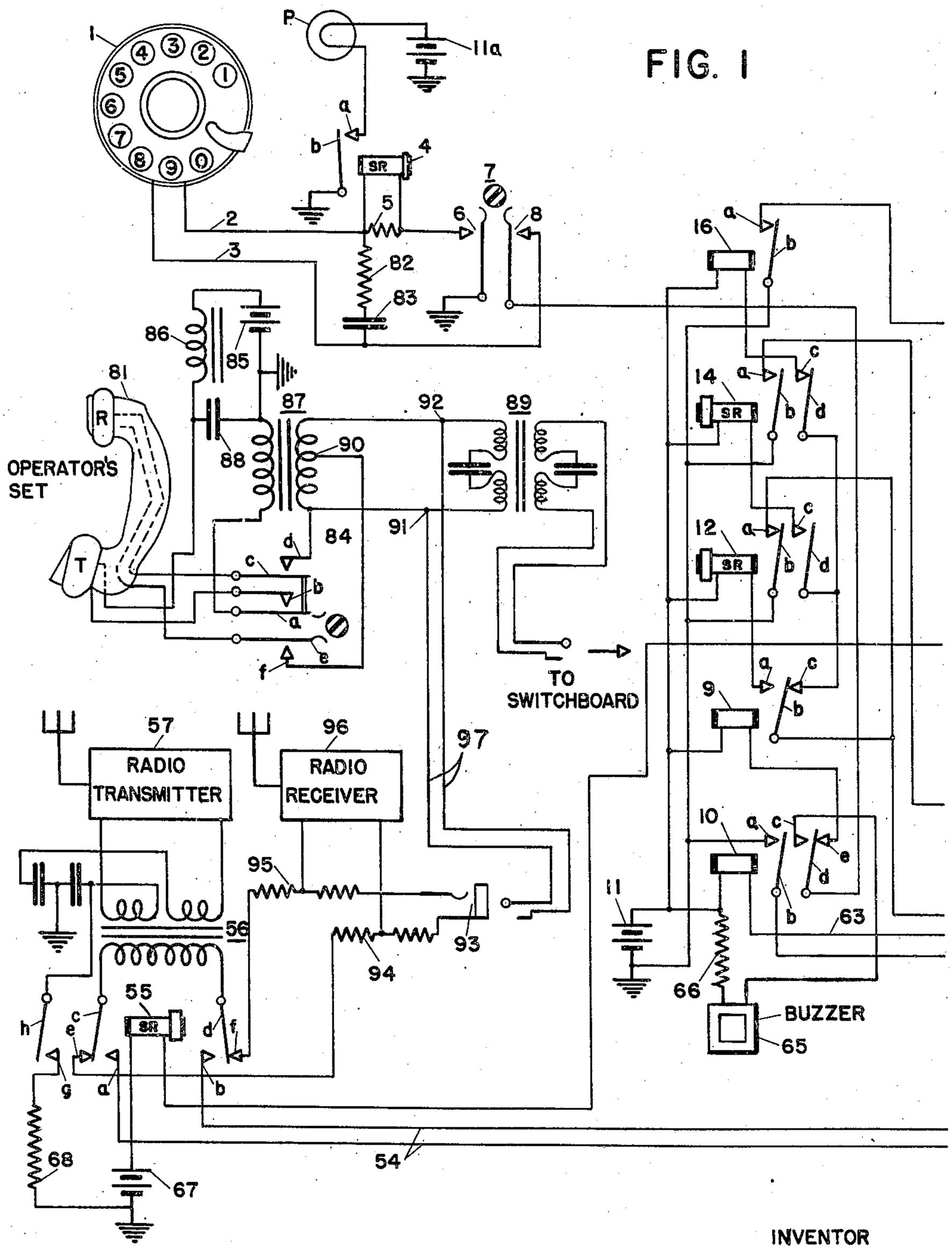
Oct. 4, 1949. D. TALLEY 2,483,445

TRANSMITTER SYSTEM

Filed Dec. 13, 1946 3 Sheets-Sheet 1

FIG. 1



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TRANSMITTER SYSTEM

Filed Dec. 13, 1946 3 Sheets-Sheet 2

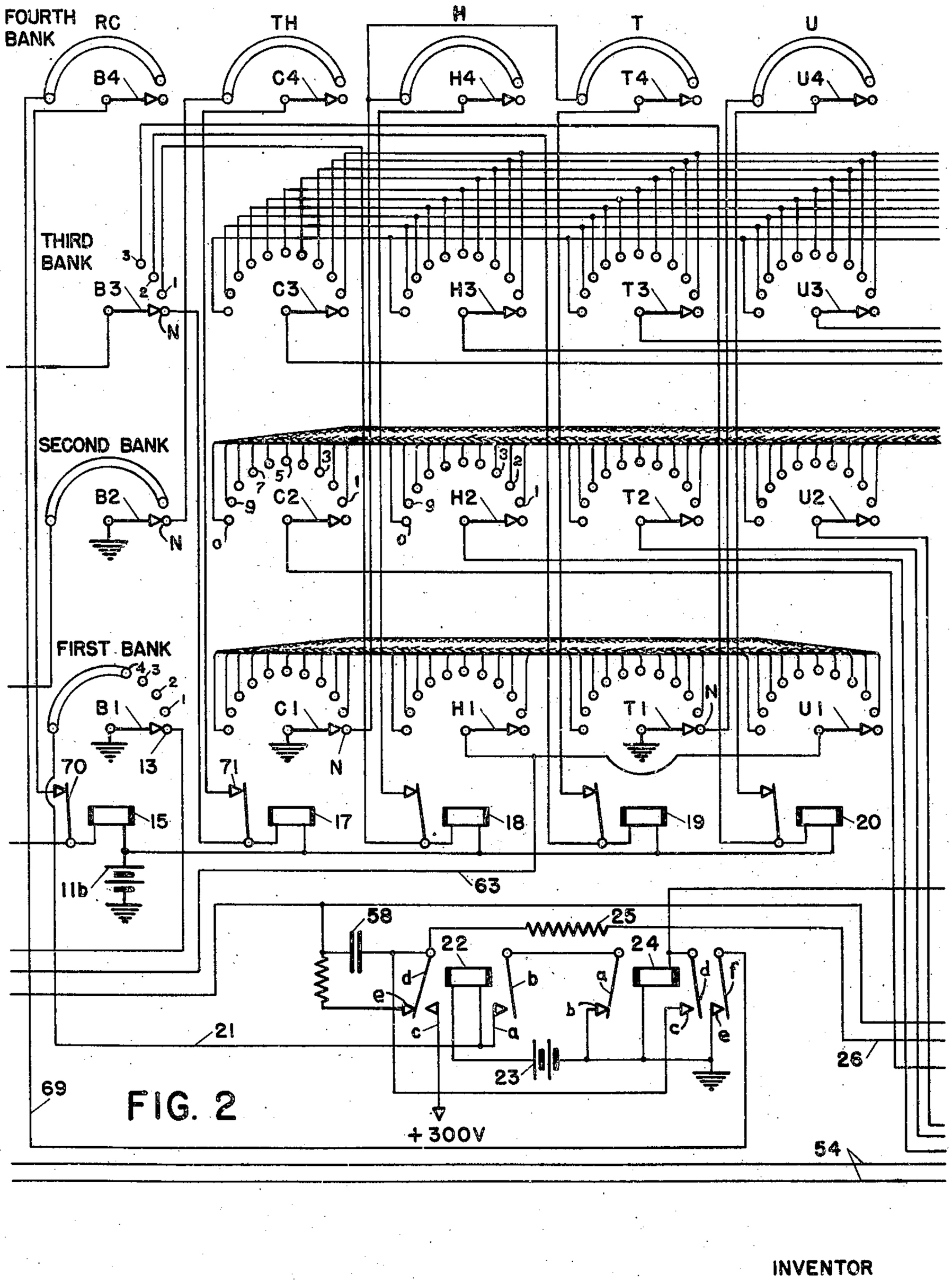

FIG. 2

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TRANSMITTER SYSTEM

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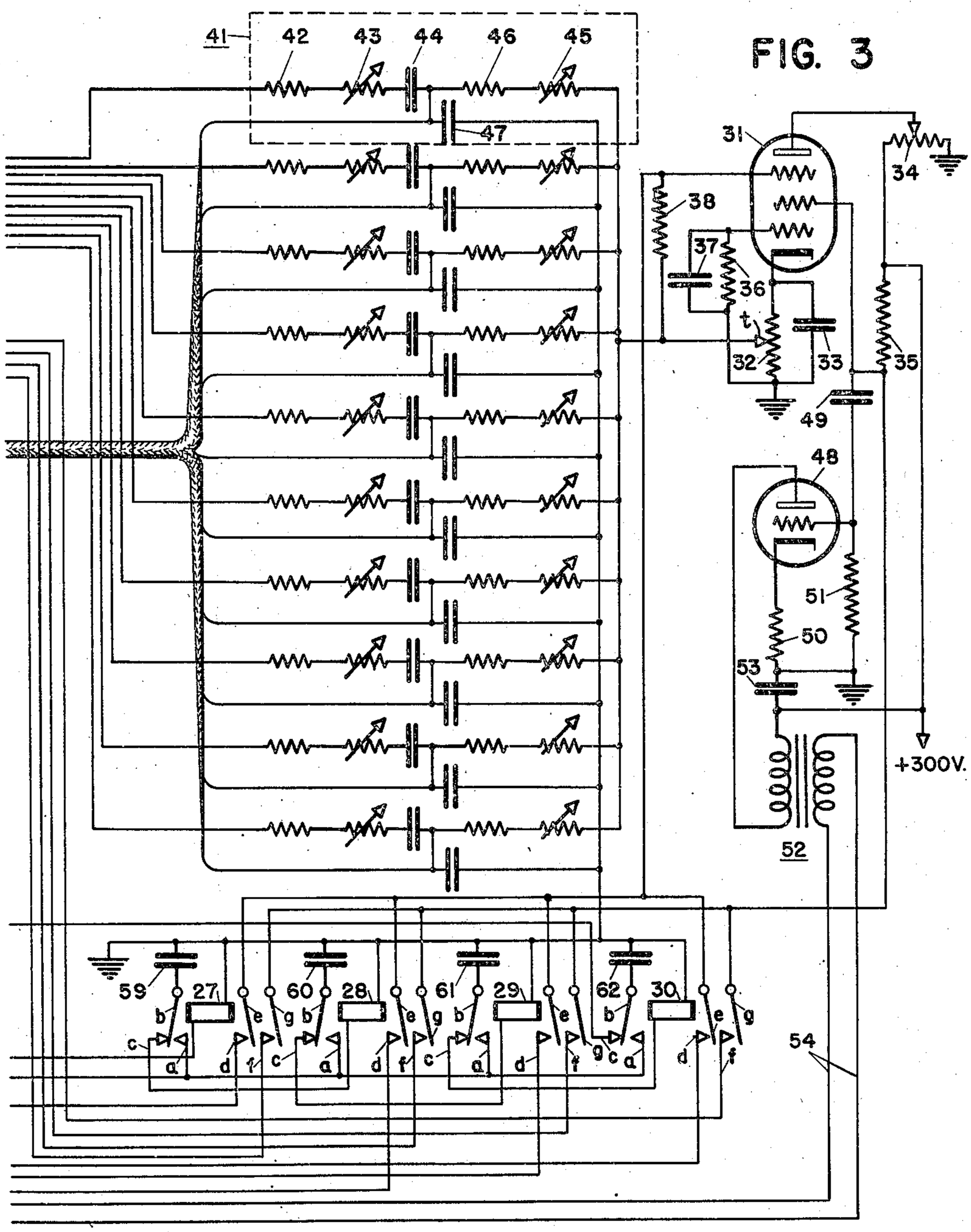
FIG. 3



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UNITED STATES PATENT OFFICE

2,483,445

TRANSMITTER SYSTEM

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Application December 13, 1946, Serial No. 716,137

6 Claims. (Cl. 177—380)

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This invention relates to radio-telephone systems and particularly to equipment which is required for calling a selected station through a radio channel.

The method of selective signaling which is herein disclosed comprises setting up in storage equipment a plural digit number constituting the call number of a desired station. The digits are translated into different audio-tone signals which are then transmitted in succession to the remote radio receiver of the called station. The selective frequency-responsive devices which may be used at any number of receiving stations are preferably of the type which comprises tuned reeds whereby the plural digital call number can be detected.

For disclosures of selective receiving systems which would suitably co-operate with my invention reference is made to two co-pending applications of Robert C. Ferrar and Gerald Menhennett, joint inventors; these applications being identified as Ser. No. 695,544, filed Sept. 7, 1946, and Ser. No. 697,670, filed Sept. 18, 1946.

The instant application specifically describes equipment which is preferably employed at a control terminal for transmitting a call signal composed of frequency-selective impulses. My system employs an ordinary telephone dial for transmitting trains of pulses corresponding to the digits of a four-digit number. The same principles of operation are applicable to call numbers having more or less than four digits. Connected with the dial for pulsing purposes is a series of storage devices, preferably of the rotary switch type. These rotary switches are first stepped into position to store the call number. Immediately thereafter the call signal itself is transmitted over a radio channel. At this time different low frequency networks are chosen for controlling the modulation frequencies generated by an oscillator and then applied to modulate a sub-carrier wave which is superimposed upon a radio frequency carrier wave. In order to transmit the several audio-frequency signals which represent the digits of a call number, relay means are employed which pick up the stored digits of the number successively. The operation is completely automatic after the dialing has been completed by the control terminal operator.

It is an object of my invention to provide control terminal equipment which may be associated with any land line telephone system and with a radio telephone system whereby a call number placed by a calling subscriber may be translated

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into modulated radio signals suitable for calling a distant station on land, water, or in the air.

It is another object of my invention to provide transmitting facilities which may be carried aboard a vehicle, vessel or airplane for calling another station whether mobile or stationary.

Still another object of my invention is to provide equipment for initiating a busy signal whenever the calling operator dials a number which is not usable in the call system. The aforementioned receiving systems of Ferrar et al. will not respond reliably to call numbers such as 4432, 5116 or 6788 because each digit must be different from the immediately preceding digit.

Other objects and features of my invention will be made apparent in the detailed description to follow. This description is accompanied by drawings in which a complete circuit diagram of the essential components is spread over three sheets bearing Fig. 1, Fig. 2 and Fig. 3, respectively. These figures are not individually described at this point because they must be viewed in their entirety, placing Fig. 1 on the left, Fig. 2 in the center, and Fig. 3 on the right, so that conductors extending from one figure to an adjacent figure may easily be traced.

Referring to the drawings, the general plan of the circuit arrangement may be briefly described as follows:

In Fig. 1 a conventional telephone dial 1 is shown; also an operator's set 81, radio apparatus including a transmitter 57 and a radio receiver 96, and various control relays the respective functions of which will presently be explained. A plurality of radio receivers having geographically spaced antennas may be included in a diversity receiving system if desired for wider coverage of the area in which mobile stations could be reached for communication with a given control station.

In Fig. 2 I show a set of rotary switches RC, TH, H, T and U, having stepping magnets 15, 17, 18, 19 and 20 respectively and each having four banks of arcuately disposed contacts and associated wiper brushes. The RC switch is used to direct the dialing pulse trains into the other rotary switches successively for storing the four digits of a call number.

In Fig. 3 I show an oscillation generator 31 having a plurality of time-constant circuits 41 which are arranged for selective connection to the input electrodes of a discharge tube 31. Relay means are also shown whereby successive selection of different time-constant circuits may be made, so that the generator will emit a chosen

series of low frequency tone signals which represent the digits of a selective call signal.

The telephone dial 1 will be understood to comprise a pulse-producing circuit-breaker connected across conductors 2 and 3. The dialing circuit may be traced from ground through contacts 6 of a dialing key 7, relay 4 (which is preferably shunted by a resistor 5), the circuit-breaking contacts (not shown) of the dial 1, contacts 8 of said key 7, normally closed contacts *d* and *e* of a relay 10, the coil of a quick-acting relay 9, and thence through a direct current source 11 to ground. A resistor 82 and a capacitor 83 (in series therewith) are preferably connected between conductors 2 and 3 for spark suppression at the contacts of the dial 1.

A pilot lamp P is lighted by power from a source 11*a* upon closure of contacts *a* and *b* on relay 4, the lamp serving to indicate that the system is in readiness for dialing the code of the called mobile station. Lamp P remains lit until key 7 is restored to normal, except when an incorrect dialing operation occurs, in which case the lamp is extinguished by release of relay 4, contacts *d* and *e* of relay 10 being opened, as will be explained later. Relay 4 is of the slow-release type, as indicated by the symbol SR within its outline. Other slow-release relays are similarly identified by this symbol.

For the sake of brevity in tracing the circuits, relay contacts will hereafter be referred to by a letter or letters having a numerical prefix corresponding to the reference for the contact-controlling relay itself. Two letters separated by a hyphen indicate closed relay contacts.

Relays 4 and 9, being in series, are energized immediately upon operating key 7. Contacts 9*a* and 9*b* are closed for the purpose of energizing a slow-release relay 12, the circuit for which may be traced from source 11 through the coil of relay 12, through relay contacts 9*a*—*b* and thence through normal contact 13 on the first bank of a rotary switch RC, to the grounded brush B1. At the outset this and all of the other rotary switches shown in Fig. 2 stand with their brushes set on their normal contacts.

When relay 12 pulls up, its circuit is locked, as can be seen by tracing it from source 11 through its own coil, contacts 9*a*—*b* and contacts 12*a*—*b* to ground. Relay 12 remains operated during the dialing of the complete code number (except for errors which cause relay 16 to operate), and is released by restoring key 7 to normal. The closing of relay contacts 12*c*—*d* prepares a circuit through the coil of a slow-release relay 14 and thence to the source 11 by which it is energized. This circuit is completed through contacts 9*c*—*b* and contacts 12*a*—*b* on the first and subsequent breaks of the contacts in the dial 1.

Relay 14 operates to close its contacts *a* and *b*, also its contacts *c* and *d*. Contacts 14*a*—*b* complete a circuit through the stepping magnet 15 for rotary switch RC. Circuit interruptions produced by the dial 1 are used to release relay 9 momentarily. So, while slow-release relays 12 and 14 remain operated each release of relay 9 closes an operating circuit for relay 16, this circuit being traced from source 11 through the coil of relay 16, through relay contacts 14*c*—*d*, relay contacts 9*b*—*c*, relay contacts 12*a*—*b*, and thence to ground.

Relay 16 counts the dialing pulses for each digital train. Closure of contacts 16*a*—*b* causes brush B3 on the third bank of rotary switch RC to be grounded. This brush, therefore, directs the

dialing pulses of successive digital trains into stepping magnets 17, 18, 19 and 20 of the rotary switches TH, H, T and U respectively, for setting the same to store the code number of the called station.

At the end of the pulse train for the thousands digit relay 9 remains operated which causes relay 14 to release after a short interval. The release of this relay de-energizes the stepping magnet 15 and causes the brushes of switch RC to move from position N to position #1. The next release and operation of the relay 9 for the second dialed digit will in a similar manner operate stepping magnet 18 for rotary switch H, thus storing the digit in the hundreds place. The rotary switches operated by stepping magnets 19 and 20 will be caused to store the remaining digits of the dialed code number.

The rotary switch RC, upon making its fourth step, that is, after the units digit has been stored, places ground potential upon a conductor 21 which leads to the coil of a relay 22 and thence to the positive terminal of a source 23, the negative terminal of which is grounded. This operation, therefore, energizes relay 22 which locks up through its own contacts *a* and *b* until such time as the locking circuit is broken by the energization of a relay 24.

Relay 22 closes its contacts *c* and *d* for carrying a 300 volt positive potential through a resistor 25 and thence to a conductor 26 which is connected jointly to front contacts *a* of four relays, 27, 28, 29 and 30 respectively. These relays are used for successive transmission of the tone frequencies which are selected by the storage means of the rotary switches so that the digits of the call number may be transmitted in proper succession.

In order to characterize the digits of the code number by different predetermined frequencies, an oscillation generator is used in association with selectable networks which are tuned to desired selective frequencies. The oscillator per se comprises an electron discharge tube 31 which is preferably of the pentode type. Its cathode is connected to ground through a cathode resistor 32 shunted by a capacitor 33. The anode is connected to a source of DC potential, preferably of 300 volts rating, the connection being made through a voltage divider 34 and an intermediate tap thereon. The voltage divider 34 is connected directly across the terminals of the 300 volt source, the negative terminal of which is grounded. The screen grid in tube 31 is connected to the same DC source through a resistor 35. The control grid is connected to ground through a resistor 36 which is shunted by a capacitor 37. The suppressor grid is connected through a resistor 38 to an intermediate point *t* on the cathode resistor 32, this point being adjustable as in the case of a potentiometer. The suppressor grid is also connected to contacts *e* of relays 27, 28, 29 and 30 in order that different ones of the rotary switches may be used to select the proper time constant networks for association with the oscillator in transmitting the elements of the code signal.

There are ten time constant networks 41 and the like, each having its resistive and capacitive components differently adjusted for determination of different audio-frequencies which are to be generated. Each of these networks comprises two sections, one containing a fixed resistor 42, in series with an adjustable resistor 43, and a capacitor 44, while the other section contains a

fixed resistor 46 in series with an adjustable resistor 45. The junction between the two sections is coupled to ground through a capacitor 47.

Any one of the networks 41 and the like may be selected to be connected to the common part of the oscillator circuit, the connections being made through contacts and brushes in the second and third banks of a rotary switch, as determined by the brush positions and by the selected operation of relays 27, 28, 29 and 30. These connections are, of course, made successively for generating the digit-representing frequencies for the thousand, hundred, ten, and unit orders of the call number. During the closure of contacts *d* and *e* on one of the relays 27, 28, 29 and 30, therefore, the suppressor grid in tube 31 is connected through a brush and contact in the second bank of a rotary switch to the junction between capacitors 44 and 47 of the selected network. Also, the closure of contacts *f* and *g* on one of the relays 27, 28, 29 and 30 connects the screen grid of tube 31 through a brush and contact in the third bank of a rotary switch to the left hand end of the selected network 41 or the like.

By those skilled in the art it will be understood that the circuit arrangement of tube 31 includes a selected one of the frequency-determining networks 41 and the like, and a given selection causes the generation of a tone frequency which may be utilized to characterize the signal for any digit of a code number. The oscillations are sustained by virtue of the feedback potentials which are derived from the tap *t* on the cathode resistor 32 and carried to the screen grid and the suppressor grid after suitable phase displacement by the two sections of the time constant network. The magnitude of the feedback potential is governed by the setting of the tap *t* along the cathode resistor 32, it being noted that this setting influences the self-biasing action with respect to the control grid, where the latter is connected to ground through the bias resistor 36.

The output from tube 31 is utilized in an amplifier tube 48, the control grid of which is coupled across a capacitor 49 to the screen grid in tube 31. The amplifier tube 48, although shown as a triode, may, if preferred, be of a multi-grid type. As shown, however, the tube 48 possesses a cathode which is connected to ground through a cathode resistor 50. Its control grid is connected to ground through a resistor 51. Its anode is connected to the positive side of the 300 volt source through the primary coil of a transformer 52. A by-pass capacitor 53 is connected across the terminals of the 300 volt source close to one terminal of the transformer primary in order to by-pass parasitic frequencies. The secondary winding of transformer 52 has its terminals connected through conductors 54 to front contacts *a* and *b* of a slow release relay 55, the energization of which takes place as soon as rotary switch RC has moved away from its normal position N. The output from the transformer 52 may thus be delivered through a transformer 56 to a radio transmitter 57 from which the call signal is radiated.

In order to actuate the relays 27, 28, 29 and 30 successively and thereby to transmit the stored digits commencing with the thousands digit, relay 22 first impresses a charge upon a capacitor 58 which is in circuit with the coil of relay 27, upon being connected between the 300 volt source and ground, as when contacts *c* and *d* of relay 22 are closed. Relay 27 therefore operates for a moment until the capacitor 58 becomes fully charged. When relay 27 operates, a charge is placed upon capacitor 59 which is then used to actuate relay 28 as soon as relay 27 releases, the discharging circuit being closed through relay contacts 27*b*—*c*.

Next a charge is impressed upon capacitor 60 during the energization of relay 28, energy being drawn from the 300 volt source through relay contacts 22*c*—*d* and through resistor 25 as in the previous case. This charge is dissipated upon the release of relay 28 through its contacts *b* and *c* and through the coil of relay 29. In like manner, capacitors 61 and 62 are successively charged and discharged by the operation of relays 29 and 30 respectively. Now, since the right hand contacts of each of the relays 27, 28, 29 and 30 are effective in closing circuits through the brushes on the second and third banks of the rotary storage switches, it will be seen that different time constant networks becomes associated with the oscillator 31 for causing the selected elements of the code signal to be translated into frequency components which are then transmitted by the radio transmitter 57.

Relay 55 is operated when rotary switch RC has made its first step to position #1. The operating circuit for relay 55 may be traced from ground through source 67, through the relay coil, through the interconnected terminals 1, 2, 3 . . . . 0 in the second bank of rotary switch RC and to its grounded brush B2. The operation of relay 55 connects the output of the low frequency tone oscillator circuit to the transmitter 57, as before described. A second function of relay 55 is to close a circuit from ground through a resistor 68 and thence through contacts 55*g*—*h* and over one conductor of the telephone line to the transmitter, whereat certain relays are actuated for closing the filament and anode circuits of a 7 kc. oscillator to be used as a sub-carrier in transmitting the call number. This sub-carrier is modulated by the low frequency tones to which the tuned reeds respond selectively at the called mobile station.

Other details of a suitable remote control system for the radio transmitter are not herein given as they are not essential to the inventive concept of this case. In general, they are in accord with usual radio telephone practice. Furthermore, it will be understood that no attempt has been made to describe or show completely such details of a practical radio-telephone system and switchboard equipment as are immaterial to a disclosure of the invention itself.

The holding time of relay 30 is concurrent with the transmission of the units digit of the call number, being governed by the time required to dissipate the charge in capacitor 61. When relay 30 releases a discharge circuit is closed for capacitor 62. This discharge circuit includes the coil of relay 24 which is energized and performs several functions as follows:

(*a*) Conductor 69 is grounded through contacts 24*e*—*f*.

(*b*) A locking circuit for relay 24 is established until relay 22 releases, this circuit being traced from the 300 volt source through contacts 22*c*—*d*, contacts 24*c*—*d*, the coil of relay 24 and thence to ground.

(*c*) One of two locking circuits for relay 22 is opened by pulling up contact 24*a* away from contact 24*b*. This leaves relay 22 subject to release by opening its second locking circuit through conductor 21, the interconnected contacts 4, 5,

6 . . . 0 and the grounded brush B1 in the first bank of rotary switch RC.

The above mentioned function (*a*) of relay 24 is for the purpose of restoring rotary switch RC to normal. The restoring circuit may be traced from ground through contacts 24*e*—*f*, conductor 69, through the interconnected terminals #1 to #0 inclusive in the fourth bank of rotary switch RC and through the interrupter contacts 70 associated with the stepping magnet 15, and through the coil of magnet 15 to the source 11*b* by which it is operated.

Rotary switches TH, H, T and U will in turn be restored to their normal positions. In the case of the rotary switch TH the interrupter circuit through its stepping magnet 17 may be traced from the grounded brush B2 on the second bank of rotary switch RC and thence through terminals #1 to #0 on the fourth bank of the rotary switch TH, and from the brush C4 thereof to the interrupter contacts 71 operated by the stepping magnet 17.

In like manner the rotary switches H, T and U will be restored to normal, each through a grounded brush on the first bank of a preceding rotary switch, except that, if desired, the rotary switches H and T may be simultaneously restored to normal, this being preferably accomplished by joining their interrupter circuits together. The return of brush C1 on first bank of rotary switch TH to its normal contact N, therefore, restores switches H and T.

Relays 22 and 55 are released when rotary switch RC has been brought to its homing position, since these relays up to that time were held by locking circuits through grounded brushes B1 and B2 respectively of rotary switch RC. The release of relay 22 will unlock relay 24. The release of relay 55 will reconnect the radio transmitter to the cord connections leading to the switchboard and to the operator's set.

As explained in the aforementioned applications of Ferrar, et al., it is not possible to use the same number in adjacent digits of the code, for example, 2233, 6775, 4288, altho a number like 2323, or 7675 may be used. The reason for this is that the responsive means at the receiver includes tuned reeds, one for each digital place in the call number. The reeds must be vibrated successively beginning with the one which represents the thousands digit. When that reed vibrates it prepares a circuit for the reed in the hundreds place to respond. If adjacent reeds were tuned to the same frequency erroneous responses would be made.

In order to avoid the transmission of unusable code numbers the first bank of contacts in rotary selector switch TH has its terminals #1 to #0 inclusive strapped to corresponding terminals in the first banks of switches H, T and U. If the operator should erroneously dial the same digit successively, as for example 8843, ground potential from the brush on the first level of rotary selector switch TH will be connected through a contact in the first level of switch H and over conductor 63 to the coil of relay 10, on the other side of which is the negatively grounded source 11. This causes relay 10 to operate and to close its contacts *a* and *b* as well as its contacts *c* and *d*. The closure of contacts *a* and *b* is effective in short-circuiting the winding of relay 27, thus preventing it from operating. The closure of contacts *c* and *d* is effective in actuating an interrupter device 65. The interrupter circuit may be traced from the grounded source 11 through

a resistor 66, through the energizing coil (not shown) of the interrupter 65, through contacts 10*c*—*d* and thence through contacts 8 of key 7, through the dial 1, contacts 6 of key 7 and thence to ground. The interrupter device 65 produces a "busy" signal and notifies the operator that she should re-dial the number. In addition to the busy signal a pilot lamp (not shown) may also be flashed to indicate false dialing. The operator will then remove her calling cord momentarily, thereby releasing the controlling terminal equipment, and should re-dial the correct number. The non-operation of the relay 27 will open an operating path for relays 28, 29, 30 and 24 so that the low frequency selective signalling tones cannot be transmitted.

In the above given example of erroneous dialing the unusable call number 8843 was mentioned. In that case brushes C1 and H1 in rotary switches TH and H would both be set on terminal #8 in their respective banks. Since these terminals are interconnected conductor 63 would be grounded and relay 10 energized. If the operator had dialed the unusable number 4883, the same result would be obtained since conductor 63 would be grounded through brush H1, interconnected terminals of the first bank in switches H and T and thence to grounded brush T1. So for that case as well as for the unusable number 4388 relay 10 would operate to avoid the erroneous call transmission.

A call number such as 4343 is usable because in the systems of Ferrar et al. covered by the aforementioned co-pending application means are employed for the use of two digit-representing reeds tuned to the same frequency and separately energized by sequence switching. Such repetition of a figure is limited, however, to non-adjacent digits. So far as the instant disclosure of transmitting equipment is concerned there is another class of unusable call numbers, namely that in which the figures in the thousands place and in the units place are alike. Transmission of a number like 8328 is, therefore, avoided, since relay 10 will be operated by grounding conductor 63 through brush U1, interconnected terminals #8 in the first banks of switches U and TH, and the grounded brush C1.

The operator's equipment for responding to toll calls and for dialing the call number of a remote radio station comprises a hand set 81 having the usual microphone T and earphone R. The operator is also equipped with a talking key 84 and with a dialing key 7 as well as a monitoring key (not shown). The microphone T is connected through a circuit which may be traced from ground and includes a battery 85, a choke coil 86, the microphone element, contacts *b* and *a* of key 84, and the primary winding of a transformer 87. The voice currents are shunted around the battery 85 and the choke coil 86 by means of a capacitor 88.

The secondary coil of transformer 87 has its terminals connected in circuit with transformer windings of a transformer 89, other windings of which are connected to a cord and plug for insertion in a suitable jack on the toll switchboard.

The receiver unit R is in circuit with contacts *c* and *d* on one side and *e* and *f* on the other side, where contact *d* is connected to the one of the terminals on each of the interconnected transformer coils 87 and 89, and on the other side through contact *f* to a tap 90 on the secondary winding of transformer 89. The secondary winding in transformer 87 is tapped at a point

90 which unequally divides this coil and provides a suitable bucking action with respect to locally produced voice currents which are induced into the earphone circuit. This arrangement however, does not appreciably attentuate the incoming voice currents from the telephone switchboard.

Connections at junction points 91 and 92 are made to a cord and plug circuit 97 which may be connected with a jack 93 and thence to voltage dividers 94 and 95 which are used for making connections both to the radio transmitter 57 and to the radio receiver 96. In place of resistive units 94 and 95 hybrid transformers may be used if desired, in which case connections would be made between the jack 93, the radio receiver 96, and the radio transmitter 57 in accordance with conventional practice.

My invention is capable of modification of its structure in various ways without departing from its spirit and scope. The details of the embodiment herein described and shown are, therefore, not to be construed as imposing any limitations upon the breadth of the invention.

I claim:

1. A station calling system of the type wherein each station has a distinctive call number to which it alone responds, said system comprising settable means for storing digit-by-digit the elements of a chosen call number, means for transmitting over a communications channel a series of signal frequency pulses each pulse of which is characterized as to frequency by the setting of a respective digital element of said storing means, means for comparing adjacent digits of a call number as stored in said settable means and means operative to prevent the transmission of such call number when like digits in any two adjacent elements of said settable means are detected by said comparing means.

2. In a station calling system a circuit interrupting dialing device for producing counting pulse trains, relay means operative under control of said device, circuit transfer means subject to control by said relay means at the termination of each counting pulse train, a plurality of rotary switch units constituting means for storing the digits of a call number, each unit comprising a stepping magnet, and a plurality of contact banks with associated brushes, interconnections between corresponding terminals in one of the contact banks of each switch unit, these particular banks constituting comparison means for detecting the presence of the same figure in adjacent ordinal places of the call number, and a relay operable under control of said comparison means; the first said relay means and said circuit transfer means being effective to cause successive responses to be made by said stepping magnets, thereby to set up the storage of a dialed call number in said storage means, and the last said relay being effective to produce results indicative of erroneous dialing and to initiate operations of (1) said relay means, (2) said circuit transfer means and (3) said storing means, thereby to restore the same to normal.

3. In a system for transmitting a train of signals suitably characterized for individual response thereto by translating means at a selected one of a plurality of stations, the components of said train corresponding to the digits of a station call number, a relay for controlling the transmission time of each signal component, a relay for initiating the transmission of the first signal component, relay means for restoring said system

to a normal state upon completion of the signal train transmission, and means including a plurality of capacitors the charging and discharging of which is progressively effected, thereby to operate first said transmission initiating relay, then successive ones of said transmission time controlling relays, and finally said system restoring means.

4. In a device for transmitting a train of signals the components of which are suitably characterized to represent the digits of a station call number, means selectively settable to positions corresponding to each digit of said number, modulation frequency generating means for characterizing said signal components, means normally operable under control of said settable means for causing said generating means to compose a signal train representing the number of a station to be called, means for blocking the control of said generating means by said settable means whenever such control would result in the composition of a signal train representing a call number in which the same figure appears twice in immediate succession, and means operative in that event to restore said device to normal prior to the transmission of any signal train.

5. In a system for transmitting a train of signals suitably characterized to constitute in their totality an indication to be transmitted from a first to a second station, in combination, a transmission channel interconnecting said stations, a plurality of storing means each presettable to a condition corresponding to a respective one of said signals, signal generator means operable in accordance with the condition of any of said storing means, when connected thereto, for transmitting a corresponding one of said signals over said channels, a chain of relays having armatures and contacts operable to connect successive ones of said storing means to said signal generator means, and energizing circuit means for said relays, said energizing circuit means including a plurality of capacitors each connected to an armature of a respective relay, a direct current source adapted to charge any of said capacitors by way of the armature connected thereto and a front contact associated with said armature, a discharge circuit for said condenser including said armature, a back contact associated with said armature, and the winding of a relay immediately succeeding in said chain the particular relay to whose armature said capacitor is connected whereby said succeeding relay will be energized momentarily upon de-energization of said particular relay, and circuit means for momentarily energizing the first relay of said chain.

6. The combination according to claim 5 wherein said last circuit means comprise a source of direct current, a condenser, and a relay having contacts adapted to connect the last-mentioned source in series with said condenser and the winding of said first relay.

DAVID TALLEY.

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