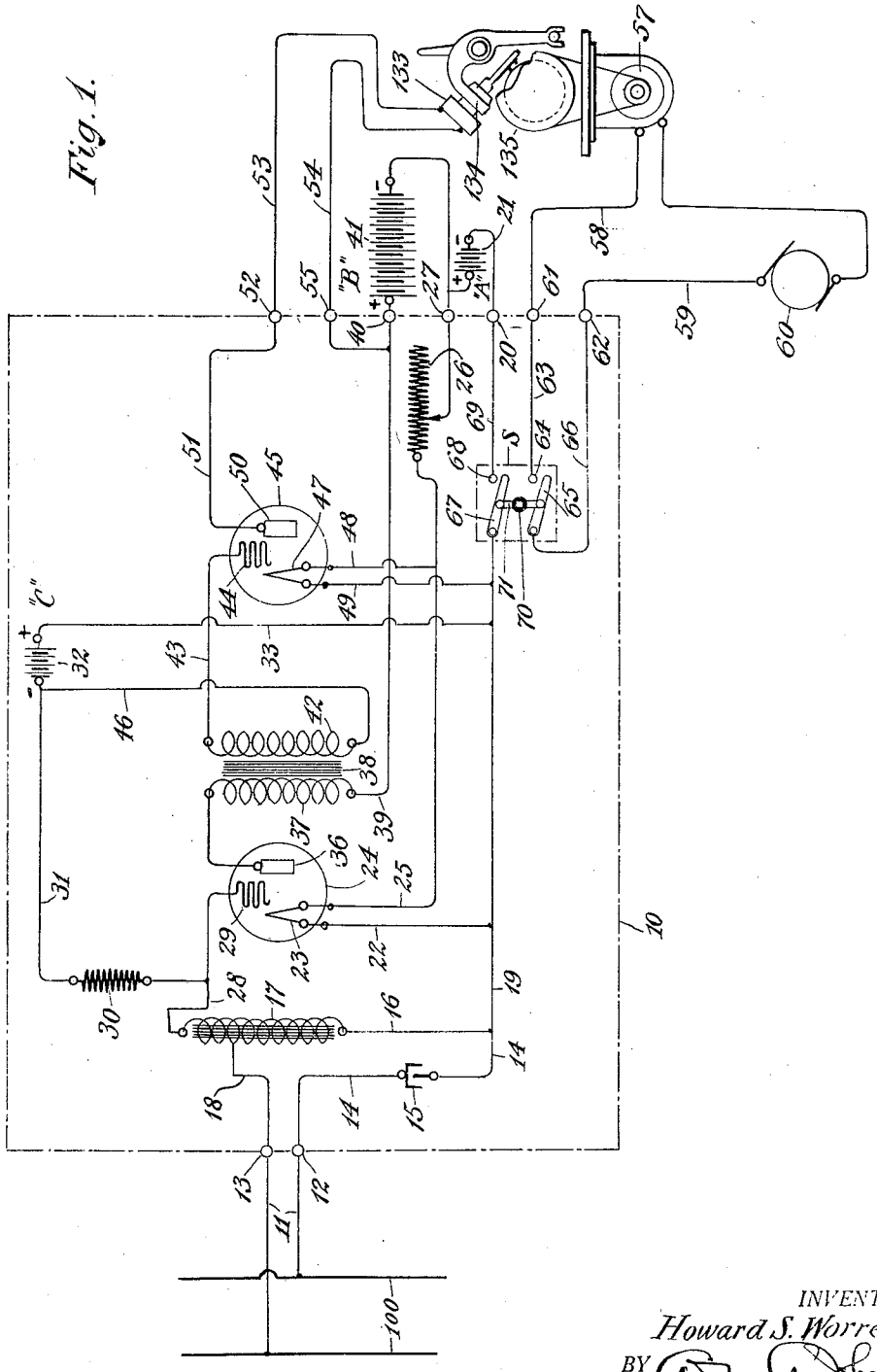
Sept. 15, 1931. H. S. WORRELL 1,823,717

TELEPHONE RECORDING SYSTEM

Filed July 22, 1926 3 Sheets-Sheet 1

Fig. 1.



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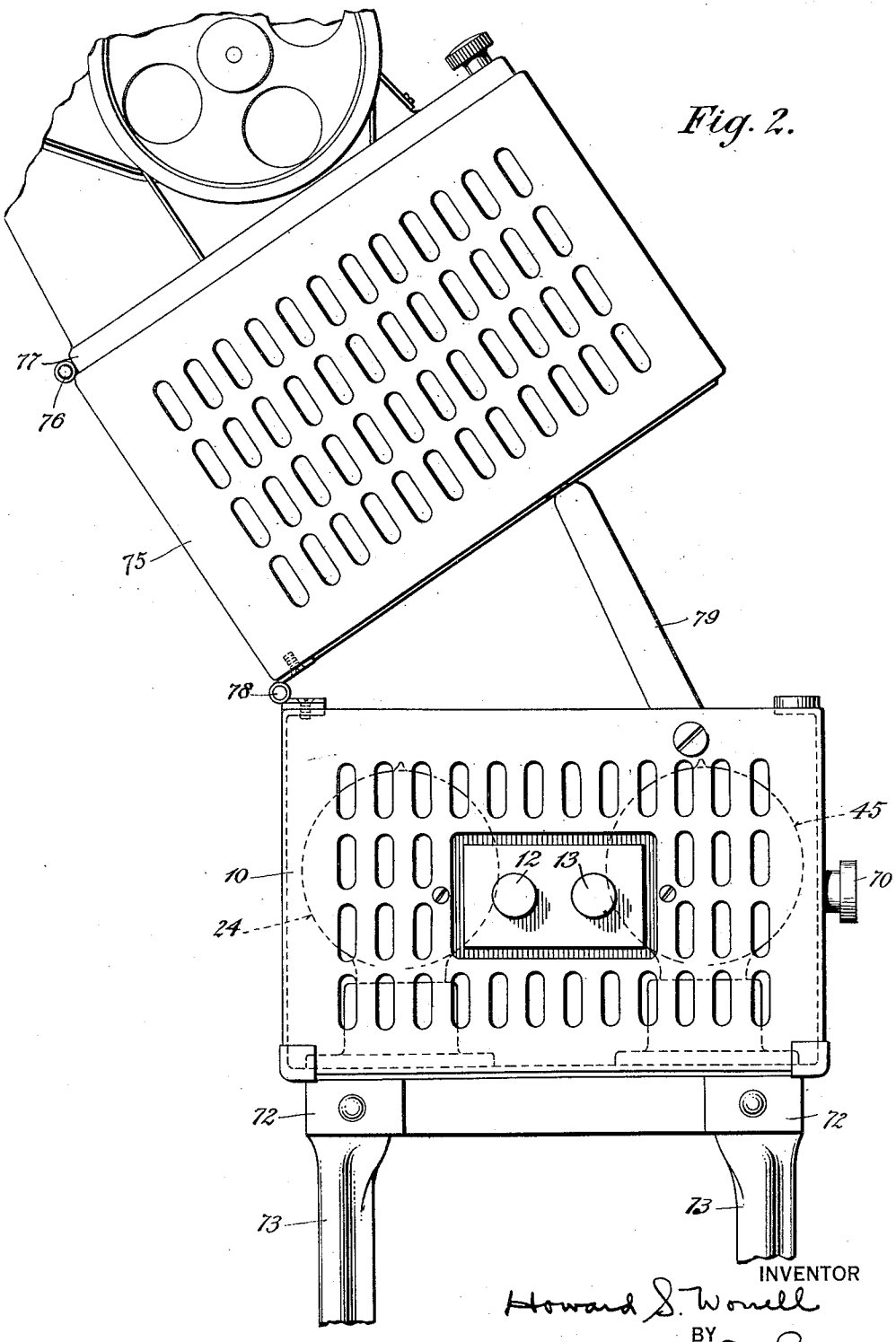
Filed July 22, 1926 3 Sheets-Sheet 2

Fig. 2.



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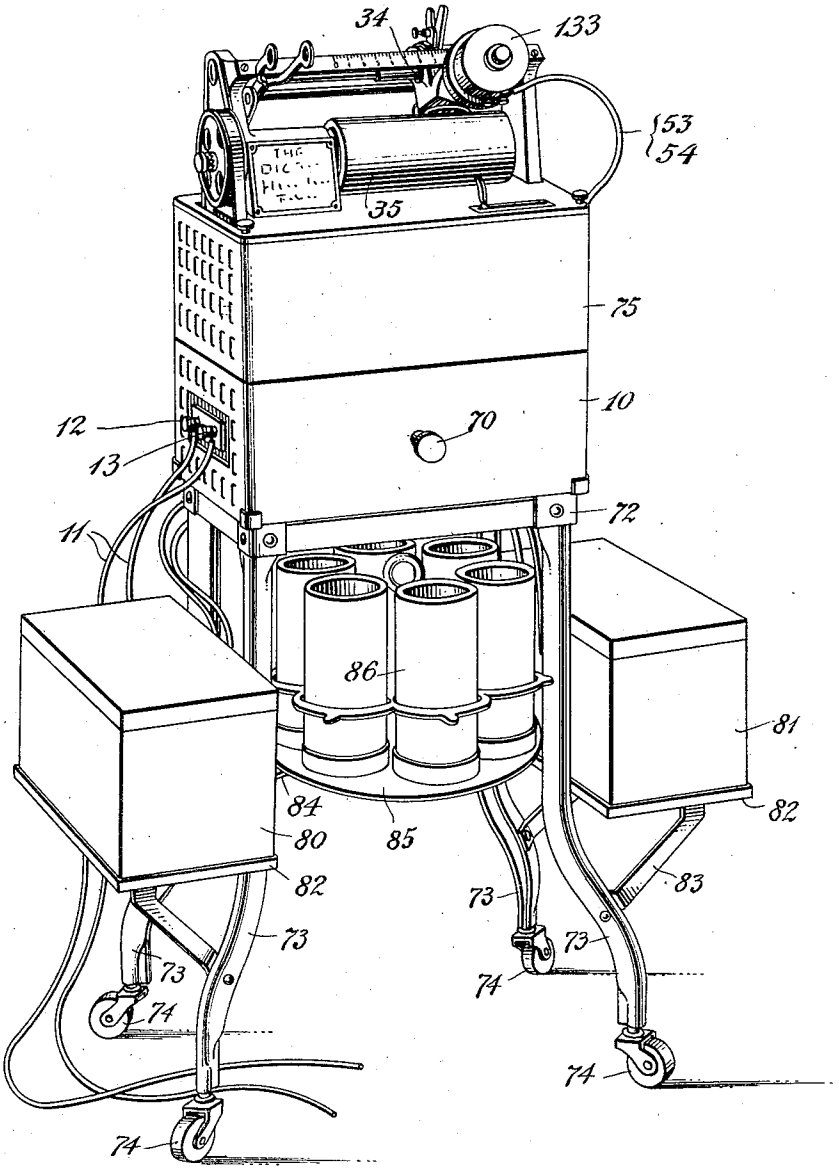
Filed July 22, 1926 3 Sheets-Sheet 3

Fig. 3.



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UNITED STATES PATENT OFFICE

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TELEPHONE RECORDING SYSTEM

Application filed July 22, 1926. Serial No. 124,232.

This invention relates to amplifying and recording telephonically transmitted sounds.

An object of this invention is to provide for amplifying and recording sounds transmitted over a telephonic circuit at audio-frequencies, and yet avoid detrimental effects to the transmission.

Another object is to provide for controlling the apparatus used to amplify and record sounds, so that it will be practically fool-proof, and will require practically no attention on the part of the user.

A further object is to provide a self-contained and unitary apparatus for amplifying telephonic sounds and recording such sounds upon a phonograph record which may be employed subsequently to repeat the sound received.

And a still further object is to provide as a single portable unit an amplifying apparatus utilizing vacuum tubes, a source of plate voltage supply, a source of filament heating current, and a source of grid bias, if the latter is used, recording and reproducing means, a supply of phonographic records, and a stand for supporting the above devices.

Other objects and advantages will hereinafter appear.

In the accompanying drawings which illustrate the present invention in the form at present preferred—

Figure 1 is a diagrammatic view showing the parts of the amplifying and controlling apparatus and their connections to each other, and the recording mechanism with its connections to the amplifying and controlling apparatus; also the connections from the telephone line to the amplifying apparatus and recording mechanism respectively.

Fig. 2 is a side view showing the cabinet for containing the coupling, receiving and amplifying means, and the cabinet for the phonographic recording means.

Fig. 3 is a perspective view of the device in accordance with this invention, showing the supporting stand, etc.

Many proposals have heretofore been made for recording telephonic conversation, but they either failed to comprehend the practical difficulties and problems, or else made no adequate solution of them. These practical difficulties and problems are for the greater part centered around the connection or coupling of the commercial telephone lines to the receiving apparatus of the phonographic recording machine.

Commercial telephone systems, including the so-called private systems such as are used by railroad companies, contain signalling, monitoring and other apparatus, interference with the functioning of which is detrimental to the entire system. Such apparatus when operated by direct currents and controlled by the closing and opening of the telephone line at the station, usually by the operation of raising the telephone receiver from its supporting hook, would, of course, be interfered with by an extra connection or circuit which might be tapped across the telephone lines, and which would permit the flow of direct-current across the connection, for this would cause the signalling or other apparatus to be operated at all times.

In telephone systems using magneto-calling, the problem is somewhat different, for, in that case, magneto or low frequency alternating-currents are used for the signalling means. In such case, the operation of the device would be interfered with by any connection across the telephone line capable of passing an appreciable amount of pulsating toned or straight alternating magneto-generated current.

In machine switching telephone systems or automatic telephone systems—these terms being used synonymously—the problem is again different, for in that case the telephone line is closed and the signals are operated as an incident to accurately timed interruptions in the telephone line, and in such cases there are, of course, passing through the telephone line interrupted or intermittent direct-currents. Hence, any connection across the line which would pass a direct-current, which in this automatic system must be interrupted, would render the line totally inoperative.

Yet, some adequate connection must needs be made to the telephone line, so that the telephonic signals or conversation may be received and recorded.

To do this, without deterimentally affecting the telephone line or the apparatus contained therein, the present invention provides a coupling device between the telephone line and the phonographic recording device, which coupling device positively prevents direct-current in the telephone line from passing through the coupler and yet permits voice or pulsating currents in the telephone line to pass through the coupler, where they are then induced in a receiving circuit, amplified and recorded on a phonograph.

This connection is also incapable of passing any appreciable amount of low frequency alternating or magneto current, but, nevertheless, does permit the high frequency or voice currents to pass through it.

This is done according to the present invention by providing across the telephone line a coupler which contains:—an auto-transformer through which the voice currents pass and which induces in the receiving and recording circuit corresponding voice currents of increased E. M. F.; and an isolating condenser in series with the auto-transformer for permitting the voice currents to flow through the auto-transformer but preventing the direct-currents of the telephone line from passing through the auto-transformer, and preventing lower frequency or magneto-currents from passing through in any appreciable amount, and also preventing any direct-current in the receiving circuit from being fed back to the telephone line.

Referring now to the coupling and amplifying system shown in Fig. 1, the apparatus in its preferred form is mounted and supported in a cabinet 10, so as to form a complete unit with the exception of the filament heating batteries and the plate voltage batteries.

As shown in Fig. 1, wires 11 tapped from the telephone line 100 are attached to terminals 12 and 13 mounted on the cabinet 10. From the terminal 12 a wire 14 leads to an isolating condenser 15, then to a wire 16 connected to an auto-transformer 17 which is connected by a wire 18 to the terminal 13 for the other wire 11. Thus, a complete circuit, including the terminal 12, wire 14, condenser 15, wire 14, wire 16, auto-transformer 17, wire 18 and terminal 13 is provided for the flow of voice currents coming from the telephone line. The flow of direct-current from the telephone line is, however, as above stated, prevented by the provision of the isolating condenser 15 in the input side of the coupler circuit.

Connected to the wire 16 of the auto-transformer 17 is a wire 19 leading through a switch S, hereinafter described, to a terminal 20 connected to the negative side of a filament heating battery 21 diagrammatically illustrated in Fig. 1. The wire 19 is also connected to a wire 22 leading to the filament 23 of a vacuum tube 24, while the other end of the filament 23 is connected by a wire 25 through a resistance 26 to a terminal 27 connected to the positive side of the filament heating battery 21. A wire 28 leads from the upper end of the auto-transformer to the grid 29 of the vacuum tube 24, the grid being provided with a leak 30 and a wire 31 leading to a "C" or biasing battery 32 whose positive side is connected by a wire 33 to the wire 19 leading to the negative side of the filament heating battery.

The voice currents, entering the coupler circuit and passing through the auto-transformer 17, induce voice currents of increased voltage in the output circuit comprising the auto-transformer 17, wire 28, grid 29 of tube 24, filament 23, wire 22, wire 19 and wire 16, leading back to the auto-transformer. These voice currents have the same characteristics as the voice currents in the input circuits and telephone lines except that they are of increased E. M. F. The greater portion of these amplified voice currents cannot flow through the said output circuit comprising the wire 28 and grid 29, because of the high resistance of the grid circuit.

The voice currents which pass through the output circuit of the auto-transformer 17, are sufficient, when picked-up and amplified by the vacuum tube 24 and one stage of audio-frequency amplification which will hereinafter be described, to satisfactorily operate an electrical recording unit 133 mounted in the carraige 134 of a phonograph to operate upon a record 135 and record thereon signals received from the telephone line 11.

Hence, for the purpose of picking-up and amplifying the out-put currents of the auto-transformer 17, the plate 36 of the vacuum tube 24 is connected to the primary 37 of an audio-frequency transformer 38 whose other wire 39 is connected with a terminal 40 which in turn is connected to the positive side of a plate battery 41 diagrammatically indicated in Fig. 1, the negative side of the plate battery being connected to a terminal 27 leading back to the filament at the same point that the positive side of the filament heating battery is connected.

Amplified current flowing through the primary 37 induces current in the secondary 42 which is connected according to common practice by a wire 43 to a grid 44 of a vacuum tube 45 and by a wire 46 with a biasing battery 32, which is connected by a wire 33

to the negative side of the filament heating battery 21. The filament 47 of the vacuum tube 45 is connected to positive and negative wires 25 and 19 respectively by wires 48 and 49 respectively, and the plate 50 of the vacuum tube 45 is connected by a wire 51 to a terminal 52 to which one wire 53 of the electrical recording unit 133 may be attached, while the other wire 54 of the electrical recording unit 133 may be connected to a terminal 55 on the cabinet 10. The terminal 55 is connected by a wire 56 to the wire 39 leading to the terminal 40 which is connected to the positive side of the plate battery.

Accordingly, it will be seen that the voice currents which are induced in the auto-transformer 17 and which pass through the output circuit consisting of the wire 28, grid 29, filament 23, and wires 22, 19 and 16 are picked-up and amplified by the vacuum tube 24, and further amplified by the vacuum tube 45 from which they are impressed upon the wires 53 and 54 leading to the electrical recording unit. This is done without making any direct-current connection to the telephone line 11 and without danger of high frequency currents feeding back to the telephone. For, it will be noted, the system does not contain any oscillating circuits, the auto-transformer 17 and the condenser 15 being in series, and, of course, being so arranged are incapable of setting up oscillation.

In order to facilitate the use of the device, the motor 57 of the phonograph and the filament heating batteries are simultaneously controlled. This is done by connecting the leads 58 and 59 from the motor and its source of supply 60 to terminals 61 and 62 respectively on the cabinet 10. The terminal 61 is connected by a wire 63 to a pole 64 of a switch S while the knife 65 of the switch S is connected by a wire 66 to the terminal 62. The switch S also contains a knife 67 connected to the wire 19 leading to the filaments of the vacuum tubes, and is adapted to cooperate with the pole 68 connected by a wire 69 to the terminal 20 connected to the negative side of the filament heating battery 21. The knives 65 and 67 are connected together by an insulating bridge 70 by means of which they are simultaneously operated, the bridge having a finger-piece 71 for manual operation. Hence, when the finger-piece 71 is moved to close the circuits when it is desired to use the device, the phonograph motor will be started at the same time the filament heating battery 21 will be connected to the filament, thus insuring that both the recording mechanism and the record operating mechanism are rendered operative.

Is should be noted that because the input circuit of the coupler contains the condenser 15, it is not necessary or even desirable to provide a switch for breaking the telephone circuit connections to the device as was considered necessary in some of the early developments of this invention.

According to the present invention, a cabinet 10 which contains the apparatus above described, is preferably mounted on a stand 72 comprising legs 73 having rollers 74 by means of which the stand may be moved from place to place as desired. The cabinet 10 is identical with the cabinet 75 of the phonograph, the top portion of which is hinged at 76, the table 77 of the phonograph upon which the carriage 34, record 35 are mounted.

According to the present invention, in order that a compact unitary device made for receiving, amplifying and recording telephonic signals may be provided, the cabinet 75 of the phonograph is mounted directly above the cabinet 10 of the receiving and amplifying means as shown in Figs. 2 and 3, and to give free access to the apparatus in the cabinet 10, the cabinets 10 and 75 are hinged together at 78 so that the cabinet 75 may be swung to position shown in Fig. 2 where it may be supported by a strut 79.

In addition to supporting not only the phonograph but the receiving and amplifying means, the stand 72 is adapted to support containers 80 and 81 for the filament heating and plate voltage batteries. These containers comprise bases 82 secured to the legs 73 and further supported by brackets 83 connected to the legs.

The stand 72 is also adapted to support on a shelf 84 a rack 85 for holding a sufficient supply of phonograph cylinders carried by containers 86. As usual, the rack 85 may be rotated to bring a cylinder into position where it may be removed. But, in order that the device may be kept as low as possible, sufficient clearance has not been left between the top of the containers 86 and the stand 72 to permit the removal of a record and container. Therefore, the supporting shelf for the rack 85 is offset forwardly so that a portion of the rack projects beyond the front of the stand 72, and the cylinder and carton which is located in that position may be, therefore, readily removed without danger of coming into contact with the stand.

In practice, wires 11 are connected to wires of the telephone line 100, and also to the terminals 12 and 13 of the coupling, receiving, amplifying and recording device above described. The said device, being supplied with the proper batteries, the phonograph motor being supplied with a suitable source of current, and a phonograph record being in position to be recorded, let it be assumed that the telephone bell connected to the lines

100 operates or that the station at which the receiving and recording device is located desires to use the telephone, the person at the instrument raises the receiver from the hook and commences the conversation. Should it be desired that the conversation be recorded, the person using the telephone operates the finger-piece 71 of the switch S and thereby makes effective the coupling, receiving, amplifying and recording mechanism, because in doing so, the filament of the vacuum tubes are connected to their heating battery and the phonograph motor operates to turn the record. This goes on without interference with the conversation being carried on by the calling and called stations, and both sides of the conversation are, of course, recorded, because the line 100 is the interconnecting line between the two stations and is not merely tapped in at one station.

When the conversation is concluded or the person using the telephone at the station where the recording device is located desires to have the recording interrupted, the finger-piece 71 is returned to switch-opening position and the conversation is either continued without recording it or is concluded according to the circumstances.

The opening and closing of the switch S which brings the receiving and recording mechanism into and out of operation has no effect upon the telephone line 100, and is not even perceptible.

It should be noted that the input circuit of the auto-transformer 17, because of the relatively low capacity of the condenser 15 which in practice might be 0.25 mfd., low frequency alternating currents or magneto-currents will not be passed through the input circuit to the auto-transformer. It should also be noted that, because the input circuit of the auto-transformer contains a condenser in series with the auto-transformer, this circuit does not interfere with the functioning of automatic or machine-switching telephone systems, for there is no possibility of the circuit being normally closed for the passage of direct currents which are used to actuate the switching mechanism in such systems.

It will, of course, be understood that battery eliminators may be used in place of batteries 21, 32 and 41 if desired, and in such cases the eliminators may be supported in the containers 80 and 81 in the same manner that the batteries 21 and 41 are now mounted. It is merely important that some source of current for heating the filament of the vacuum tube and for supplying voltage for the plate circuits be provided.

Variations and modifications may be made within the scope of this invention and portions of the improvements may be used without others.

Having now described the invention, what is claimed as new and for which it is desired to obtain Letters Patent, is:—

1. An electrical system comprising a commercial telephone line; a coupler connected across said telephone line having in series with it a condenser to permit voice-currents to pass through the coupler but preventing passage of direct and signal operating currents either to or from the telephone line; an output circuit for the coupler; a thermionic device in the output circuit; and an electrically operated phonographic recording device controlled by said thermionic device, said coupler being continuously in circuit with the telephone line, and the output circuit of said coupler being normally open when the system is not in use; and means for rendering said thermionic device operative and thereby electrically completing the output circuit of the coupler.

2. A device for receiving and recording telephonic sounds and conversations, and adapted to be tapped across a commercial telephone line, comprising electrically operated phonographic recording means; thermionic amplifying means for amplifying voice currents to be impressed upon said recording means; a coupler between said thermionic amplifying means and the telephone line comprising means forming a complete electrical circuit across the telephone line for the passage of voice currents on the input side, and a thermionic device on the output side connected to the first mentioned thermionic device; control means for the phonographic recording means whereby the latter may be rendered operative to record sound; a source of current for the filaments of the said thermionic devices; and means for concurrently operating said control means to render the phonographic recording means operative and connecting the thermionic devices to the source of current for the filaments of thermionic devices, the last-named means being ineffective upon the input circuit of said coupler which is at all times electrically completed for the passage of voice currents therethrough.

3. The combination in a system for recording telephonic currents of electrical phonographic recording means, driving means for said recording means, an amplifier connected to said recording means, a connection between said amplifier and a telephone line, said connection comprising a condenser, and a single switch for simultaneously rendering said recording means and said amplifier operative and inoperative, said connection between said amplifier and said telephone line forming with said telephone line a complete circuit through which current flow is not affected by the operation of said switch.

4. An electrical system comprising a com-

merical telephone line; a coupler connected across said telephone line having in series with it a condenser to permit voice-currents to pass through the coupler but preventing passage of direct and signal operating currents either to or from the telephone line; an output circuit for the coupler; a thermionic device in the output circuit; and an electrically operated phonographic recording device controlled by said thermionic device, said coupler normally having its output circuit open when the system is not in use; and means for rendering said thermionic device operative and thereby electrically completing the output circuit of the coupler.

5. A device for receiving and recording telephonic sounds and conversations, and adapted to be tapped across a commercial telephone line, comprising electrically operated phonographic recording means; thermionic amplifying means for amplifying voice-currents to be impressed upon said recording means; a coupler between said thermionic amplifying means and the telephone line comprising means forming a complete electrical circuit across the telephone line for the passage of voice-currents on the input side; control means for the phonographic recording means whereby the latter may be rendered operative to record sound; a source of current for the filament of the said thermionic device; and means for concurrently operating said control means to render the phonographic recording means operative and connecting the thermionic device to the source of current for the filament thereof, the last named means being ineffective upon the input circuit of said coupler, which is at all times electrically completed for the passage of voice-currents therethrough.

Signed at Bridgeport, in the county of Fairfield, and State of Connecticut, this 20th day of July 1926.

HOWARD S. WORRELL.