Jan. 1, 1935. B. F. MIESSNER 1,985,946

AMPLIFYING AND REPRODUCING SYSTEM

Filed Jan. 25, 1929 2 Sheets-Sheet 1

Fig. 1.

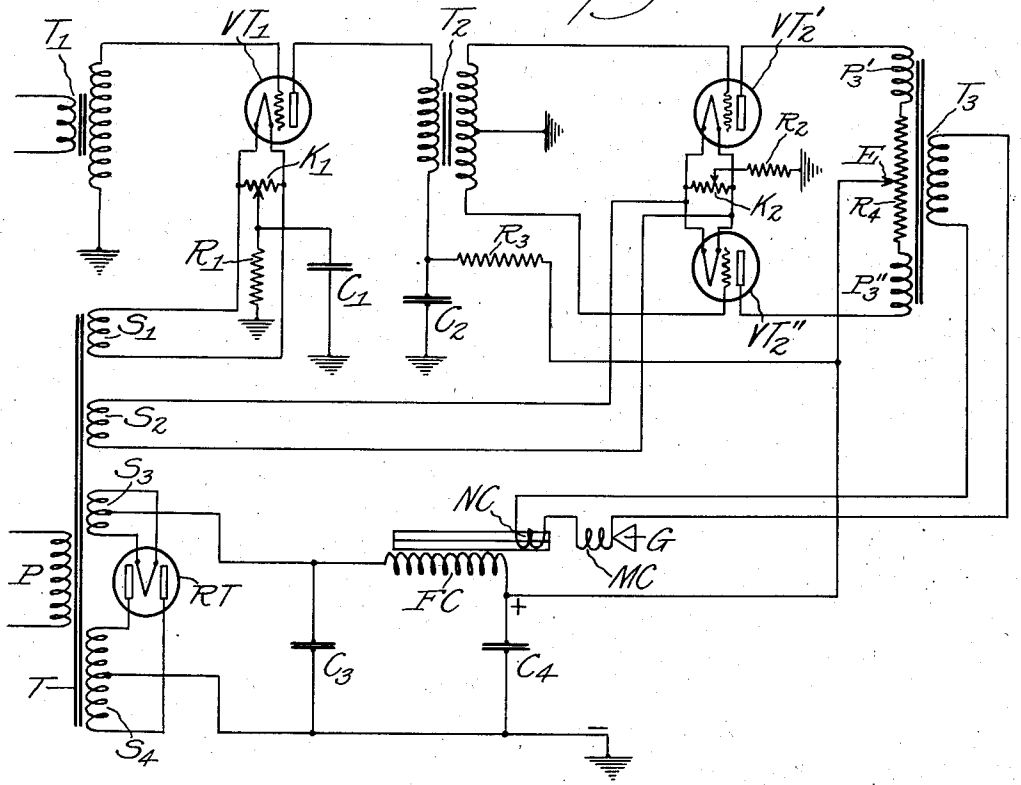


Fig. 2.

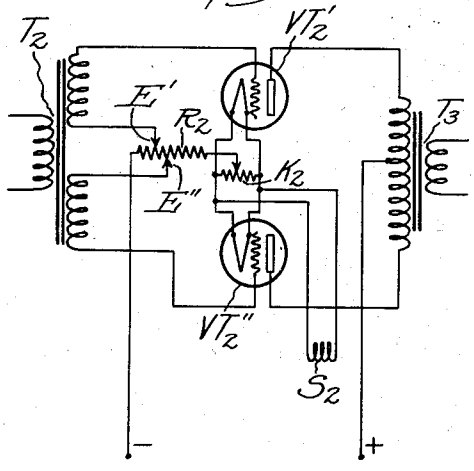
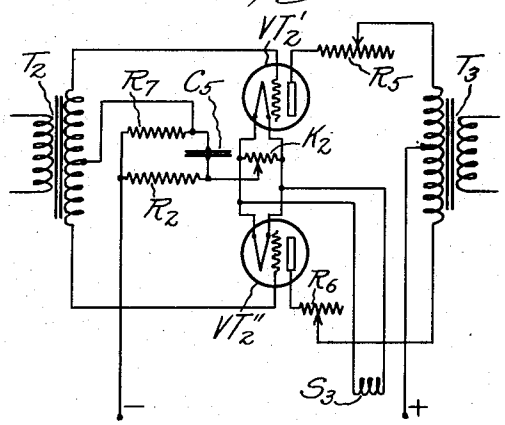


Fig. 3.



Inventor
BENJAMIN F. MIESSNER

WITNESS
Oliver W. Holmes

By Attorney

Jan. 1, 1935. B. F. MIESSNER 1,985,946

AMPLIFYING AND REPRODUCING SYSTEM

Filed Jan. 25, 1929 2 Sheets-Sheet 2

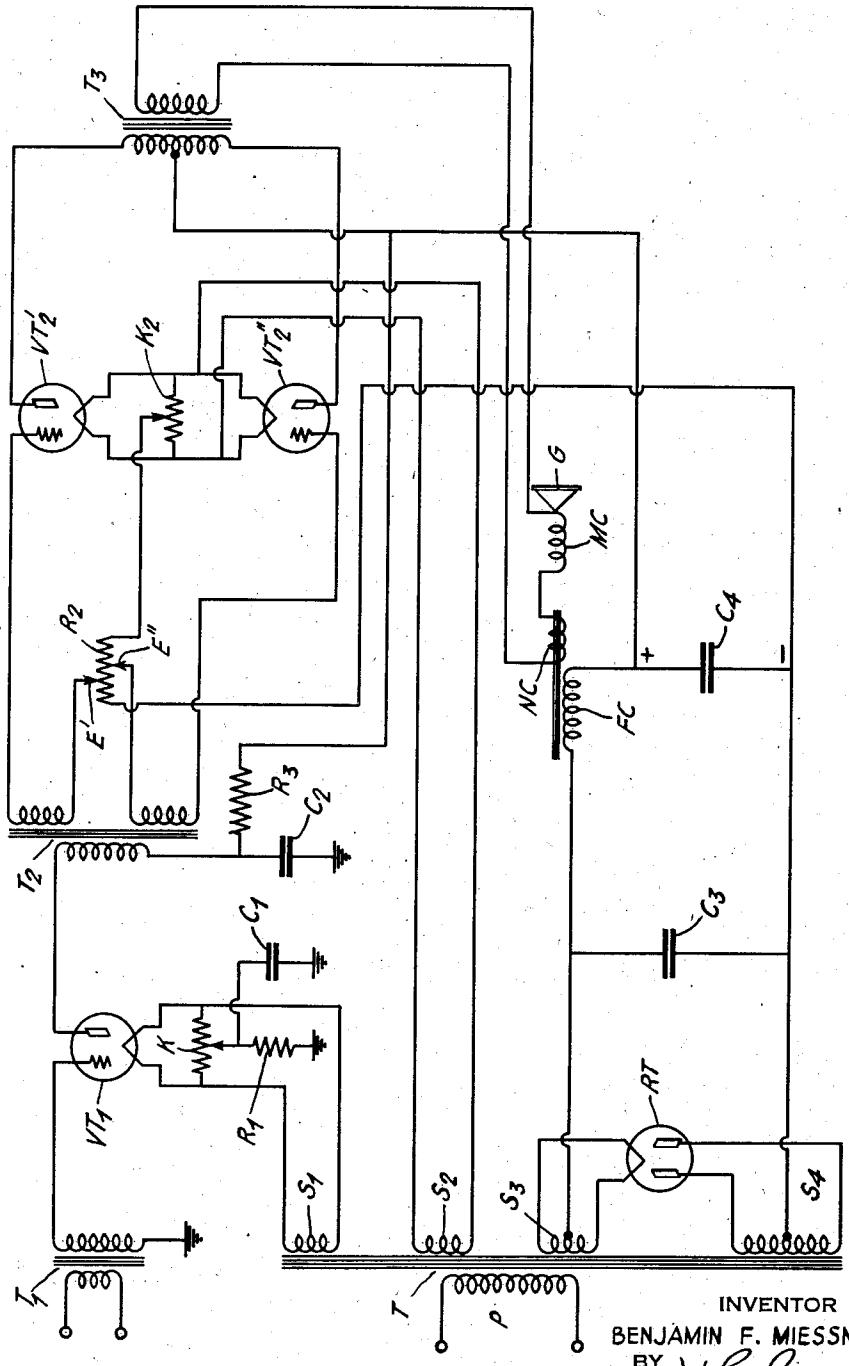


Fig. 4

INVENTOR
BENJAMIN F. MIESSNER
BY H. G. Brower
ATTORNEY

Patented Jan. 1, 1935 1,985,946

UNITED STATES PATENT OFFICE

1,985,946

AMPLIFYING AND REPRODUCING SYSTEM

Benjamin F. Miessner, Short Hills, N. J., assignor, by mesne assignments, to Radio Corporation of America, New York, N. Y., a corporation of Delaware

Application January 25, 1929, Serial No. 334,871

10 Claims. (Cl. 179—171)

The present invention relates to amplifying and reproducing systems, and particularly such systems employing three electrode vacuum tubes and energized reproducing devices.

A particular object is to energize the vacuum tubes and the field of the reproducing device in a system from a source of uni-directional fluctuating current while maintaining hum production in the reproducing device low.

Another object is to avoid the use of an excessive amount of the bulky and heavy apparatus usual to filter systems employed in connection with the energizing of vacuum tubes from unsteady sources of electrical energy.

The features of my invention are described with the aid of the figures of the accompanying drawings in which like reference characters represent like elements so far as possible in the several figures.

Fig. 1 diagrammatically illustrates an amplifying and reproducing systems including the features of my invention. Fig. 2 shows a modified form of a feature of my invention in the amplifying portion of the system. Fig. 3 shows another modification of the feature of Fig. 2. Fig. 4 illustrates the system shown in Fig. 2 in connection with a more complete circuit.

Referring to Fig. 1, a cascade connected amplifier is shown to include a three electrode vacuum tube VT_1 coupled through transformer T_2 to a pair of three electrode tubes VT_2' and VT_2'' connected in push-pull relation in well-known manner. Transformer T_1 provides an input for currents to be amplified to tube VT_1, and transformer T_3 provides an output to a reproducing device later described.

A transformer T having a primary P included in an alternating current supply system has a secondary S_1 for supplying heating current to the filament of tube VT_1, a secondary S_2 for supplying heating current to the filaments of tubes VT_2' and VT_2'', a secondary S_3 for heating the filament of a rectifier tube RT, and a secondary S_4 for supplying alternating current to the anodes of rectifier tube RT for rectification and supply to the plate circuits of the amplifier tubes by way of the filter system including condensers C_3 and C_4, and coil FC, the positive and negative terminals of the filter output being as indicated by the conventional signs, the negative terminal being shown grounded. The plate potential for tube VT_1 is indicated as reduced through passing the current through series resistance R_3 and further filtered with the aid of condenser C_2. Potentiometers K_1 and K_2 provide for connections of the filaments of the tubes to ground through grid bias producing resistances R_1 and R_2 respectively. Condenser C_1 is a signal current by-pass around resistance R_1. The features so far mentioned are usual to general practice and require no detailed explanation.

The two sections P_3' and P_3'' of the push-pull output transformer T_3 are shown connected through a resistance R_4 to which the positive side of the filter output is connected through a variable contact E to energize the plate circuits of tubes VT_2' and VT_2'', an arrangement I find of particular value in an amplifying system having a push-pull stage of amplification when the system is energized from an alternating current supply. If the two sides of a push-pull amplifier are nicely balanced throughout the arrangement will automatically neutralize hum producing effects resulting from energizing the tubes from an alternating current source, which would be a desirable feature if the one push-pull stage of amplification were the only stage in use, but in multi-stage amplification it is often most desirable to have some hum producing current in the push-pull stage to neutralize hum producing currents that come from one or more preceding stages; or it may be desirable to have a residual hum producing current in the push-pull stage to pass onward for a particular use, such as neutralizing hum current in a succeeding reproducing device, which hum producing current may well exist in some forms of reproducing devices used in particular ways, as the so-called dynamic load speaker having its field coil energized by current coming from the source used for energizing the tubes of the amplifier. I show in Fig. 1 and will describe later the use of a dynamic speaker involving such a neutralizing effect.

In general the commercial production of tubes and devices for making up a push-pull stage of amplification, and usual means for energizing the tubes, do not permit of assembling with any hope of having the system balanced for hum elimination, or unbalanced in any desired way, and it may be that any haphazard unbalance obtained

results in hum of phase opposed to that desired for neutralizing. In other words, it is particularly useful to be able to determine the degree and phase of hum producing current that can be obtained in any assembly of apparatus making up a push-pull stage of amplification, and this I provide for in resistance R_4 and the adjustment of contact E thereon. By adjusting this contact one way or the other I can overcome any hum unbalance in the push-pull system, or can generate any degree and phase of hum in the push-pull system to neutralize hum coming from tube VT_1, or the residual of hum in a plurality of preceding tubes. In addition it is possible to have from the neutralizing of hum as between the push-pull stage and preceding stages a residual of desired phase to pass onward to a reproducing device, or for other use, if desirable.

I show a dynamic speaker having a field coil FC connected in the filter circuit in order to utilize the rectified current thereof for energizing the field, and at the same time employ the inductive effect of this field winding usefully for filtration purposes, thus avoiding the use of separate means for energizing the field coil and eliminating the use of one or more filter choke coils usual in filter systems.

I show the usual movable coil MC mechanically associated with a conical or other suitable sound producing element G of dynamic speaker practice, the movable coil being in the field of the core of field coil FC. The movable coil MC is connected in circuit with the secondary of output transformer T_3.

Because field coil FC is energized from the same unidirectional fluctuating current that energizes the tubes the effect of its fluctuating field on movable coil MC can be opposed by residual fluctuations of proper phase from the push-pull stage passing through coil MC. However, in view of the small number of turns in the coil MC in usual dynamic speaker construction it is difficult to create enough fluctuating field in coil MC to adequately oppose the fluctuating field of field coil FC, and in such cases an additional bucking or neutralizing coil NC wound on the core of the field coil and connected in series with the movable coil is of great help in accomplishing the desired result.

Of course transformers T_2 and T_3 can be poled as may be required to aid in arriving at phase conditions favorable to the neutralizing effects I have described; however, this is not in itself a specific feature of the present invention, I having utilized this feature in systems described and claimed in patent applications heretofore filed by me.

In Fig. 2 I show how the hum conditions in the push-pull stage can be determined and controlled in a way different from that in Fig. 1. In this case I provide separate connections from the two sections of the secondary of push-pull transformer T_2 to the grid bias producing resistance R_2 through adjustable contacts E′ and E″. Since the fluctuating current flows through resistance R_2 it is possible by selecting proper points of contact thereon to introduce any desired unbalancing effects in the push-pull stage, so that such an arrangement can be inserted in Fig. 1 as the equivalent of the push-pull arrangement shown therein.

Fig. 4 which shows the same type of push-pull circuit as Fig. 2 illustrates the connection of the system to a power supply device and also to a utilizing circuit. The input of the push-pull arrangement in Fig. 4 is coupled to the output of a tube VT_1 through a transformer T_2.

Fig. 3 shows another arrangement for determining and controlling the hum producing characteristics of a push-pull stage of amplification. I show variable resistances R_5 and R_6 in the plate circuits of tubes VT_2' and VT_2'' in lieu of the adjustable resistance R_4 in Fig. 1, and adjustment of these resistances permits of determining and controlling the hum producing current and phase of it in the push-pull stage. In some constructions one of these resistances may suffice for securing the adjustment desired.

If it is needed to moderate feed back coupling between the grid and plate circuits in the grid bias producing resistance of the push-pull stage the provision for avoiding this shown in Fig. 3 is effective. The arrangement constitutes a filter including a high resistance R_7 and a condenser C_5 of adequate capacity to by-pass signal current direct to the filament from the grid circuits.

Having described my invention I claim:

1. In an amplifier system, the combination of a pair of electron discharge tubes including grid, filament and plate circuits, means for energizing the filaments of said tubes in parallel with alternating current, push-pull input and output devices therefor connected respectively in the grid-filament and plate-filament circuits of said tubes, an impedance common to said grid-filament and plate-filament circuits for developing a grid-bias potential, and connections between said input devices and said impedance for regulating the space current of said tubes whereby the fluctuations in the output current of one of said tubes may be made to neutralize the fluctuations in the output current of the other of said tubes.

2. In an amplifier, a pair of multi-electrode tubes, means for energizing the cathodes of said tubes with alternating current, said tubes having their input and output circuits connected in push pull relation, a grid biasing resistor means common to the grid-cathode circuits of said tubes, and a variable connection from the grid of each tube to said biasing means.

3. In an amplifier, a pair of multi-electrode tubes, means for energizing the cathodes of said tubes, said tubes having their input and output circuits connected in push pull relation, a grid biasing resistor means common to the grid-cathode circuits of said tubes, and an adjustable tap from the grid of each tube to said biasing means, said taps being independent of each other.

4. In an amplifier system the combination of a pair of electronic tubes each thereof including anode, cathode and grid electrodes push-pull input and output circuits therefor, a source of energy to be amplified said energy having superimposed thereon an undesired hum component, means for coupling said source to said push-pull input circuit said means acting to impress upon said push-pull input circuit the energy desired to be amplified together with the superimposed undesired hum component, a translating device, means for coupling the push-pull output circuit to said translating device, said push-pull output circuit including an anode return circuit common to both said tubes comprising a potential developing element and a source of uni-directional fluctuating current in series, means for connecting the grid input electrodes of both of said tubes to said potential developing element for imparting a grid biasing potential to both

of the tubes, said grid biasing potential including a fluctuating component derived from said source of fluctuating current and means for controlling the phase and magnitude of the grid biasing potential fluctuating component so that it opposes the effect of the undesired component transferred to the push-pull input circuit to any desired degree.

5. In an amplifier system the combination of a pair of electronic tubes each thereof including anode, cathode and grid electrodes, push-pull input and output circuits therefor, a source of energy to be amplified, said energy having superimposed thereon an undesired hum component, means for coupling said source to said push-pull input circuit, said means acting to impress upon said push-pull input circuit the energy desired to be amplified together with the superimposed undesired hum component, a translating device, means for coupling the push-pull output circuit to said translating device, said push-pull output circuit including a common anode return circuit comprising a potential developing element and a source of uni-directional fluctuating current in series, means for connecting the grid input electrodes of both of said electronic tubes to said potential developing element for imparting a grid biasing potential to both of said tubes, said grid biasing potential including a fluctuating component derived from said source of fluctuating current and means for controlling the phase and magnitude of the grid biasing potential fluctuating component so that its effect upon said tubes when combined with the effect of the undesired hum component transferred to the push-pull input circuit produces in the push-pull output, a fluctuating current component of predetermined phase and amplitude.

6. In an amplifier system, an electronic relay, input and output circuits therefor, a pair of electronic tubes, push-pull input and output circuits for said tubes, a source of uni-directional fluctuating current connected to the anode circuits of both the electronic relay and the push-pull connected tubes to furnish anode current for the same whereby there exists in the output circuits of both said relay and push-pull connected tubes a fluctuating current component derived from said source, means for coupling the output circuit of said relay to said push-pull input circuit said means acting to transfer fluctuating current components present in the output of said electronic relay to said push-pull input circuit, a potential developing element in said push-pull output circuit forming a series circuit with said source of current whereby current flowing in the push-pull output circuit of said tubes passes through said potential developing element, means for supplying biasing potentials to both said push-pull connected tubes comprising means for including at least a portion of said element in said push-pull input circuit whereby there is impressed upon the push-pull input circuit the effect of at least a portion of the fluctuating current component from said source and means for adjusting the magnitude and phase of said impressed fluctuating current component to oppose to any desired degree the effects of the fluctuating current component transferred to said push-pull input circuit through said coupling means.

7. In an amplifier system the combination of a pair of electronic tubes, push-pull input and output circuits therefor, a source of energy to be amplified including an undesired hum component, means for coupling said source to said push-pull input circuit, said means acting to impress upon said push-pull input circuit not only the energy desired to be amplified but also the undesired hum component, a translating device, means for coupling the push-pull output circuit to said translating device, a common filament energizing system for both said tubes including a source of alternating current, the filaments of said tubes being connected in parallel relative to said source of alternating current, an impedance effectively across said source of alternating current and said filaments, a common plate return connection from the center of said push-pull output circuit to a point of said impedance said connection including a potential developing element and a source of uni-directional fluctuating current in series therewith, means for connecting the grid input electrodes of both said electronic tubes to said potential developing element for imparting a grid biasing potential to both said tubes, said grid biasing potential including a fluctuating component derived from said source of fluctuating current and means for controlling the phase and magnitude of the grid bias potential fluctuating component so that its effect upon said tubes is combined with the effect of the undesired hum component transferred to said push-pull input circuit to produce in the push-pull output circuit a fluctuating current component of predetermined phase and amplitude.

8. In an amplifier system the combination of a pair of electronic tubes each thereof including anode, cathode and grid electrodes, push-pull input and output circuits therefor, a source of energy to be amplified the energy to be amplified having superimposed thereon an undesired hum component, means for coupling said source to said push-pull input circuit said means acting to impress upon the push-pull input circuit the energy desired to be amplified together with the superimposed undesired hum component, a translating device of the type utilizing a field winding, means for energizing said field winding comprising a source of uni-directional fluctuating current, means for coupling the push-pull output circuit to said translating device said push-pull output circuit including a common anode return circuit comprising a potential developing element and said source of uni-directional fluctuating current in series, means for connecting the grid input electrodes of both of said electronic tubes to said potential developing element for imparting a grid biasing potential to both of said tubes, said grid biasing potential and said translating device field including a fluctuating component derived from said source of fluctuating current, means for controlling the phase and magnitude of the fluctuating current component impressed upon said thermionic tubes so that its effect when combined with the effect of the undesired hum component transferred to said push-pull input circuit produces in the push-pull output a fluctuating current component of predetermined phase and amplitude, the effects of said last named fluctuating current component being transferred to said translating device through said coupling between the push-pull output circuit and the translating device whereby the effects of the fluctuating current component in the field of said translating device due to the energization thereof from said source of uni-directional fluctuating current is substantially neutralized.

9. In an amplifier a pair of multi-electrode electronic tubes, means for energizing the cathodes of

said tubes with alternating current, push-pull input and output circuits for said tubes, a potential developing element common to the grid cathode circuits of said tubes, a variable connection from the grid of each tube to said biasing means and a common anode return circuit including said grid biasing means and a source of uni-directional fluctuating current.

10. In an amplifier circuit a pair of multi-electrode electronic tubes, means for energizing the cathodes of said tubes, push-pull input and output circuits for said tubes, a potential developing element common to the plate-cathode circuits of said tubes, a variable connection from the grid of each tube to said potential developing element, and a source of uni-directional fluctuating current connected in said common portion of the plate cathode circuits of said tubes.

BENJAMIN F. MIESSNER.