatedly and alternately initiating transmission to another station and conditioning the receiving apparatus to respond to reception of waves from said other station, selective relay means responsive only to a predetermined calling modulation, selective relay means responsive only to a predetermined replying modulation, means connecting the first-mentioned relay means for control by the receiving apparatus when the aforesaid switch means has not been operated, and means responsive to the operation of the switch means for connecting the second-men-

tioned relay means under control of the receiving apparatus in lieu of the first-mentioned relay means.

5. In a station of a wave signalling system, wave transmitting apparatus, wave receiving apparatus, and means for controlling said apparatus, comprising call switch means, reply switch means, means responsive to an operation of the call switch means for repeatedly and alternately initiating transmission of a call to another station and conditioning the receiving apparatus to respond to reception of waves from said other station, means responsive to operation of the reply switch means when the call switch means has not been operated, for initiating transmission of a reply call to another station in answer to an original call from said other station, and means responsive to operation of said call and reply switch means in succession, for maintaining the transmitting apparatus inoperative and for continuously conditioning the receiving apparatus for reception of waves.

6. In a station of a wave signalling system, wave transmitting apparatus, wave receiving apparatus, switch means for controlling the transmitting and receiving apparatus, means operable when the switch means has not been operated, for periodically energizing the receiving apparatus to render it operative during the intervals of energy supply and thereby to conserve energy in listening for calls from another station, and means responsive to an operation of said switch means for repeatedly and alternately initiating transmission to another station and conditioning the receiving apparatus to respond to reception of waves from said other station.

7. In a station of a wave signalling system, wave transmitting apparatus, wave receiving apparatus, and control means therefor comprising call and reply switch means selectively operable to call another station and to reply to a call received from another station, means responsive to an operation of the call switch means for repeatedly and alternately initiating transmission to another station and conditioning the receiving apparatus to respond to reception of waves from said other station, in accordance with a predetermined program, and means responsive to an operation of the reply switch means for repeatedly and alternately initiating transmission to another station and conditioning the receiving apparatus to respond to reception of waves from the last mentioned other station, in accordance with a predetermined program which is substantially different from the first-mentioned program, whereby two-way call signalling may be effected with another station which has transmitted a call in accordance with a program identical with the first-mentioned predetermined program.

8. In a wave signalling system, a plurality of stations each having wave transmitting and receiving apparatus, means at one of the stations for periodically energizing the receiving apparatus to render it operative during the intervals of energy supply, said means including control means limiting the duration of said operative intervals to a predetermined time substantially shorter than the intervals when the receiving apparatus is not energized, and at another of the stations, switch means, for controlling the transmitting and receiving apparatus, including means responsive to an operation of said switch means for periodically and alternately initiating transmission to the first station and conditioning the receiving apparatus to respond to reception of

waves transmitted from the first station, during immediately successive intervals and with the receiving intervals substantially shorter in duration than the periodic receiving intervals at the first station.

9. A wave signalling system having a plurality of stations and comprising: at one station, wave transmitting apparatus, wave receiving apparatus, switch means for controlling the transmitting and receiving apparatus, and means responsive to an operation of said switch means for repeatedly and alternately initiating transmission to another station and conditioning the receiving apparatus to respond to reception of waves from said other station; and at said other station, wave transmitting means adapted to transmit a characteristic call and switch means for interrupting transmission of said characteristic call therefrom; said first station having means controlled by its receiving apparatus and operable in response to cessation of said characteristic call from the other station, for interrupting operation of the means for alternating transmission and reception at the first station.

10. In a wave signalling system, in combination, a plurality of stations each including wave transmitting means and wave receiving means, modulating means at each station for selectively modulating a carrier, set up by the transmitting means, with any selected one of a plurality of different predetermined selective characteristics respectively corresponding to the other stations or with another predetermined selective characteristic common to all stations, whereby each station may transmit either a calling carrier modulated with any selected one of said plurality of characteristics or a replying carrier modulated with said common predetermined characteristic, and selective relay means at each station controllable by the receiving means and settable to respond only to received modulation of a calling carrier of selective characteristic corresponding to the station or to respond only to received modulation of a reply carrier of common selective characteristic, whereby a response may be produced at the station in response to reception of either a calling or a replying carrier.

11. In a station of a wave signalling system, wave receiving means, wave transmitting means, modulating means including means for impressing a primary basic modulation on a carrier set up by the transmitting means, a plurality of selectable circuit interrupting devices for effecting secondary modulation of said carrier set up by the transmitting means, at a corresponding plurality of respectively different predetermined frequencies, and another circuit interrupting device for effecting secondary modulation of said carrier set up by the transmitting means at another predetermined frequency, and control means for said transmitting and modulating means, including call switch means for initiating transmission of a carrier modulated by said primary modulating means and also by a selected one of said plurality of selectable circuit-interrupting devices

to call another station, and reply switch means for initiating transmission of a carrier modulated by said primary modulating means and also by said other circuit interrupting device to effect a reply call in response to a call received by the receiving means from another station.

12. In a station of a wave signalling system, wave transmitting means, wave receiving means, call switch means for causing the transmitting means to call another station, selective relay means controllable by the receiving means and responsive only to one or another of two different predetermined signalling modulations of a carrier received by said receiving means, means operable when said call switch means has not been operated, for causing said relay means to be responsive only to a predetermined one of said two modulations, to listen for calls from another station, and means responsive to operation of said call switch means, for causing said relay means to be responsive only to the other of said modulations, to listen for reply calls from another station.

13. In a station of a wave signalling system, wave transmitting means, wave receiving means, means for producing an alarm signal selectively in response to reception of carriers having one or another of two different signalling modulations, said last-mentioned means having selective control means controllable by the receiving means and responsive only to one of said signalling modulations and selective control means controllable by the receiving means and responsive only to the other of said signalling modulations, and means for selectively conditioning the station to listen for an original call, or for a reply call in response to transmission of a call to another station by the transmitting means, said station-conditioning means being adapted to bring one or the other of the aforesaid selective control means into play, respectively in accordance with the conditioning of the station to listen for an original call or to listen for a reply call.

14. In a station of a wave signalling system, in combination, wave transmitting means, wave receiving means, selective relay means controllable by the receiving means and responsive only to a predetermined signalling modulation of a carrier received by said receiving means, selective relay means controllable by the receiving means and responsive only to another predetermined signalling modulation of a carrier received by said receiving means, control means for said transmitting and receiving means for selectively conditioning the station to listen for an original call from another station or to listen for a reply call from another station in response to a call sent by said transmitting means, and means controlled by said control means for bringing one or the other of said selective relay means under control of the receiving means respectively in accordance with the conditioning of the station to listen for an original call or a reply call.

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