

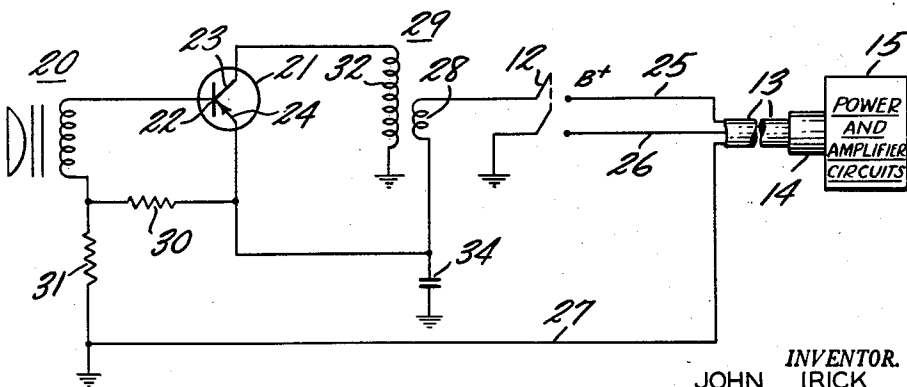
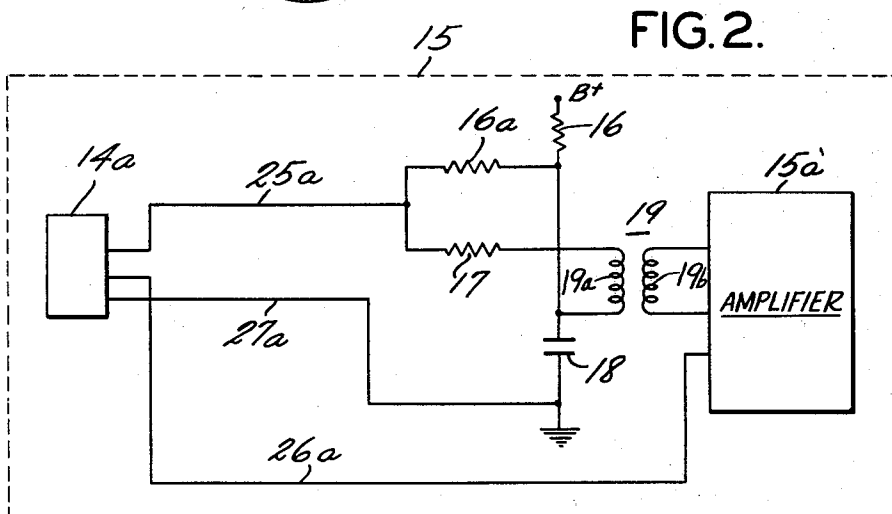
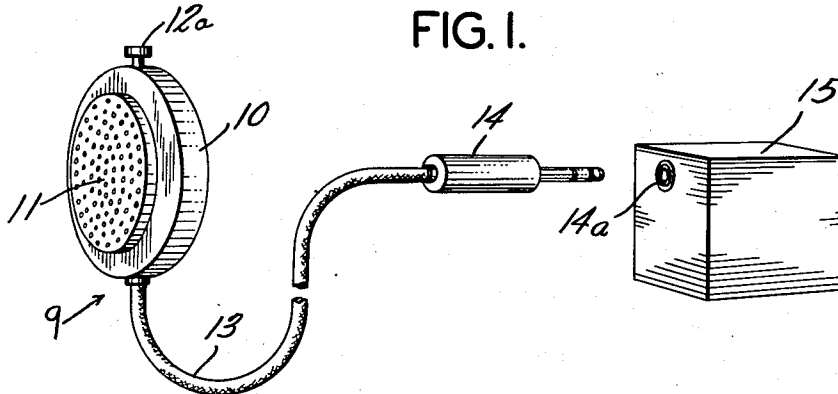
March 22, 1960

J. IRICK
MICROPHONE UNIT

2,929,877

Filed Oct. 9, 1953

2 Sheets-Sheet 1



INVENTOR.
JOHN IRICK

FIG. 3.

BY
Campbell, Brumbaugh, Frost & Graves
ATTORNEYS

March 22, 1960

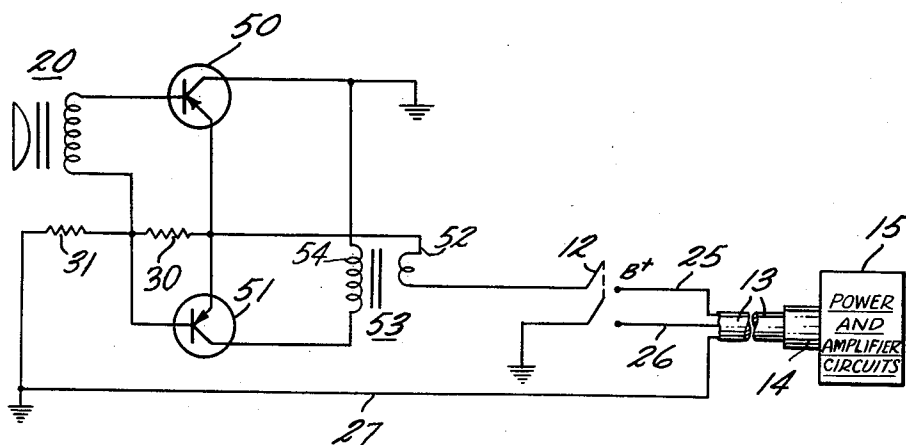
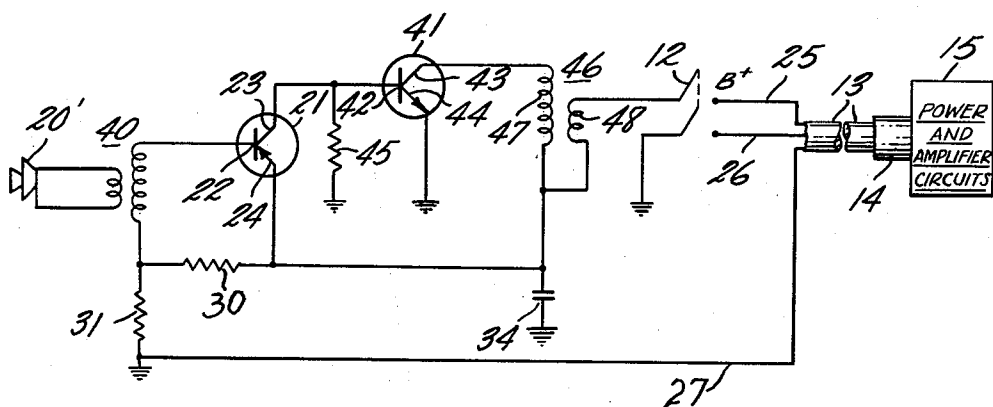
J. IRICK

2,929,877

MICROPHONE UNIT

Filed Oct. 9, 1953

2 Sheets-Sheet 2



JOHN IRICK *INVENTOR.*

BY
Campbell, Brumbaugh, Free & Graves
his ATTORNEYS.

1

2,929,877

MICROPHONE UNIT

John Irick, Huntington, N.Y., assignor to Telephonics Corporation, Huntington, N.Y., a corporation of New York

Application October 9, 1953, Serial No. 385,140

2 Claims. (Cl. 179—1)

This invention relates to microphone units, and has particular reference to a microphone unit incorporating a transistor amplifier and so arranged as to be interchangeable with existing units.

Carbon microphones commonly employed in the past in radio and telephone transmissions have suffered from several disadvantages including susceptibility to humidity, aging, mechanical shock damage and a relatively high noise level due to both the noise inherent in current flow through carbon and that generated by the shifting of the carbon granules as the microphone is handled. In attempting to obtain a suitable microphone not susceptible to the disadvantages of carbon microphones, various expedients have been tried, including use of magnetic and dynamic types of microphones, but both types require electron tube amplifiers, since the output level of magnetic or dynamic microphones is relatively low in comparison with that of the carbon microphone. Inasmuch as the electron tube amplifiers required for magnetic or dynamic microphones materially increase the bulk of the equipment and susceptibility of damage, the magnetic or dynamic microphones, although free of the disadvantages of carbon microphones, introduced additional problems of equal or greater magnitude, particularly when the apparatus is intended for portable or field service.

In accordance with the present invention a microphone unit is provided which is unaffected by humidity, does not change its characteristic after long use, is relatively insensitive to shock, and is arranged to be directly interchangeable with the conventional carbon type microphone in existing transmitters without adaptation change of the latter.

A preferred embodiment of the microphone unit of this invention comprises a magnetic or dynamic type microphone, a low noise unit as compared with a carbon microphone, coupled to a transistor amplifier, all of these components being contained in a standard carbon microphone housing. Consequently the low noise microphone unit may be directly plugged into a standard carbon microphone receptacle. The same low voltage supply adequate for operation of the carbon microphone is sufficient for the operation of the new substitute microphone unit which also utilizes the power feed lines for transmitting the audio signals therefrom.

It will be seen that the new microphone unit simultaneously overcomes all of the operational disadvantages of a carbon microphone and retains the advantages of compactness and sufficiency of low input power, and adds the valuable advantage of direct substitution for the carbon microphone in existing equipment without any change therein.

For a more complete understanding of the invention reference may be had to the accompanying drawings in which:

Figure 1 is a perspective view of a microphone unit embodying the present invention;

Figure 2 is a schematic circuit diagram of a typical

2

power supply that may receive a microphone unit constructed in accordance with the present invention;

Figure 3 is a schematic circuit diagram of a transistor amplifier that may be employed in the present invention;

Figure 4 is a schematic diagram of another transistor amplifier that may be utilized in this invention, and

Figure 5 is a schematic diagram of a further transistor amplifier that may be employed in the invention.

Referring to the drawings and more particularly to Fig. 1, a microphone unit in accordance with the invention is enclosed in the microphone case 10 and includes a magnetic or dynamic microphone, which are inherently low noise units, mounted behind the perforated mouthpiece 11 as well as the amplifier components described in detail below.

Extending through the top of the case 10 is a switch actuating button 12a while extending through the bottom thereof is a cable 13 joined to the components in the case 10 and coupled to a standard microphone plug 14. A microphone jack 14a, coupled to standard carbon microphone power supply and amplifier circuits 15, receives the plug 14.

A representative type of standard carbon microphone power supply and amplifier circuits 15 which have been conventionally employed in association with carbon type microphones are shown in Fig. 2, it being understood that other circuits performing similar functions may be substituted therefor. A source of B+ voltage is coupled to the jack 14a by a conductor 25a to dropping resistors 16 and 16a having suitable values and to a damping resistor 17 in turn joined to one side of a primary winding 19a of an input transformer 19.

The other side of primary winding 19a is joined to the junction of the resistors 16 and 16a and coupled through a relatively high capacity condenser 18 to ground. The secondary winding 19b of the transformer 19 leads into a conventional amplifier 15a as does a conductor 26a joined at its other extremity to the jack 14a. A lead 27a is connected to a terminal on the jack 14a and to ground.

The components mounted in the microphone case 10 are diagrammatically shown in Fig. 3 as including the magnetic microphone 20 directly coupled to a base 22 thereon and having an output impedance approximately matching the input impedance of a transistor 21. In the circuit of Fig. 3 it is preferable to employ a junction transistor such as the Raytheon CK721, for example. It will be understood that when an alternative low noise microphone is employed in place of the magnetic microphone 20, an input transformer will be employed to properly match the impedance of such a microphone to the input impedance of the transistor 21.

In order to supply the necessary voltage for proper operation of the transistor amplifier, a conductor 25, adapted to be connected through the cable 13 and the plug 14 to the conductor 25a, is coupled through the switch 12 and a secondary winding 28 of an output transformer 29 to an emitter 24 on the transistor 21.

The positive side of a condenser 34 is connected to the B+ terminal of switch 12 through the winding 28 and to ground through a bleeder network consisting of resistors 30 and 31. The resistors 30 and 31 are so chosen that the voltage drop across the resistor 30 places the emitter 24 of the transistor 21 at a slightly higher positive potential than the base 22, an arrangement necessary when the PNP junction type transistor is employed. Obviously, an NPN type transistor may be utilized with minor circuit changes. The value of the resistor 30 is chosen to limit the current flow to a collector 23 to a safe operating range for the transistor 21.

The collector 23 is coupled to ground through a primary winding 32 of the output transformer 29. It is preferable to employ a special type sub-miniature type of

output transformer 29 in this circuit, the primary and secondary windings being connected so that the direct current therethrough will generate magnetomotive forces that are in opposition. With this arrangement, saturation of the minute magnetic core will be minimized.

The condenser 34 has a relatively high capacity to bypass the audio signals to ground as well as serving to maintain the potential across the bleeder network, including the resistors 29 and 30, at a constant reference value.

After the circuit components have been assembled all parts except the microphones 20 may be embedded in a substance such as a polyester resin in the shape to fit in the case 10, with projecting terminal plugs adapted to be inserted in the existing sockets in the case 10. The unit is accordingly compact and fits within the case 10 in the same space formerly occupied by a carbon microphone unit with the diaphragm of microphone 20 positioned behind the mouthpiece 11.

In a typical operation of this embodiment of the invention, the plug 14 of the microphone unit in the case 10 is inserted in the jack 14a of the power and amplifier circuits 15. The actuation of the button 12a closes the switch 12 and results in the energization of the transistor amplifier as well as the amplifier 15, due to its being grounded through the conductor 26. Upon the impingement of sound waves on the magnetic microphone 20, a signal will be introduced to the base 22 causing the collector current flowing through the primary winding 32 and the collector 23 to vary, such variation being transmitted to the secondary winding 28.

Since the condenser 34 has a relatively high capacity, one side of the secondary winding 28 is at audio ground and the output signals will be transmitted to the jack 14 through the conductors 25 and 27. The relatively high capacity of the by-pass condenser 34 minimizes feedback of the audio signals. From the plug 14, the audio signals will be transmitted through the jack 14a, the conductor 25a, the resistor 17, the transformer winding 19a and the condenser 18 to ground. Since the condenser 18 has a large capacity, it will by-pass the audio signals therethrough so that the primary winding of the transformer 10 is effectively tied to the ground for audio signals. The audio signals will then be coupled into the amplifier 15a and subsequently to any desired radio or telephone transmitting circuit.

In an exemplary embodiment of this form of the invention, the circuit components may take the following values; transistor 21=Raytheon CK-721, resistor 30=4.5 ohms, resistor 31=220 ohms, condenser 34=20 mfd., magnetic microphone 20=700 ohms output impedance, load impedance=90 ohms, B+ voltage (at condenser 34)=9 v.

Employing these circuit constants, the unit shown in Fig. 2 will deliver between 36 db mv. and 44 db mv. of output with 115 db sound power level at the microphone. The noise level was -16 db mv. which is 16 db lower than the equivalent carbon microphone. However, there is 6 db less gain in this circuit than in the carbon microphone so that an actual 10 db signal to noise gain is obtained.

Referring next to Fig. 4, a circuit arrangement employing many of the components found in Fig. 3 is shown, so that like elements will be designated by like reference characters. In this embodiment of the invention, a dynamic microphone 20' is coupled by an input transformer 40 to the base 22 of the transistor 21. The first stage is identical to that found in Fig. 3, with the resistors 30 and 31 forming a bleeder network to supply the necessary reference voltages to the emitter 24 and the base 22.

The output signals from the transistor 21 are coupled from the collector 23 to a second junction transistor 41 of the NPN type having a base 42, a collector 43 and an emitter 44. A resistor 45 may be connected to

ground between the transistors 21 and 41, if found necessary to limit the collector current of the transistor 41. However, it has been found that the system will operate in many instances without such a resistor.

The collector circuit of the transistor 41 includes a primary winding 47 of an output transformer 46, similar to the transformer 29 found in Fig. 3, and having a secondary winding 48, one side of which is connected through the switch 12 to the conductor 25 and the other side connected to the primary winding 47 and to the condenser 34. Since the transistor 41 is of the NPN type, the collector 43 is biased positively with respect to the emitter 44 and the base 42 by the B+ supply through the secondary winding 48 and the primary winding 47.

The operation of the embodiment of the invention illustrated in Fig. 4 is similar to that described in connection with Fig. 3, with the exception that the signal appearing at the collector 23 of the transistor 21 is further amplified by the transistor 41 and coupled therefrom to the output transformer 46, and subsequently to the power and amplifier circuits 15. In comparing the performance of the circuit of Fig. 4 with that of Fig. 3, the additional transistor stage introduces slightly more noise into the output so that the noise under quiescent conditions is approximately the same as when a carbon microphone is employed. However, due to a gain increase of about 6 db over the carbon microphone, an overall improvement of about 6 db in the signal to noise ratio is provided by this arrangement. Furthermore, of course, the advantages of immunity to severe environmental conditions outlined above are obtained by employing this circuit.

Referring next to Figure 5, another circuit that may be employed in the present invention is shown. The chief difference between the circuit of Fig. 5 and the previously described circuits resides in the employment of a cascade arrangement of transistors that eliminates the somewhat bulky by-pass condenser. Elements in this circuit similar to those previously described have been designed by the like reference characters. Describing this circuit in more detail, the magnetic microphone 20 is coupled at one end to the base of a junction transistor 50 of the PNP type and at the other end to the base of a similar transistor 51. The proper bias voltages are afforded the transistors 50 and 51 by a bleeder network including the resistors 30 and 31 connected to the B+ voltage supply at the conductor 25 through a secondary winding 52 of an output transformer 54 and the switch 12. The collectors of the transistors 50 and 51 are joined to opposite sides of a primary winding 54 of the output transformer 53.

In a typical operation of the circuit shown in Fig. 5, the signals derived from the microphone 20 are amplified by the transistor 50 and applied to the secondary winding 52 from the primary winding 54. A portion of these output signals will be fed back to the base of the transistor 51 across the resistor 30 in phase with the signals from the microphone 20. The result will be an increase in the signal strength in the winding 52.

It will be understood that the above described embodiment of the invention is illustrative only and modifications thereof will occur to those skilled in the art. Thus, point type transistors could be substituted for the junction type transistors described in connection with the present arrangements although at the present time, the junction type are preferable due to the lower noise level and higher gain that may be obtained therewith. Furthermore other known transistor amplifiers may be incorporated in the invention. Also, the amplifier circuit may be molded into the cord 13 near or at the plug 14 when the microphone case 10 must be of a minimum size to be as inconspicuous as possible. Therefore, the invention is not to be limited to the specific apparatus disclosed herein but is to be defined by the appended claims.

I claim:

1. A microphone unit for use with a standard carbon

5

microphone power supply and amplifier circuits to replace a high noise level carbon microphone comprising a housing, a low noise microphone mounted in said housing, a transistor amplifier mounted in said housing and connected to said microphone, a cable including a plurality of conductors connected to said transistor amplifier, said cable extending from said housing for supplying power to and transmitting signals from said transistor amplifier on the same conductors, and a plug connected to the end of said cable outside of said housing adapted to be plugged into the standard carbon microphone power supply and amplifier circuits.

2. A microphone unit as defined in claim 1, wherein a switch including an actuating arm is located in the

5

10

6

housing and connected in at least one of the conductors leading from the transistor amplifier, said arm extending through said housing to facilitate actuation of the switch.

References Cited in the file of this patent

UNITED STATES PATENTS

2,380,438	Hornickel	July 31, 1945
2,406,583	Blauvelt	Aug. 27, 1946
2,579,162	Veneklasen	Dec. 18, 1951
2,613,282	Scaife	Oct. 7, 1952

FOREIGN PATENTS

860,641	Germany	Dec. 22, 1952
---------	---------	---------------