

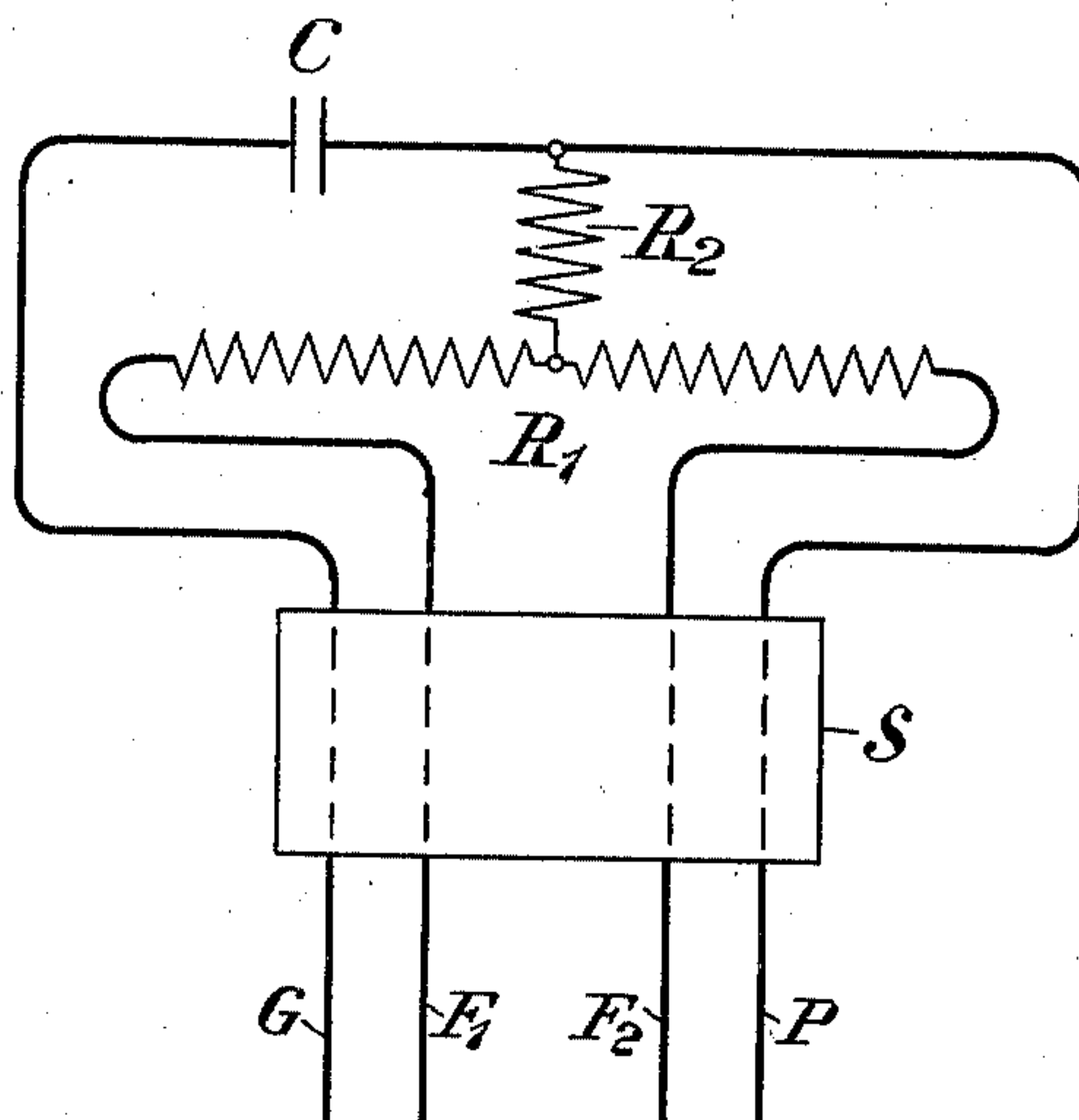
April 8, 1941.

C. F. LANDENBERGER ET AL

2,237,492

ELECTRICAL NETWORK

Filed Oct. 7, 1939



INVENTORS
C. F. Landenberger and
BY *T. J. Talley 3rd.*
William R. Hallard
ATTORNEY

UNITED STATES PATENT OFFICE

2,237,492

ELECTRICAL NETWORK

Charles F. Landenberger, Camden, N. J., and
Thomas J. Talley, 3rd, Philadelphia, Pa., assign-
ors to American Telephone and Telegraph Com-
pany, a corporation of New York

Application October 7, 1939, Serial No. 298,522

4 Claims. (Cl. 250—27)

This invention relates to electrical networks and circuits. More particularly, this invention relates to networks and circuits for use in place of vacuum tubes which may, for example, form part of repeater systems.

It has become the practice in the multiple repeater systems to measure the change in gain of the overall amplifier of each individual repeater when the filament current is varied between two stated limits. Such tests—which are known as activity tests—are especially useful in 4-wire repeaters and similar circuits having two (or more) tandem arranged tubes, as, for example, the usual three-electrode tubes of the 102 and 101 type, which are respectively voltage amplifier and amplifier output tubes. If the change in gain as the filament is thus varied exceeds a predetermined value, it then becomes important to determine which of the tubes of the repeater under test is at fault.

In a repeater of the type above-referred to which is found faulty, another tube, for example, of the 102 type which is known to have zero gain variation with filament current changes, is substituted for the one in the repeater set or system being examined. The test is then repeated and if the measurements now come within the prescribed limits, the operator becomes practically assured that the prior tube under test was unsatisfactory. That tube may then be discarded.

One of the difficulties with the test above-noted is that it requires the availability of several tubes known to have substantially zero gain variation with filament current changes. Experience shows that such tubes may not always be readily available. Test tubes do not long retain their original status because they are generally handled many times and are subjected to considerable current and voltage effects.

It is one of the objects of the present invention to overcome difficulties of the kind already noted. This may be accomplished by constructing a simple network which may be mounted on a tube base in such a way as to be readily substituted for a tube under test, without requiring the availability of a tube (or tubes) of substantially perfect activity.

One form of network which has been found suitable for this purpose comprises a resistance connected between the filament terminals of the tube socket and a condenser connected between the grid and plate terminals of the socket. This network is of very simple form. The resistance

simulates the filament circuit of the tube. The condenser acts to insulate the grid terminal of the tube from the plate terminal as well as from the filament terminals without preventing the flow of alternating current from the input circuit to the output circuit connected to the plate and filament terminals of the tube circuit.

This invention will be better understood from the detailed description hereinafter following when read in connection with the accompanying drawing which shows one form of network to be employed in the invention.

Referring to the drawing, the reference character S designates a tube base of well-known construction having two filament terminals or prongs F_1 and F_2 , a grid terminal or prong designated G and a plate terminal or prong designated P. A resistor R_1 is connected between the filament terminals or prongs F_1 and F_2 . A condenser C is connected to the grid and plate terminals or prongs G and P, respectively. A second resistor R_2 may preferably be connected between the right-hand contact of condenser C and the midpoint of resistor R_1 .

If the network just described is to replace a vacuum tube of, for example, the 102 type, the resistor R_1 would then be a non-inductive resistor designed to dissipate about 5 watts and it would have the average hot resistance of the filament of the 102 type tube which it would replace. The condenser C would be of a capacity of about 1 microfarad and it would be designed for continuous operation at 150 volts or more. The condenser would completely insulate the grid terminal G from the plate terminal P without preventing the flow of alternating current between these terminals. The resistor R_2 would preferably be a non-inductive resistor designed to dissipate about 1 watt. Its resistance would equal approximately the plate-to-filament resistance of the 102 type tube, thereby permitting the flow of normal plate current therethrough. It will hence be apparent that the normal filament current traverses resistor R_1 of the network, and the normal plate current traverses resistor R_2 and divides between the two halves of resistor R_1 . The current or signals of the input circuit will be transmitted through condenser C to the output circuit of the network.

A simple network of the kind shown in the drawing, together with the normal tube base of well-known construction, may thus be substituted for a tube of a repeater or other circuit and hence obviate the need for one or more

substantially perfect tubes for making activity tests or other measurements. This type of network has been found to eliminate the usual uncertainty regarding the condition of the tube or tubes which have formerly been used in such tests. Such a repeater or other circuit would, however, have a gain less than normal.

The passive network described is the direct current equivalent of the tube which it replaces. A considerable amount of alternating current power will flow through the network and the delivered power will be independent of the current flowing through the resistor R_1 corresponding to the filament circuit.

If a repeater or other system comprises two (or more) tubes connected in tandem, the substitution of the network for one of the tubes will permit the direct determination of the gain variation of the other tube of the repeater system. Of course, no tube of known gain variation will be required for the measurement as already explained hereinabove. It is especially noted that a passive network of the kind here involved need not undergo frequent periodic tests, as would be the case with "standard" vacuum tubes, to determine their suitability for filament-activity tests.

A certain form of passive network has been shown and described herein for use in performing certain types of tests of repeaters and the like. The specific circuits described may be of other and widely varied organizations without departing from the spirit of the invention and the scope of the appended claims. It will be apparent that other forms of passive networks may be constructed within the scope of this invention to be used in place of other types of tubes used in repeater and like systems.

What is claimed is:

1. A passive network device to replace a vacuum tube comprising a vacuum tube base having four terminals, a non-inductive resistor connected to two of said terminals and having a resistance substantially equal to the average hot resistance of the filament of said vacuum tube, and a condenser connected between the other two terminals of said base through which alternating current may flow.

2. A device to replace a vacuum tube comprising a vacuum tube base having two pairs of terminals, one of the pairs of terminals forming an input circuit and the other pair of terminals forming an output circuit for the transmission of signals from the input circuit to the output circuit, a non-inductive resistor connected between one of the terminals of the first pair and one of the terminals of the second pair, and a condenser connected between the remaining two terminals, the non-inductive resistor simulating the filament circuit of said vacuum tube, the condenser freely transmitting the signals impressed upon said input circuit to said output circuit.

3. An arrangement simulating a vacuum tube to be used in place of the vacuum tube, comprising the combination of a vacuum tube base having four terminals, a first non-inductive resistor connected between two of said terminals, said resistor having a resistance equal to that of the filament of the equivalent vacuum tube, a condenser connected between the remaining two terminals, and a second non-inductive resistor connected between one of the condenser terminals and a point along first resistor, said second resistor having a resistance equal to the plate-to-filament resistance of the equivalent vacuum tube.

4. A passive network device to replace a vacuum tube comprising a vacuum tube base having four terminals, a first non-inductive resistor connected to two of the terminals of said base and having a resistance substantially equal to the average hot resistance of the filament of said vacuum tube, a condenser connected between the other two terminals of said base through which alternating current may flow, and a second non-inductive resistor to interconnect one terminal of said condenser with the midpoint of said first resistor, said second resistor having a resistance substantially equal to the average resistance between the plate and filament of said vacuum tube.

CHARLES F. LANDENBERGER.
THOMAS J. TALLEY, 3RD.