April 21, 1925. 1,534,086

E. O. SCRIVEN

TRANSFORMER CIRCUITS

Filed Aug. 8, 1922

Fig. 1.

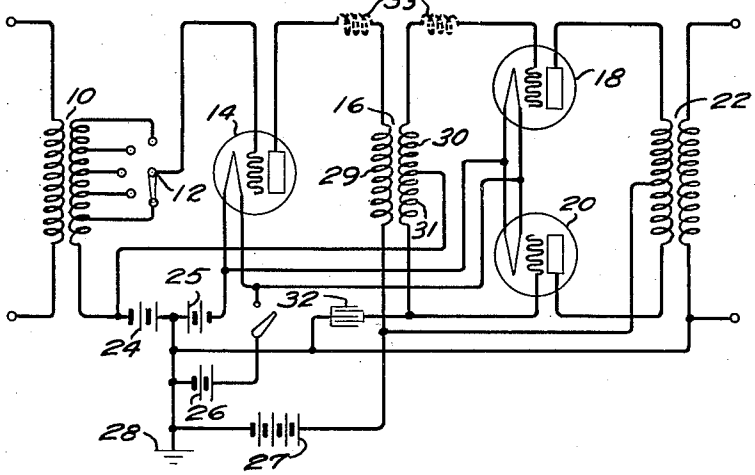


Fig. 2

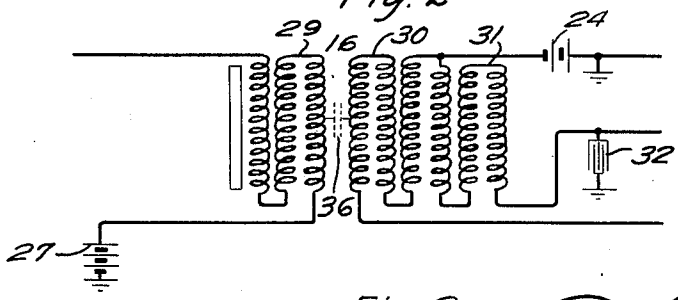
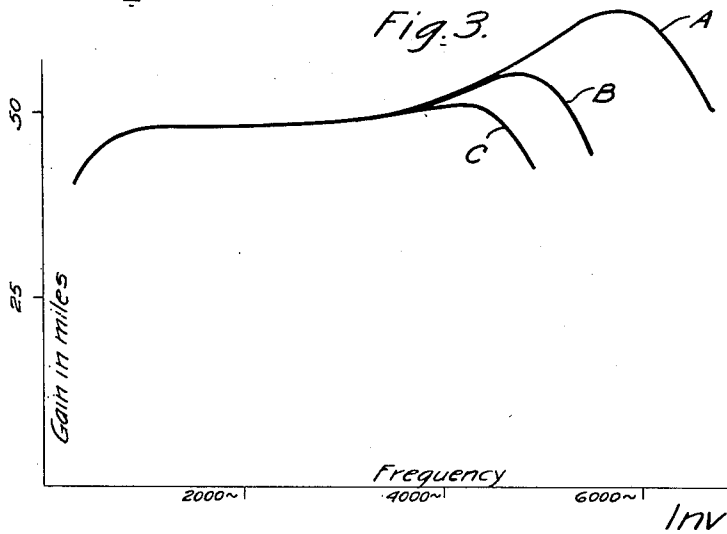


Fig. 3.



Inventor:
Edward O. Scriven
by J. E. Roberts Atty.

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UNITED STATES PATENT OFFICE.

EDWARD O. SCRIVEN, OF NEW YORK, N. Y., ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

TRANSFORMER CIRCUITS.

Application filed August 8, 1922. Serial No. 580,532.

To all whom it may concern:

Be it known that I, EDWARD O. SCRIVEN, a citizen of the United States, residing at New York, in the county of New York, State of New York, have invented certain new and useful Improvements in Transformer Circuits, of which the following is a full, clear, concise, and exact description.

This invention relates to transformers and transformer circuits and particularly to transformers employed to inductively couple a vacuum tube repeater to a source of impulses to be repeated.

In certain amplifier circuits an input transformer has heretofore been employed with which has been associated either an actual inductance or leakage inductance of a value to resonate with the vacuum tube electrode capacities and the capacities between the turns of the secondary winding at a frequency near or above the upper limit of the essential speech range. The effect of this arrangement is to increase the transmission through the amplifier at the higher frequencies, which would otherwise be attenuated by the shunt capacities referred to.

It has sometimes been found in cases where filters are not employed that sufficient energy is transmitted at or near the resonant frequency to cause singing of the amplifier.

An object of this invention is to reduce the transmission at the higher frequencies in transformer circuits of the above type and thereby prevent singing.

Another object is to obtain an effective balance of capacities in a transformer in which one winding is superimposed on another.

In the embodiment of the invention shown herein, a two-stage amplifier comprises one vacuum tube in the first stage and two oppositely connected tubes in the second stage. A transformer, which is employed to connect the two stages, comprises a single primary winding and two secondary windings superimposed thereon. The outer terminal of the primary and the junction of the secondaries are connected to ground. The inner layer of the innermost secondary has a capacity to the primary and therefore to ground. This capacity is thus effectively in shunt to the innermost secondary and is added to the shunt capacity of the tube connected across that winding. In accordance with this invention a small condenser is connected between ground and the outer layer or ungrounded terminal of the outermost secondary. This condenser serves to balance the natural capacity of the innermost secondary and serves also to increase the shunt capacity and thereby reduce the gain and the danger of singing at the upper audible frequencies.

Fig. 1 represents diagrammatically an amplifier circuit embodying the invention.

Fig. 2 represents diagrammatically the arrangement of windings of the interstage transformer.

Fig. 3 represents graphically the effect of using the invention.

An input transformer 10 is adjustably connected by switch 12 to a vacuum tube amplifier 14. Interstage transformer 16 connects tube 14 to amplifier tubes 18 and 20 of the second stage, the latter being connected oppositely, or in push-pull relation. Output transformer 22 serves to impress the amplified energy upon any desired work circuit. The grids of the tubes are rendered negative by battery 24. The filaments are heated by batteries 25 and 26 in series. Space current is supplied by battery 27. The circuit is grounded at 28.

Transformer 16 comprises a primary winding 29 and secondary windings 30 and 31. The junction of windings 30 and 31 is connected to ground through battery 24. Transformer 16 is designed to have leakage inductance represented in the drawing as series inductances 33. Actual inductance may, of course, be employed if desired. This effective series inductance forms a resonant circuit with the capacities of the tubes in the second stage and with the capacities between the turns of a secondary winding at a frequency in the upper part of the voice range and increases the transmission at the higher frequencies where it would otherwise fall off due to the shunt capacities.

It has been found, as above stated, that the transmission is sometimes great enough to produce singing at the resonant frequency. It has further been found that by increasing the shunt capacity an effect is obtained which appears to correspond to reducing the cut-off frequency of a filter.

In Fig. 3, curve A represents the transmission of the circuit with only natural capacities present; curve B represents the

transmission with a small condenser 32 connected from the outermost terminal of secondary winding 31 to ground, while curve C represents the transmission using a slightly larger value of condenser 32. It will be noted that in curves B and C the maximum amplification is much less than in curve A for the high unessential frequencies, while there is no substantial reduction for the essential frequencies of speech and music.

Referring to Fig. 2, the manner in which the increase in shunt capacity is obtained will be understood. It is seen that the natural capacity 36 is effectively connected through ground across secondary winding 30. Condenser 32 is in substantially the same relation to winding 31. A symmetrical arrangement thus is obtained in which the capacities 32 and 36 cooperate to eliminate danger of singing.

The invention claimed is:

1. A transformer comprising a winding having its outer layer connected to ground, a second winding superimposed on said first winding and having its outer layer connected to ground, a third winding superimposed on said second winding and having its inner layer connected to ground, and a condenser connected between ground and the outer layer of said third winding.

2. In an electric circuit, a line, a transformer comprising a primary and two secondary windings, said secondary windings being connected symmetrically as to the two sides of said line, the physical arrangement of said secondary windings being unsymmetrical whereby one of said secondary windings has a greater capacity to said primary winding than the other, and a capacity between said other secondary winding and said primary winding.

3. A transformer comprising several windings, two of said windings being serially connected, one of said two windings having greater capacity than the other to a third of said windings, and a path comprising a condenser connecting said other winding to said third winding.

4. In combination, a transformer having two secondary windings, two vacuum tubes having cathodes connected together and to the adjacent terminals of said windings, and having control electrodes connected to the non-adjacent terminals of said windings, one of said control electrodes being connected to said cathodes through a path comprising a natural capacity in said transformer, and a path comprising a condenser connecting the other of said control electrodes to said cathodes.

5. A transformer comprising a multi-layer primary and two multi-layer secondary windings, the layer of said primary winding adjacent to one of said secondary windings, and the junction of said secondary windings being connected to ground through paths of low impedance whereby the natural capacity between the adjacent layer of said primary winding and one of said secondary windings is effectively connected in shunt to said secondary winding, and a capacity connected between the terminal of the non-adjacent layer of the other of said secondary windings and ground for effectively balancing said natural capacity.

6. In combination, a vacuum tube amplifier having input electrodes, an input transformer therefor, said transformer having a primary winding and a secondary winding superimposed thereon, and means for connecting the natural capacity between said windings effectively in shunt to said secondary winding and to said input electrodes.

7. In combination, a multi-stage amplifier comprising a vacuum tube, a transformer having its primary winding in the output circuit of said vacuum tube, the outer terminal of said winding being connected to ground through a path of low impedance, the secondary of said transformer comprising two windings superimposed in order on said primary winding, two vacuum tubes having their cathodes connected to ground and to the adjacent terminals of said secondary windings, and having their control electrodes connected to the non-adjacent terminals thereof, and a condenser in a path in shunt to the outer of said windings.

In witness whereof, I hereunto subscribe my name this 2nd day of August A. D., 1922.

EDWARD O. SCRIVEN.