Jan. 18, 1927. 1,615,044

E. O. SCRIVEN

TRANSFORMER CIRCUIT

Filed August 8, 1922

Fig. 1.

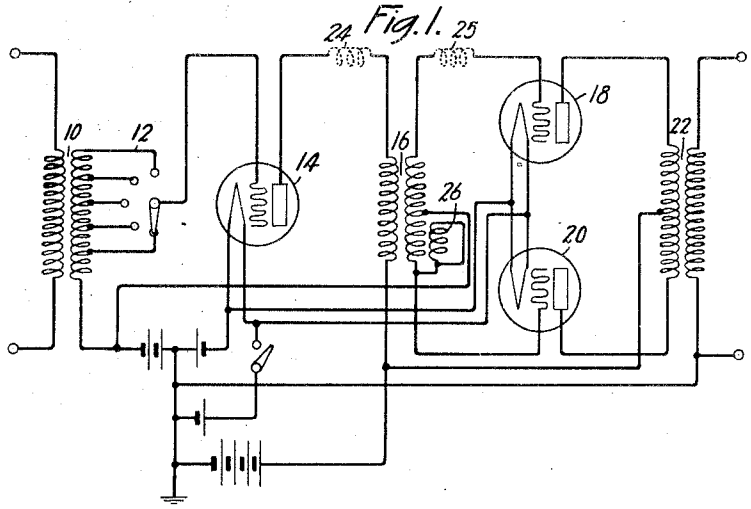


Fig. 2.

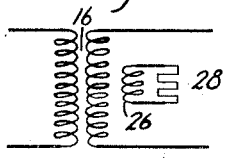


Fig. 3.

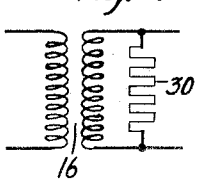


Fig. 4.

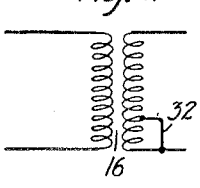
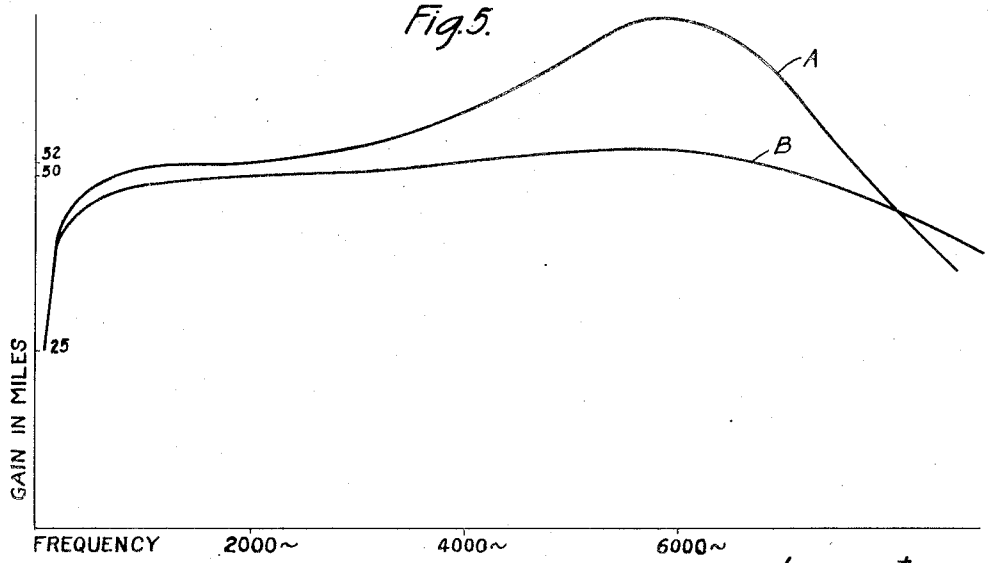


Fig. 5.



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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 CIRCUIT.

Application filed August 8, 1922. Serial No. 580,533.

This invention relates to transformers and transformer circuits and particularly to circuits in which a transformer is employed to connect a vacuum tube amplifier to a source of impulses to be amplified.

In amplifiers for speech frequencies, transformers have heretofore been used having either an actual inductance or leakage inductance resonating with the tube capacity at a frequency in the upper part of the audible range. This produces an increase in gain at the upper frequencies which would otherwise be attenuated by the shunt capacity.

In certain cases where filters are not employed, it has been found that the gain at the resonance frequency may be sufficient to cause the circuit to sing.

An object of this invention is to reduce the gain in circuits of the above type at and near the resonant frequency, without substantially reducing the gain at lower frequencies.

Another object of the invention is to provide an economical method of shunting a transformer winding with resistance.

The above objects are attained in the preferred form of the invention by placing on the transformer a small third winding having its terminals shunted by a conductor of low resistance, the resistance of the third winding being so proportioned to the voltage developed across the third winding that it is the equivalent of a large resistance connected in shunt to one of the main windings. This damps the resonance above referred to and is found to be much more economical than the insertion of a large resistance in shunt to the secondary winding.

Other objects of the invention will be apparent from the following detailed description and claims taken in connection with the accompanying drawings, in which—

Fig. 1 illustrates diagrammatically a vacuum tube amplifier circuit embodying the invention;

Fig. 2 shows a modification of the transformer shown in Fig. 1;

Fig. 3 illustrates a circuit which is the equivalent of the transformer circuits in Figs. 1 and 2;

Fig. 4 represents a further modification;

Fig. 5 illustrates graphically the effect of using the invention.

An input transformer 10 is connected by a variable switch 12 to a vacuum tube amplifier 14. An interstage transformer 16 connects tube 14 to tubes 18 and 20, which are arranged oppositely or in push-pull relation. An output transformer 22 serves to impress the amplified energy on any desired work circuit.

Transformer 16 is designed to have a leakage inductance which is represented in the drawing as inductances 24 and 25 in series with the primary and secondary respectively. The actual inductances or inductance may, of course, be employed if desired. This effective series inductance resonates with the tube capacity at a frequency near the upper limit of the speech range. The effect of this resonance is to build up the gain at frequencies in the upper part of the voice range which would otherwise be attenuated due to the shunt capacities. Curve A, in Fig. 5 illustrates the gain characteristic of the circuit without the damping means hereinafter referred to. With the particular arrangement having the characteristic of curve A, resonance occurs at about 6000 cycles. At and near this frequency the gain is so great as to cause danger of singing due to feed-back to the input circuit of the first tube.

In order to damp the resonance, a few turns of wire, forming a third winding 26, are employed. If the resistance of the turns is properly chosen, the terminals may be connected through a simple conductor of negligible resistance, as in Fig. 1, or a small resistance 28 may be inserted as shown in Fig. 2.

Since the voltage developed across the third winding is low, a small resistance in this circuit is the equivalent of a larger and more expensive resistance connected across the secondary winding as shown at 30, for example, in Fig. 3. If the primary and secondary are formed of 3500 turns of #40 wire, and 14000 turns of #40 wire, respectively, the tertiary winding may comprise 20 turns of #31 wire. The resistance of the tertiary winding circuit is about one ohm and is the equivalent of a resistance of about 500,000 ohms connected across the secondary. The gain characteristic of the circuit after the insertion of the third winding, is shown in curve B, in Fig. 5. It will be noted that in the lower part of the speech range there is a loss of only two miles of standard cable,

while at the resonance frequency the loss is so great as to give practically uniform transmission throughout the important part of the voice range.

Instead of using a third winding the terminals of a few turns of the secondary winding may be connected by a conductor of low resistance as shown at 32 in Fig. 4. In general, however, it is more convenient to use a separate winding. If desired, the third winding 26 may have its potential established by a connection to the secondary winding, as shown in Fig. 1.

While the invention has been illustrated in a particular amplifier circuit, it is obvious that it is capable of wide application and is restricted only by the scope of the appended claims.

The invention claimed is:

1. A telephone repeating transformer comprising main windings and means for damping the resonance of the transformer at a selected portion of the speech frequency range comprising a third winding with a less number of turns than said main windings having its terminals connected by a path of low resistance, the resistance of the circuit comprising said third winding and said path being so proportioned to the voltage developed across said third winding as to be the equivalent of a large resistance connected across one of said main windings.

2. In combination, a vacuum tube amplifier, an input transformer therefor having leakage reactance, said leakage reactance resonating with the capacity of said tube at a frequency in the upper part of the voice range, and a tertiary circuit and resistance inductively coupled with said transformer for damping said resonance.

3. An amplifying circuit for repeating a broad band of frequencies comprising a transformer, with primary and secondary windings, said circuit having a resonance region tending to give the wave components in the resonance region a greater amplification than the wave components throughout the remainder of the band of frequencies to be repeated, and thereby distort the form of the waves repeated, a tertiary winding inductively related to said circuit and a resistance associated with said tertiary winding, said resistance and tertiary winding being proportioned with respect to the other elements of the circuit to reduce selectively the amplification over the resonance region and substantially annul the distortive properties of said circuit.

4. In combination, a telephone repeating coil comprising primary and secondary windings, said coil having a frequency amplitude characteristic which is non-uniform with frequency within the frequency limits of the waves to be transmitted through said coil, and a third winding having a less number of turns than either of said mentioned windings, said third winding being inductively coupled to said coil, and connected in a circuit of low impedance, the impedance and turns-ratio of said circuit with respect to the other elements of the circuit being so proportioned as to have a compensating action on the non-uniform frequency amplitude characteristic of said repeating coil.

5. In a wave transmission circuit, an amplifier, a transformer associating said amplifier with said circuit, the system formed by said elements having a point of maximum gain at a particular part of the frequency range tending to cause the system to sing at said part of the frequency range, and means comprising an auxiliary winding inductively coupled to the windings of said transformers to receive energy therefrom and having its terminals out of energy transfer relation with the path of transmission of waves through said system, the constants of said auxiliary means being so proportioned with respect to the other elements of the circuit as to counteract the tendency of said circuit to sing.

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

EDWARD O. SCRIVEN.