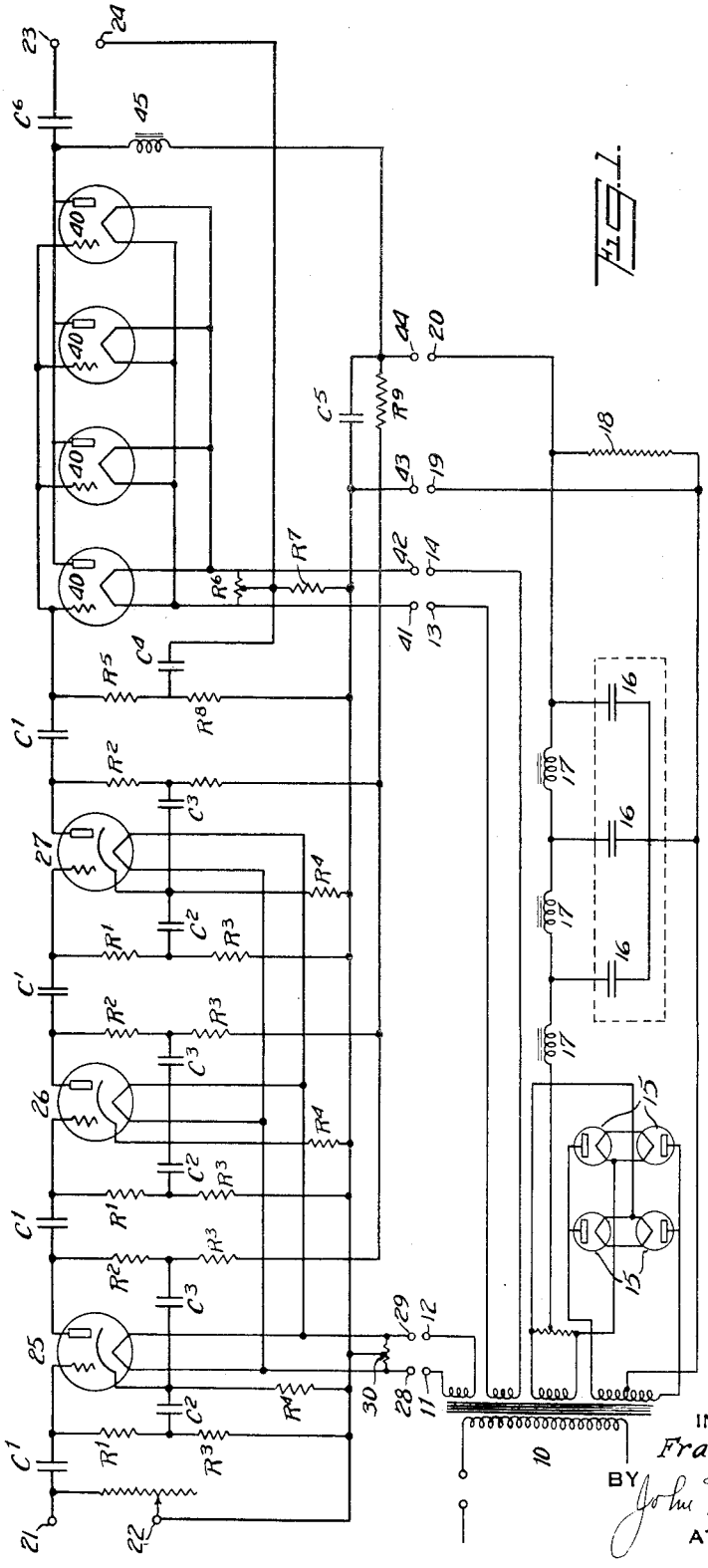
March 13, 1934. F. M. BEST 1,950,653

ELECTRICAL AMPLIFIER AND THE LIKE

Filed July 18, 1930 2 Sheets-Sheet 1



March 13, 1934. F. M. BEST 1,950,653

ELECTRICAL AMPLIFIER AND THE LIKE

Filed July 18, 1930 2 Sheets-Sheet 2

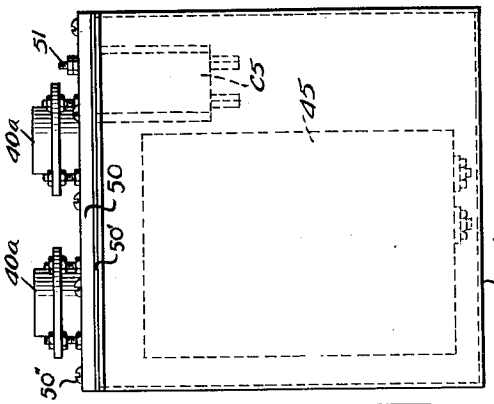


FIG. 4.

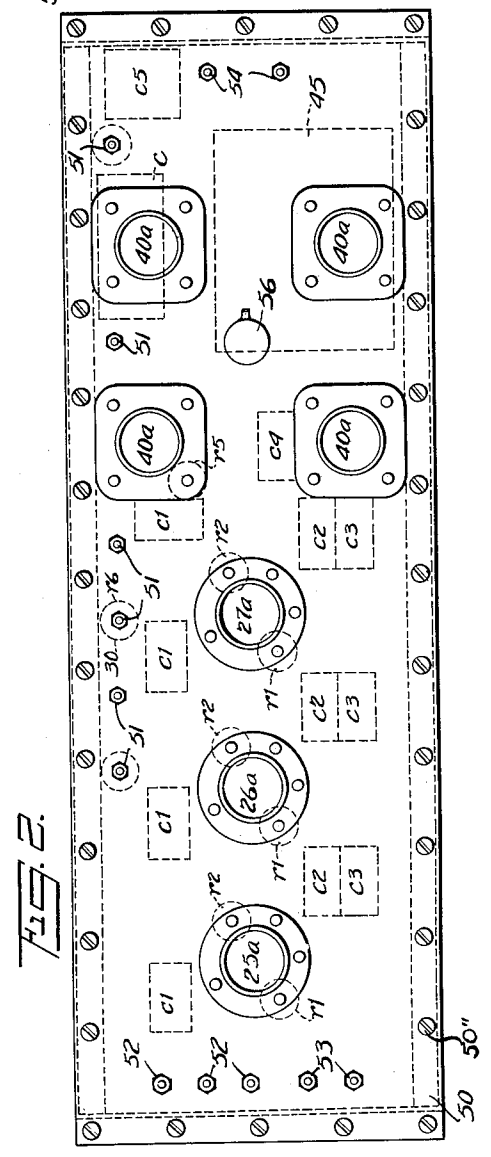


FIG. 2.

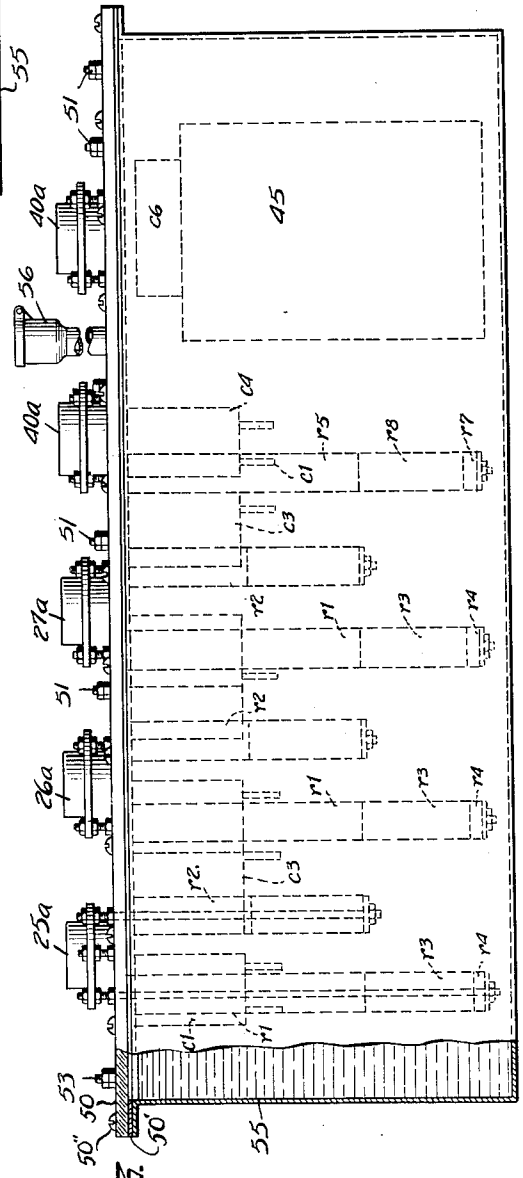


FIG. 3.

INVENTOR
Frank M. Best
BY
John M. Cole
ATTORNEY

Patented Mar. 13, 1934

1,950,653

UNITED STATES PATENT OFFICE

1,950,653

ELECTRICAL AMPLIFIER AND THE LIKE

Frank M. Best, New York, N. Y.

Application July 18, 1930, Serial No. 468,859
In Great Britain, July 19, 1929

8 Claims. (Cl. 250—16)

The present invention relates to electrical amplifiers and the like and is more particularly directed toward the provision of devices such as sound amplifiers, power packs and the like wherein a large number of resistors, condensers, chokes, transformers, and the like is employed in circuit arrangements adapted for high frequency or high voltage work, as in radio receiving sets, public address systems, theatres, and the like.

It has heretofore been the general practice in radio receiving sets, public address systems and the like to mount the various resistors, condensers, transformers, chokes and similar pieces of apparatus on suitable supports connecting the parts together and to the sockets and the input and output terminals. These parts have always been left in the free air and where they were subject to deterioration, crystallization, overheating and other changes which render them unsatisfactory and unreliable for many purposes, more especially where great power is employed.

Where a large number of these resistors and condensers, transformers and the like are in a circuit, it is highly important that all the parts be maintained at a constant temperature, in order that constant characteristics of a circuit may be available. Where these devices are all in the air, the temperature rises are not uniform, the resistors may become so hot as to materially change their resistance, thereby upsetting the circuit and throwing it out of balance. Furthermore, the high temperatures to which these parts may be brought when in the air bring about permanent changes in the resistance of the parts, owing to crystallization, permanent hardening and other forms of deterioration which take place in the metal and the insulation. Contraction and expansion also will change the characteristics of the circuit.

When these various electrical elements are left in the open air they are likely to absorb moisture and become loaded with dust, which may be magnetic, this in turn causing deterioration of the insulation, changing the resistance, causing the puncturing of the insulation and frequently a break down of one or more of the elements. The latter is particularly true in audio frequency transformers.

According to the present invention, the various units, such as amplifiers, power packs, and the like, are made up as complete units wherein the tube sockets and the like are accessible but wherein all of the other parts which need not be accessible are immersed in oil. This may be readily accomplished by placing the tube sockets on an insulating cover plate which supports resistors, condensers, transformers, chokes, and the like in such a manner that they may be submerged in oil when the supporting plate is employed as a cover for a liquid-tight container. The oil acts as a perfect insulator for all the parts, excludes dust and moisture and maintains all the parts at the same temperature. It furthermore eliminates the corona discharge which is found to be present in certain installations where the resistance is in the open air. As the oil maintains the electrical characteristics constant, there is a lowering of the common impedance of the system and a vastly improved over all performance results.

It is also possible to build the units far more compactly and to design them to handle heavier currents and more power than where the elements are in the open air.

Where the various resistances, condensers, etc. are in the open air, the uneven heating which is brought about by the operation of the device upsets the balance of the parts and starts them into audio oscillation or "motor boating", which may render the output current useless. It has been found, however, that the same electrical unit which is valueless when the parts are in open air may become entirely satisfactory by merely immersing all the resistors, condensers and the like in oil.

The accompanying drawings illustrate a circuit arrangement of one form of electrical unit which may employ the present invention and structural details of a typical unit.

In these drawings:

Figure 1 is a wiring diagram showing a power amplifier for a public address system receiving its power from a power pack;

Figure 2 is a top plan view illustrating the layout of the tube sockets, condensers, resistors and the like of the amplifier of Figure 1;

Figure 3 is a side elevational view of the amplifier shown in Figure 2; and

Figure 4 is an end view of the same.

In Figure 1 the transformer is indicated at 10. The power pack has two output terminals 11 and 12, adapted to deliver heater current, at say, 2½ volts to the 4-element voltage amplifying tubes of the amplifier. It has other output terminals 13 and 14, adapted to deliver heater current at, say, 7½ volts to the power amplifier tubes of the amplifier. The secondary of the power transformer 10 is connected through a number of rectifier tubes 15 and associated condensers 16, inductances 17 and resistor 18, so as to pro-

vide high voltage direct current for the power tubes in the usual manner. These high voltage terminals are indicated at 19 and 20.

In the amplifier part of the circuit the input terminals for the current to be amplified are shown at 21 and 22. The output terminals are indicated at 23 and 24. This amplifier is shown as the one which employs three four-element voltage amplifying tubes 25, 26 and 27, adapted to receive variable input current from the input terminals and supplied by heater current from the terminals 28 and 29, adapted to be connected to a center tap resistor 30 and the terminals 11 and 12 of the power pack. These tubes are connected with grid blocking condensers, indicated at C^1, grid resistors, indicated at R^1, by passing condensers, indicated at C^2 and C^3, plate resistors, indicated at R^2, blocking resistors, indicated at R^3, and bias resistors, indicated at R^4.

The output from the tube 27 is led to a four tube power amplifier having four three-element tubes 40, supplied with heater current from the terminals 41 and 42, adapted to be connected to the terminals 13 and 14 of the power pack and to resistors R^6 and R^7, as indicated. The grids of these tubes are connected to a resistor R^5, which is connected with a resistor R^8, and a condenser C^4, as indicated. The resistor R^6 is also connected to the voltage amplifier and to the power pack terminal 43 through a condenser C^5, as shown. The plates are connected to an output condenser C^6, and to the other power pack terminal 44 through an output and plate feed choke 45. The output terminals are connected in as indicated. A blocking resistor R^9 is interposed between the output blocking resistor R^3 and the terminal 44.

Were one to embody such a circuit in physical resistor apparatus and leave it in the open air, it is apparent that a large number of resistances and capacities is present, each of which is likely to be impaired by dust and moisture and to have its resistance changed by change in temperature. Figures 2, 3 and 4 show a structural arrangement and layout for these parts.

An insulating plate 50 of suitable size is provided. This plate carries on the upper face a number of binding posts for connecting with the power pack and providing for input, volume control, and output connections. The binding posts for connecting to the power pack are along the upper edge and indicated at 51. The volume control binding posts are indicated at 52. The input binding posts at 53 and the output binding posts 54.

The UY sockets for the voltage amplifier tubes 25, 26 and 27 are indicated at 25*a*, 26*a*, and 27*a*, while the UX sockets for the power amplifier tubes are indicated at 40*a*. The resistors are mounted on studs passing through the proper contacts on the sockets 25*a*, 26*a* and 27*a*, and the first of the 40*a* sockets.

The resistors and condensers are indicated by dotted lines in Figures 2 and 3. The same reference letters (but in the lower case) are employed in Figures 2 and 3 for indicating the corresponding parts.

All these condensers, resistors, chokes and any transformers which may be employed are secured to the under side of the plate 50, and the parts carried below the plate are adapted to be received inside of an oil tank 55. A gasket 50′ is interposed between the plate and upper edge of the tank and the plate is secured in place by screws 50″. This tank is filled with oil and the oil extends a short distance up into a filling spout 56, provided with the screen and lime cup to filter out dust and moisture and to act as a breather.

Figures 2, 3 and 4 indicate the manner in which the amplifier is assembled with all the parts, except the tube sockets, in oil. To secure the most satisfactory operation, the power pack should be similarly assembled on a plate with the sockets above and with all the resistances, condensers and transformer coils below and adapted to be immersed in oil. The arrangement of these electrical elements in oil may be applied to radio receiving sets, power amplifiers and the like for use in broadcast receivers, public address systems, talking pictures, and it will be found that operation of these devices is much improved over what it would be were the parts in the open air.

I shall now give certain specific examples of suitable constants for circuits arranged according to my invention, the circuit constants being illustrative only of constants which I have successfully used in practice.

In a circuit similar to that illustrated in Figure 1, I have successfully used the following constants with No. 227 4-element tubes and No. 250 power tubes:

Capacities C^1, C^2, C^3, and C^4=1 microfarad
Capacities C^5 and C^6=2 microfarads
Resistances R^1—100,000 ohms
Resistances R^2—40,000, 40,000 and 20,000 ohms (reading from the left)
Resistances R^3—25,000, 35,000, 25,000, 35,000 and 15,000 (reading from the left)
Resistances R^4—2,000, 2,000 and 1,800 ohms (reading from the left)
Resistance R^5—100,000 ohms
Resistance R^6—20 ohms
Resistance R^7—375 ohms
Resistance R^8—11,000 ohms
Resistance 30—20 ohms

The circuit arrangement and diagram illustrated and described above, and the particular circuit constants given, are merely a specific example of an embodiment of my invention. Many variations and modifications of the circuits and arrangements herein described fall within the scope of my invention.

What is claimed is:

1. A resistance coupled amplifier or the like comprising an insulating plate having input and output terminals, a plurality of sockets on the upper side of the plate, a plurality of audio frequency current controlling elements, secured to the lower side of the plate and connected to the sockets, a liquid-tight container to which the plate is secured with the current controlling elements therein, and oil in the container in which the elements are submerged so that the elements are held at a substantially uniform temperature throughout.

2. A resistance coupled amplifier or the like comprising a plurality of coupled resistors and condensers, a container containing oil for immersing the said coupled elements whereby the said elements are maintained at a substantially uniform temperature.

3. A resistance coupled amplifier or the like comprising in combination a container, an insulating plate therefor having vacuum tube sockets on the upper side thereof, a plurality of condensers and resistors on the lower side of said plate connected together and to the sockets to give predetermined operation, and oil in said

container in which the said condensers and resistors are immersed.

4. In combination, in a high frequency signaling apparatus, a liquid-tight receptacle, a plate across the upper part of the receptacle, vacuum tube sockets secured to the upper side of the plate, and cooperative signal current transmitting apparatus including resistances and condensers secured to the lower side of the plate and electrically connected with the sockets, the space within said receptacle surrounding said apparatus being filled with insulating oil, whereby the resistances and condensers are held at a substantially uniform temperature throughout.

5. In combination, in a high frequency signal receiving apparatus, a liquid-tight receptacle, a plate across the upper part of the receptacle, vacuum tube sockets secured to the upper side of the plate, cooperative signal current transmitting apparatus secured to the lower side of the plate and electrically connected with the sockets, the space within said receptacle surrounding said apparatus being filled with insulating oil, whereby the signal current transmitting apparatus underneath the plate is held at a substantially uniform temperature throughout, and a breather for the receptacle, the breather having a dust screen and a dehydrator.

6. In combination, in a resistance coupled amplifier, a liquid-tight receptacle, a plate across the upper part of the receptacle, vacuum tube sockets secured to the upper side of the plate, and cooperative resistances and condensers secured to the lower side of the plate and connected to the sockets for amplifying high frequency currents, the space within said receptacle surrounding said resistances and condensers being filled with insulating oil, whereby the resistances and condensers are held at a substantially uniform temperature throughout.

7. In combination, in a resistance coupled amplifier, a liquid-tight receptacle, a plate across the upper part of the receptacle, vacuum tube sockets secured to the upper side of the plate, cooperative resistances and condensers secured to the lower side of the plate and connected to the socket for amplifying high frequency currents, and a power pack secured to the lower side of the plate for supplying heater current for the vacuum tubes, the space within said receptacle surrounding said resistances, condensers, and power pack being filled with insulating oil, whereby the resistances, condensers, and power pack are held at a substantially uniform temperature throughout.

8. In combination, in a resistance coupled amplifier, a liquid-tight receptacle, a plate across the upper part of the receptacle, vacuum tube sockets secured to the upper side of the plate, cooperative resistances and condensers secured to the lower side of the plate and connected to the socket for amplifying high frequency currents, and a filling spout carried by the plate, the spout carrying a screen and lime cup, the space within said receptacle surrounding said resistances and condensers being filled with insulating oil, whereby the resistances and condensers are held at a substantially uniform temperature throughout.

FRANK M. BEST.