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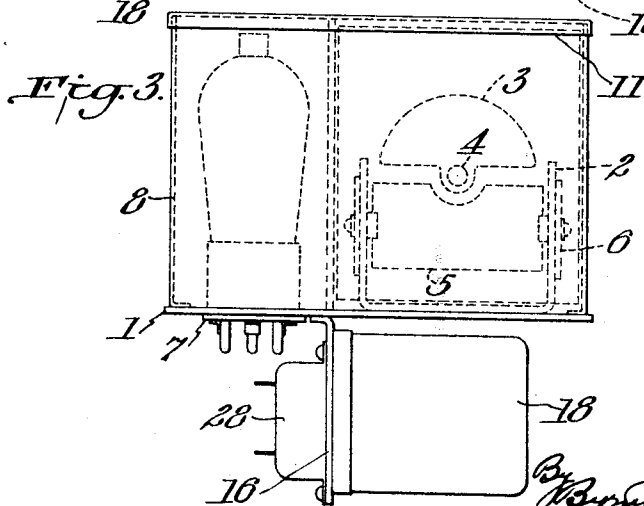
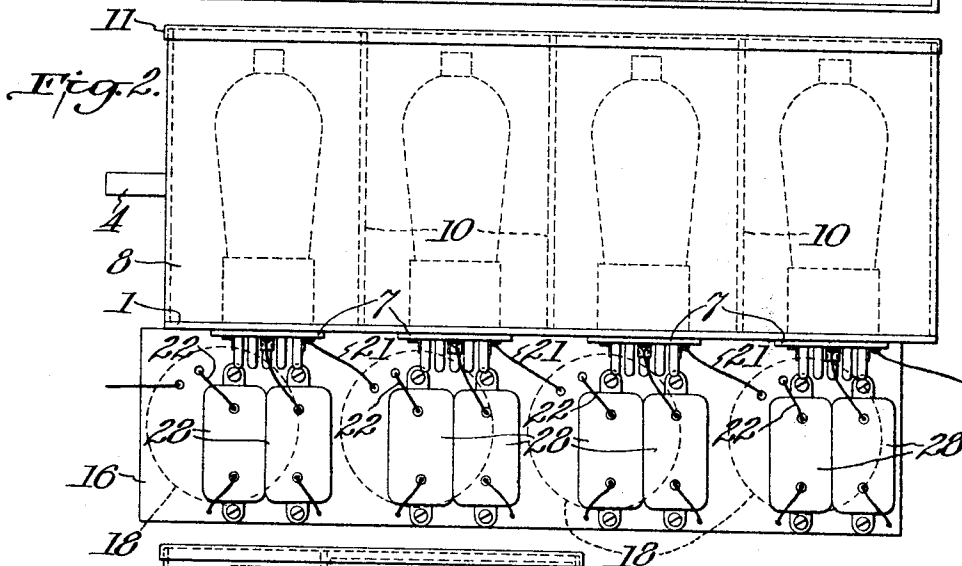
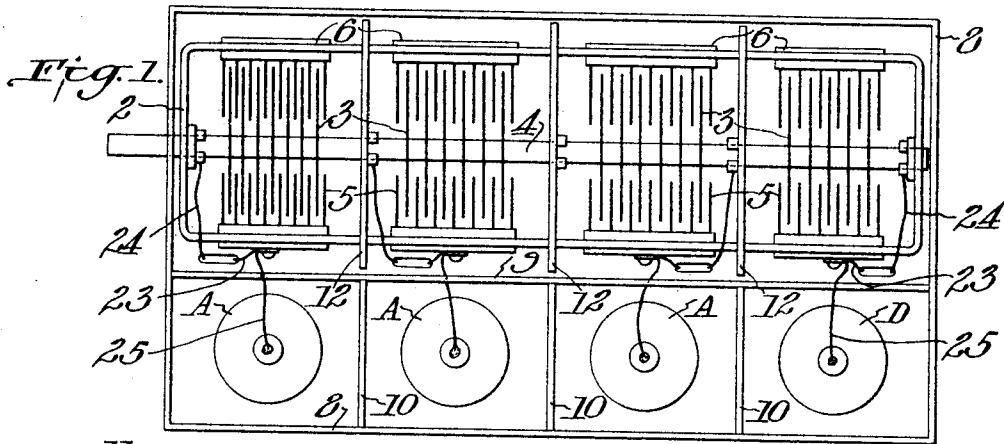
H. A. SNOW

1,895,902

SCREEN GRID AMPLIFIER

Filed Aug. 29, 1929

2 Sheets-Sheet 1



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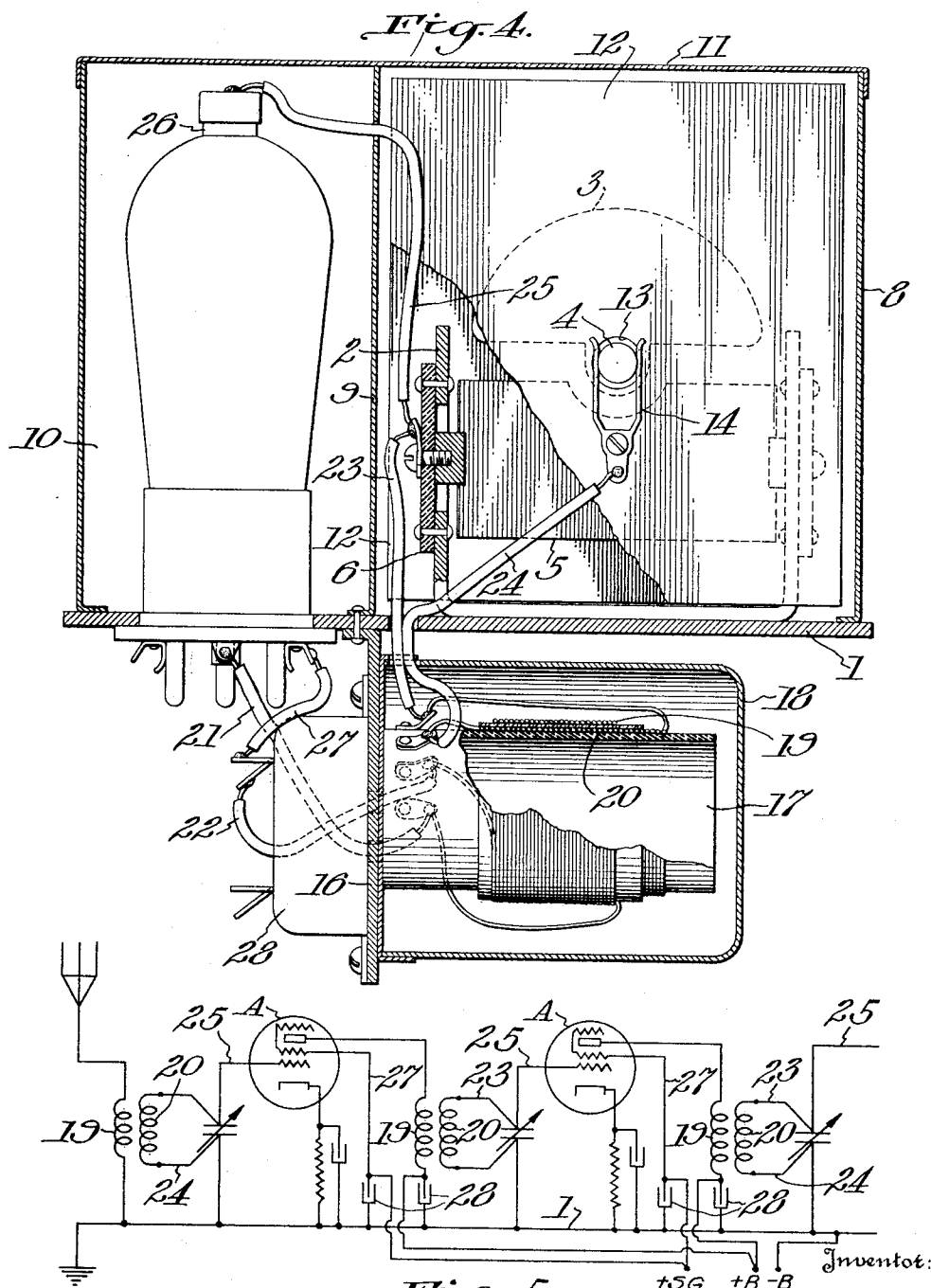
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UNITED STATES PATENT OFFICE

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SCREEN-GRID AMPLIFIER

Application filed August 29, 1929. Serial No. 359,277.

This invention relates to screen-grid amplifiers and particularly to the mechanical arrangement of the circuit elements and of the shielding members in a cascaded amplifier.

Although the electrical characteristics of the screen-grid audions are such as to indicate relatively high amplification when several stages are cascaded it has been found that the mechanical arrangements and the shielding previously employed in cascaded stages are inadequate when applied to tetrodes. The high amplification in the individual stages gives rise to such differences of potential in closely adjacent circuits that retroactive effects and/or interstage couplings produce distortion and may render the cascaded amplifier unstable. To secure good tone quality and stability it was the common practice, in the early commercial use of screen-grid amplifiers, to operate the tubes under such conditions that the amplification obtained was relatively low.

An object of the present invention is to provide a stage or cascaded stages of screen-grid amplifiers in which the mechanical arrangement and shielding of the circuit elements is such that undesired couplings between the circuit elements are substantially eliminated. A further object is to provide an adequately shielded amplifier of the screen-grid type in which the mechanical arrangement of the circuit elements facilitates the shielding and avoids losses in or between the circuit elements.

These and other objects of the invention will be apparent from the following description when taken with the accompanying drawings in which:

Figs. 1, 2 and 3 are a plan view, a side elevation and an end elevation, respectively, of a cascaded amplifier embodying the invention,

Fig. 4 is a transverse section, on an enlarged scale, through the amplifier, and

Fig. 5 is a fragmentary diagram of the electrical circuits.

In the drawings, the numeral 1 indicates the metal base plate upon which or to which all of the elements of the amplifier are se-

cured. The frame 2 of a gang condenser is secured upon and extends longitudinally of the base plate 1, the rotors 3 being carried by and grounded upon a common shaft 4 which is in turn grounded upon the condenser frame 2. The stators 5 may be mounted upon strips of insulating material 6 carried by the condenser frame, but the specific design of the gang condenser does not constitute an essential feature of the present invention.

A plurality of tube sockets 7 for receiving amplifier tubes A and a detector D are mounted on the base plate 1 and aligned in a row which is parallel to the condenser shaft 4, the several sockets being in transverse alignment with the respective stators 5 of the condenser.

Metal plates are provided to form a shield for the condenser and individual shields for the several tubes which are inserted in the tube sockets 7. As shown in the drawings, the shield comprises an open shell 8 which houses both the condenser and the tube sockets, an intermediate plate 9 which extends parallel to the condenser shaft and separates the condenser from the row of sockets, and a series of plates 10 which extend between plate 9 and one side of the shell 8 to form separate cells for the individual tubes.

The plate 9 is of the same height as the walls of the shell 8 and a single cover shield 11 is hinged to or slidable over the top of the shell to complete the several shields.

It is to be understood that the relative position of the shielding plates and the circuit elements is important, but that the detailed construction and interlocking of the plates to form the shields for the condenser and for the individual tubes is subject to considerable variation.

Metal plates 12 are provided between the adjacent units of the gang condenser and are carried by and grounded to the condenser frame 2, the plates 12 preferably extending approximately but not necessarily into contact with the metal walls which form the shield for the condenser. The plates 12 are provided with apertures 13 through which the condenser shaft 4 passes and frictional

contact brushes 14 are mounted on each plate for engagement with the rotor shaft. As best shown in Fig. 4, these grounding brushes take the form of a U-shaped plate of resilient metal, the opposed legs of the plate bearing against the opposite sides of the shaft and the base of the plate being secured by a screw or the like to the respective shield plate 12, and terminating in a soldering lug 15.

A metal plate 16 depends below the base plate 1 to provide a support for the forms 17 on which the interstage transformers are wound and for the metal cans or shells 18 which shield the individual transformers. The depending plate 16 is parallel to the condenser shaft 4 and, for convenience of assembly, is preferably in vertical alignment with the metal plate 9 which extends between the condenser and the tubes.

The transformer windings are single layer coils with the primary winding 19 wound upon and spaced from the secondary winding 20 by a sheet of insulating paper or the like. The longitudinal axes of the several transformers are mutually perpendicular to the depending plate 16 and to the shaft 4 of the condenser. As shown in Fig. 2, each transformer is located beneath the particular section of the condenser which tunes the transformer secondary but is somewhat displaced from a vertical plane passing through the center of the condenser section as this arrangement minimizes the length of the leads to the plate terminal of the preceding tube.

The terminals for the transformers are secured on the form 17 adjacent the end which is fixed to the dependent plate 16, the primary winding terminals being located upon the upper section of the form at the side adjacent the preceding tube socket, and the secondary terminals are secured to the top of the form 17. The plate 16 is provided with passages adjacent the primary winding terminals of the transformer, and the plate terminal lead 21 and battery or power supply device lead 22 for each transformer extend through the respective passages and are soldered to the appropriate terminals of the transformers. Leads 23 and 24 extend from the high and low potential terminals respectively of the transformer secondaries through the base plate 1 to the stator and rotor respectively of the associated condenser section, the low potential leads 24 being soldered to the lugs 15 of the friction brushes which bear upon the condenser shaft at a point adjacent the rotor which tunes the particular secondary winding. The lead 25 from each stator 5 extends upwardly to a point approximately in horizontal alignment with the control grid terminal 26 and then extends horizontally through a passage in metal plate 9.

The current supply lead 22 of each trans-

former primary and the lead 27 from the screen-grid terminal of each tube are grounded through a condenser 28 of high capacity to reduce or eliminate common radio frequency paths in the voltage supply circuits.

Particular attention is directed to the fact that each secondary winding 20 is directly connected to the terminals of the respective condenser section which tunes the secondary, thus avoiding the formation of paths common to more than one tuned circuit. Furthermore, the common condenser shaft is grounded to the condenser frame between adjacent rotors thus avoiding coupling between adjacent stages. The grid terminal and wiring of each tube is shielded from the plate terminal and winding of the same tube by the main base 1 of the amplifier, by the depending plate 16 and by the intermediate plate 9 which extends between the condenser and the series of tubes.

As viewed in end elevation, the base plate 1 and the vertical plates 9 and 16 divide the space occupied by the amplifier into four quadrants; the tubes, the condenser and the transformers being located in separate quadrants, while the fourth quadrant affords adequate space for the other circuit elements.

The electrical circuits of the amplifier may follow any conventional or suitable form. One arrangement which has been used is shown in the diagram of Fig. 5. The heater circuits for the amplifier tubes A are not shown in this diagram but may be of the usual type, the supply leads and other circuit elements being located within the quadrant below the tubes. In place of transformers having separate primary and secondary windings, the interstage couplings may take the form of autotransformers or impedance couplings.

While I have indicated and described one arrangement for carrying my invention into effect, it will be apparent to one skilled in the art that my invention is by no means limited to the particular organization shown and described, but that many modifications may be made without departing from the scope of my invention as set forth in the appended claims.

What I claim is:

1. A cascaded radio frequency amplifier of the type including a plurality of screen-grid audions, transformer couplings between said audions, a gang condenser for simultaneously tuning said transformers, and grounded metal plates providing a shield for said gang condenser and individual shields for each audion and each transformer, characterized by additional metal plates grounded to said shielding plates and arranged between adjacent units of said gang condenser, leads directly connecting each unit of said condenser with the respective terminals of

the transformer winding associated therewith to avoid the formation of paths common to more than one tuned circuit, and means individual to each rotor section of said condenser for grounding the respective rotors to the additional grounded metal plates through the common operating shaft.

2. In a cascaded radio frequency amplifier of the type employing a plurality of screen-grid amplifier tubes, a metal base plate, a gang condenser mounted upon said plate, a plurality of tube sockets carried by said plate and alined in a row extending parallel to the shaft of said gang condenser, metal plates grounded on said base plate and cooperating therewith to provide a shield around said gang condenser and shields between the respective pairs of adjacent sections thereof, an inductive circuit element cooperating with each of the sections of said gang condenser to provide a tuned interstage coupling, means for supporting said inductive circuit elements from said base plate and beneath said gang condenser, individual shields for each of said inductive circuit elements, leads located beneath said base plate for connecting said sockets and inductive circuit elements to sources of current for energizing the amplifier tubes placed in said sockets, and by-pass condensers associated with certain of said leads, said supporting means comprising a metal plate grounded upon said base plate and cooperating therewith to provide a shield between said inductive circuit elements and the space in which said leads and by-pass condensers are located.

3. In an amplifier stage, a metal base plate, a socket on said plate for receiving a screen-grid audion, a metal plate depending below said base plate at one side of said socket, a coupling transformer mounted on said depending plate at the side thereof opposite to said socket, anode circuit leads extending from said transformer through said depending plate and connected respectively to the anode terminal of said socket and to a source of current, a lead from the screen-grid terminal of the socket to a source of current, said lead lying below said base plate, and by-pass condensers positioned below said base plate for by-passing radio-frequency currents from the said leads which are connected to said sources of current.

4. In a cascaded radio frequency amplifier of the screen-grid type, a base plate, a gang condenser mounted on said base plate, a plurality of sockets on said base plate and alined in a row parallel to the shaft of said condenser, metal plates cooperating with said base plate to form a shield for said condenser and individual shields for the tubes inserted in said sockets, a plate depending below said base plate, interstage transformers mounted on the depending plate, said transformers comprising cylindrical windings arranged

with the longitudinal axes thereof normal to said depending plate and to said condenser shaft, individual shields for said transformers, and leads completing each radio frequency circuit between said sockets, transformers and condenser independently of said shielding plates.

5. In a cascaded tetrode amplifier, a metal base plate, a gang condenser mounted upon said plate, a plurality of tube sockets carried by said plate in a row extending parallel to the shaft of said gang condenser, the separate sockets being in transverse alinement with the respective sections of said condenser, metal plates cooperating with said base plate to provide a shield around said condenser and individual shields for tetrodes placed in the said sockets, means depending below said base plate to provide a support for interstage transformers, individual metal shields for each transformer, said shields being grounded on said base plate, and circuit elements completing all radio frequency circuits independently of said metal shields and plates.

6. In a tuned radio frequency amplifier of the type including cascaded tetrode stages, a metal base plate, metal plates above and cooperating with said base plate to provide an open-topped box for the reception of a gang condenser and a series of cells extending along one side of said box, a socket mounted on said base plate within each of said cells, a gang condenser within said box and having the sections thereof in lateral alinement with the respective cells, each section of said condenser comprising a stator insulated from the condenser frame and a rotor grounded to the frame, metal plates between and shielding adjacent condenser sections from each other, interstage coupling transformers supported from said base plate and positioned below said condenser, metal shields enclosing the respective transformers and grounded on said base plate, conductive electrical connections from the grid terminal of each transformer to its respective condenser stator, and individual connections of negligible radio frequency impedance from the low potential terminal of each transformer to the respective condenser rotor associated therewith.

7. In a cascaded amplifier employing screen-grid audions, a metal base plate, a gang condenser mounted on said plate, a plurality of tube sockets carried by said plate alined in a row parallel to the shaft of said condenser, metal plates cooperating with said base plate to provide a shield surrounding said gang condenser and cells for individually shielding the tubes mounted in the respective sockets, a metal plate depending below said base plate, a plurality of interstage coupling transformers mounted on said depending plate, individual shields for said trans-

formers, leads located at one side of said depending plate for connecting the respective transformer primary windings to a source of current supply and the anode terminal of the appropriate socket, and leads located on the opposite side of said depending plate and connecting the grid terminals of the transformers to their respective condenser stators.

8. The invention as set forth in claim 7, wherein the lead from a condenser stator to the grid of the tetrode associated therewith passes through the metal plate shielding said tetrode from the condenser at substantially the lever of the tetrode control-grid terminal.

9. A cascaded radio frequency amplifier of the type including a plurality of screen grid tubes, transformer couplings between said tubes, a gang condenser for simultaneously tuning said transformers, and grounded metal plates providing a shield for said gang condenser and individual shields for each tube and each transformer, characterized by additional metal plates grounded to said shielding plates and arranged between adjacent units of said gang condenser, and means individual to each rotor section of said condenser, and in sliding contact with the common operating shaft of the condenser, for grounding the respective rotors to the additional grounded metal plates through the common operating shaft.

10. A cascaded radio frequency amplifier of the type including a plurality of screen grid tubes, transformer couplings between said tubes, a gang condenser for simultaneously tuning said transformers, and grounded metal plates providing a shield for said gang condenser and individual shields for each tube and each transformer, characterized by additional metal plates grounded to said shielding plates and arranged between adjacent units of said gang condenser, and flexible means individual to each rotor section of said condenser, and in sliding contact with the common operating shaft of the condenser, for grounding the respective rotors to the additional grounded metal plates through the common operating shaft.

11. A cascaded radio frequency amplifier of the type including a plurality of screen grid tubes, transformer couplings between said tubes, a gang condenser for simultaneously tuning said transformers, and grounded metal plates providing a shield for said gang condenser and individual shields for each tube and each transformer, characterized by additional metal plates grounded to said shielding plates and arranged between adjacent units of said gang condenser, and a frictional contact brush, secured to each additional grounded plate, in sliding contact with the common operating shaft of the gang condenser for grounding the rotors to the said additional plates.

12. A cascaded radio frequency amplifier of the type including a plurality of screen grid tubes, transformer couplings between said tubes, a gang condenser for simultaneously tuning said transformers, and grounded metal plates providing a shield for said gang condenser and individual shields for each tube and each transformer, characterized by additional metal plates grounded to said shielding plates and arranged between adjacent units of said gang condenser, and a pair of resilient brushes individual to each rotor section of said condenser, and in sliding contact with the common operating shaft of the condenser, for grounding the respective rotors to the additional grounded metal plates through the common operating shaft.

13. A cascaded radio frequency amplifier of the type including a plurality of screen grid audions, transformer couplings between said audions, a gang condenser for simultaneously tuning said transformers, and grounded metal plates providing a shield for said gang condenser and individual shields for each audion and each transformer, characterized by additional metal plates grounded to said shielding plates and arranged between adjacent units of said gang condenser and leads directly connecting each unit of said condenser with the respective terminals of the transformer winding associated therewith to avoid the formation of paths common to more than one tuned circuit.

In testimony whereof, I affix my signature.
HAROLD A. SNOW.