Nov. 21, 1933. H. RODER 1,936,438

COUPLING MEANS

Filed May 6, 1933

Fig.1.

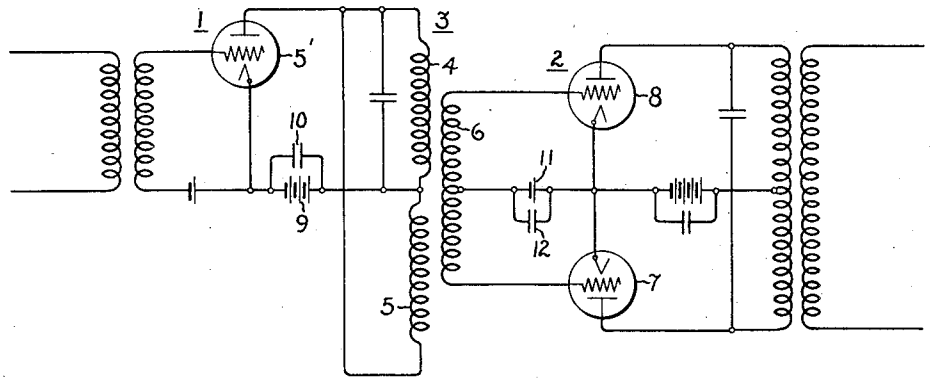


Fig.2.

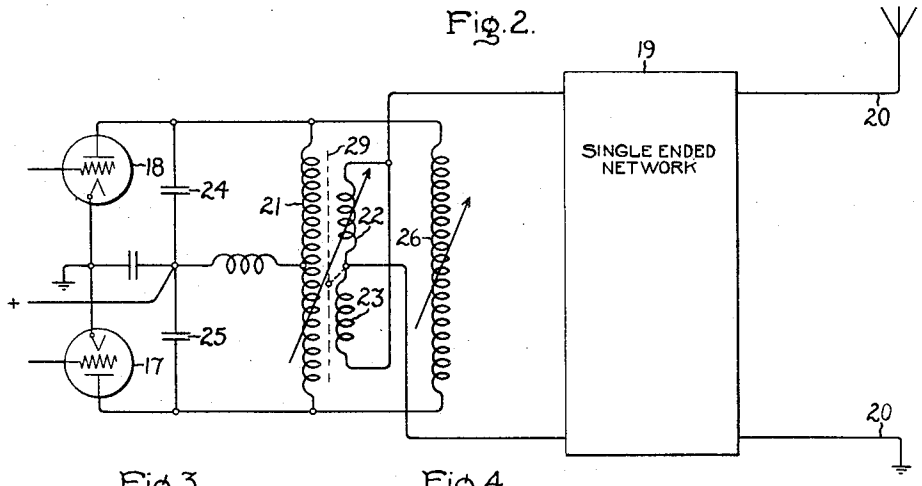


Fig.3.

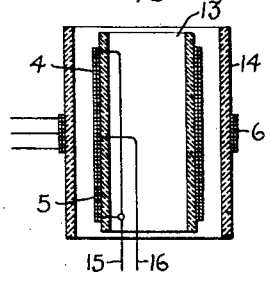
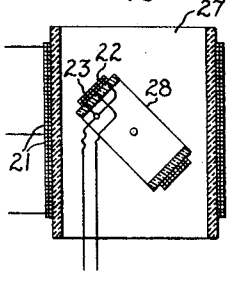


Fig.4.



Inventor:
Hans Roder,
by Charles E. Mullen
His Attorney.

Patented Nov. 21, 1933 1,936,438

UNITED STATES PATENT OFFICE

1,936,438

COUPLING MEANS

Hans Roder, Schenectady, N. Y., assignor to General Electric Company, a corporation of New York

Application May 6, 1933. Serial No. 669,743

4 Claims. (Cl. 178—44)

My invention relates to circuit coupling means and more particularly to means for coupling a single ended circuit with a circuit of the double ended, balanced, or push pull type. All of these types of circuits will be referred to herein as double ended circuits.

When transformers are employed for coupling a single ended circuit with a double ended circuit difficulties are likely to result, particularly at radio frequencies, due to inherent capacity between the primary and secondary windings. The winding connected in the single ended circuit ordinarily is grounded at one end and the opposite end is at high alternating potential. The winding connected in the double ended circuit is ordinarily grounded at the middle and its opposite terminals are at high alternating potential. Accordingly if the winding which is connected in the double ended circuit be positioned with respect to the other winding to produce a maximum of mutual inductance between the windings considerable capacitive coupling will exist between the windings. This will be apparent for example when it is considered that for maximum mutual inductance one of the windings should be situated about midway between the terminals of the other. Thus the points of zero alternating potential on the two coils will be widely spaced apart and similarly other points of the coils of about equal voltage will be widely spaced apart. Thus considerable voltage exists between the coils throughout their length thereby giving rise to objectionable capacitive effects.

If, on the other hand, to minimize these capacitive effects, the points of zero voltage on the two coils are placed in proximity to each other, then maximum mutual inductance is not obtained.

One of the objects of my invention is to provide an inductive coupling system for use between single ended and double ended circuits in which these undesirable capacitive effects are greatly reduced and in which maximum mutual inductance between the windings may be had.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention, however, both as to its organization and method of operation together with further objects and advantages thereof may best be understood by reference to the following description taken in connection with the accompanying drawing in which Figs. 1 and 2 represent different embodiments of my invention; and Figs. 3 and 4 show in greater detail coupling coils constructed in accordance with my invention.

Referring to the drawing I have shown in Fig. 1 thereof a single ended electron discharge amplifier 1 coupled to a double ended or push pull amplifier 2 through a transformer 3. The transformer 3 comprises a pair of primary windings 4 and 5 which are wound in opposite relation on a common axis having their adjacent terminals connected together and to the cathode of discharge device 5' through a source of potential 9 and bypass condenser 10. The opposite terminals of coils 4 and 5 are connected to the anode of the discharge device. The transformer 3 also has a secondary winding 6 which is wound in the same direction throughout its length and the opposite terminals of which are connected to the grids of the discharge devices 7 and 8. The midpoint of this winding may be connected to the cathodes of the discharge devices 7 and 8, voltage source 11 and bypass condenser 12.

As thus arranged it will be seen that the fluxes produced by the coils 4 and 5 are in aiding relation in the coil 6 and that the coil 6 may be positioned relative to the coil 5 for maximum mutual inductance. It will also be seen that the midpoint of the coil 6 and adjacent terminals of the coils 4 and 5, all of which are at zero alternating electromotive force, are arranged in close proximity to each other whereby the capacity effect between the primary windings and secondary windings is reduced. This capacity effect may be further reduced by concentrating the secondary winding about the point of zero potential of the primary winding. This construction is shown more in detail in Fig. 3 in which the coils 4 and 5 are shown wound upon a form 13 and the coil 6 is shown wound upon a form 14. The opposite terminals of the coils 4 and 5 are shown as connected together and as connected to a common lead 15 while the adjacent terminals of these windings are connected to a lead 16. The winding 6 is shown as having three leads extending thereto corresponding to those which extend to the cathode and to grids of the discharge devices 7 and 8 of Fig. 1.

Fig. 2 shows a transformer constructed in accordance with my invention connected to supply oscillations from a double ended circuit comprising discharge devices 17 and 18 to a single ended circuit. This single ended circuit is represented in the drawing by the rectangle 19 and may comprise any suitable network such as an electron discharge amplifier, filter, or tuning system for an antenna 20. In this case the primary

winding 21 of the transformer is wound in the same direction throughout its length whereas the secondary windings 22 and 23 are wound in opposite directions, adjacent terminals thereof being connected to one side of the single ended circuit and opposite terminals being connected to the other side of the single ended circuit. The primary winding 21 in this figure is shown as connected in parallel with the tuned circuit comprising condensers 24 and 25 and a tuning reactance 26. This transformer is also shown by the arrow drawn therethrough as being of the variable coupler type.

A transformer of the construction indicated in Fig. 2 is shown in greater detail in Fig. 4 in which the primary winding 21 is wound upon a form 27 and the secondary windings 22 and 23 are shown as wound upon a form 28. Form 28 carrying the secondary windings is arranged to be rotatable about an axis common to the planes of the minimum potential turns of both the primary and secondary windings.

It will be seen in both Figs. 3 and 4 that the secondary windings of the transformer are narrow relatively to the width of the primary windings, that is, that they are concentrated about the zero voltage point thereby to produce a minimum capacity effect between the windings while at the same time securing a maximum of mutual inductance.

If desired, the capacity effect between the windings may be still further reduced by means of the grounded shield between the primary and secondary windings which is indicated in Fig. 2 by the dotted line 29.

While I have shown particular embodiments of my invention it will be understood that I do not wish to be limited thereto since further modifications may be made. I therefore contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. In a system for coupling a single ended circuit with a double ended circuit, comprising a transformer having a pair of primary windings and a pair of secondary windings, one pair of said windings being wound in opposite directions and connected in parallel in said single ended circuit and the other pair of windings being wound in the same direction and connected in balanced relation in said double ended circuit, and the points of zero alternating potential on both pairs of windings being placed in close proximity to each other.

2. In combination, a single ended circuit having a winding connected between ground and a point of high alternating potential, a double ended circuit having a winding disposed in inductive relation with said first winding, the opposite terminals of said winding being connected to opposite sides of said double ended circuit and an intermediate point on said winding being connected to ground, a third winding connected in parallel with said first winding and so wound as to cause the flux produced thereby to aid the flux produced by said first winding in said second winding, said first and third windings being so positioned with respect to said second winding that the points of ground potential on all of said windings are in close proximity and equal inductive coupling is produced between said single ended circuit and each side of said double ended circuit.

3. In a system for coupling a single ended circuit with a double ended circuit, comprising a transformer having a pair of primary windings and a pair of secondary windings, one pair of said windings being wound in opposite directions and connected in parallel in said single ended circuit and the other pair of windings being wound in the same direction and connected in balanced relation in said double ended circuit, and the points of zero alternating potential on both pairs of windings being placed in close proximity to each other, and the windings of one of said pairs being relatively closely spaced about the zero voltage point of said other pair.

4. In a system for coupling a single ended circuit with a double ended circuit, comprising a transformer having a pair of primary windings and a pair of secondary windings, one pair of said windings being wound in opposite directions and connected in parallel in said single ended circuit and the other pair of windings being wound in the same direction and connected in balanced relation in said double ended circuit, said pairs of windings being so spaced relative to each other as to produce a maximum of mutual inductance between the pairs of windings and a minimum of capacity between said pairs of windings.

HANS RODER.

DISCLAIMER

1,936,438.—*Hans Roder*, Schenectady, N. Y. COUPLING MEANS. Patent dated November 21, 1933. Disclaimer filed November 30, 1934, by the assignee, *General Electric Company*.

Hereby enters the following disclaimer to claims 1 and 4 of the said Letters Patent, which are in the following words, to wit:

"1. In a system for coupling a single ended circuit with a double ended circuit, comprising a transformer having a pair of primary windings and a pair of secondary windings, one pair of said windings being wound in opposite directions and connected in parallel in said single ended circuit and the other pair of windings being wound in the same direction and connected in balanced relation in said double ended circuit, and the points of zero alternating potential on both pairs of windings being placed in close proximity to each other."

"4. In a system for coupling a single ended circuit with a double ended circuit, comprising a transformer having a pair of primary windings and a pair of secondary windings, one pair of said windings being wound in opposite directions and connected in parallel in said single ended circuit and the other pair of windings being wound in the same direction and connected in balanced relation in said double ended circuit, said pair of windings being so spaced relative to each other as to produce a maximum of mutual inductance between the pairs of windings and a minimum of capacity between said pairs of windings."

[*Official Gazette January 1, 1935.*]