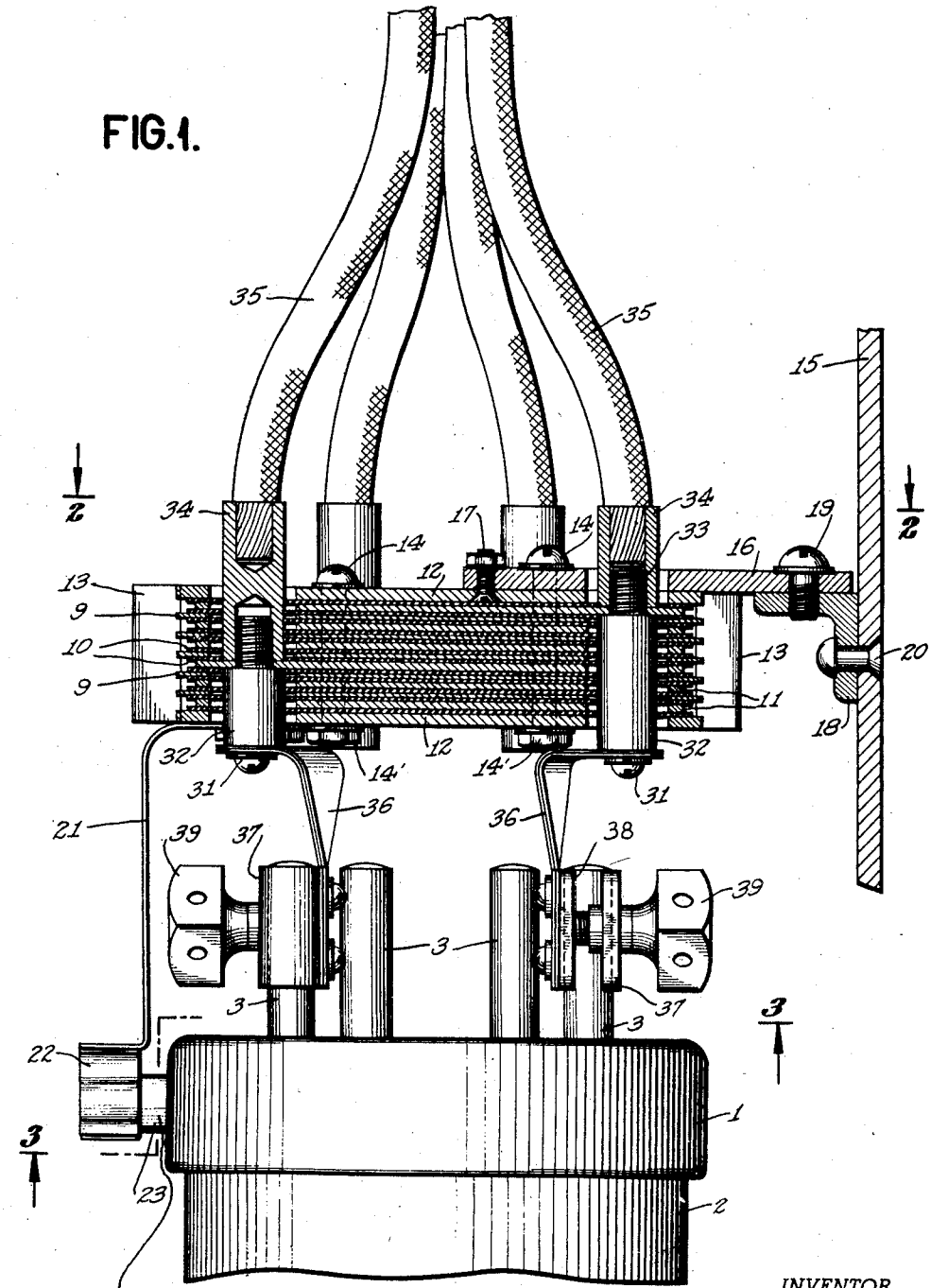
Nov. 16, 1943. F. D. WEBSTER 2,334,660

CONDENSER AND CIRCUIT THEREFOR

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FIG. 1.



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FIG.2.

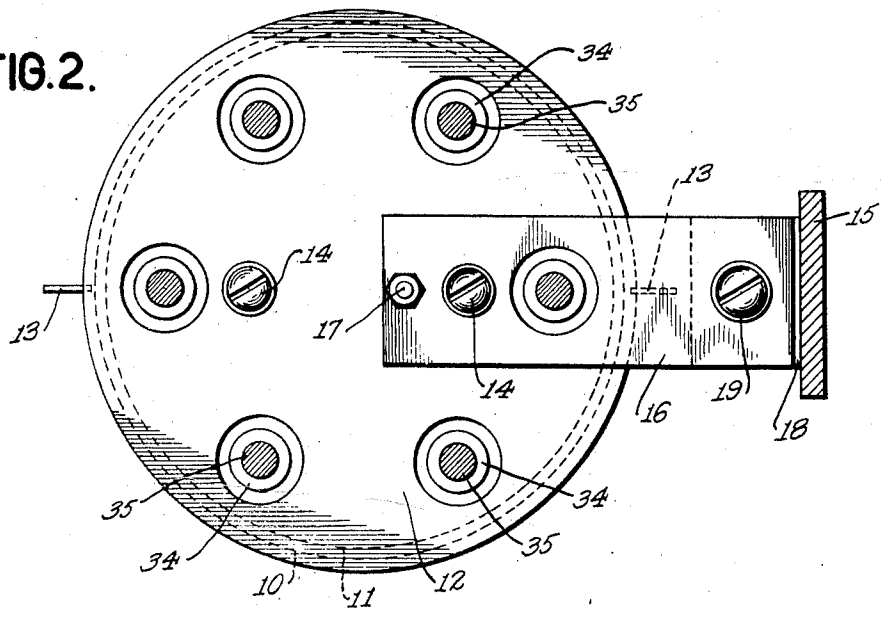
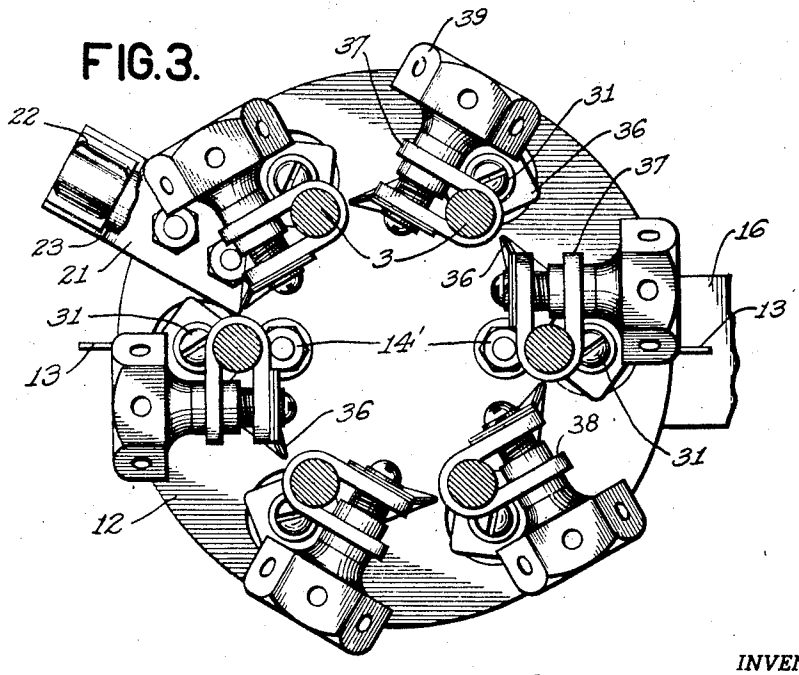


FIG.3.



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FIG.4.

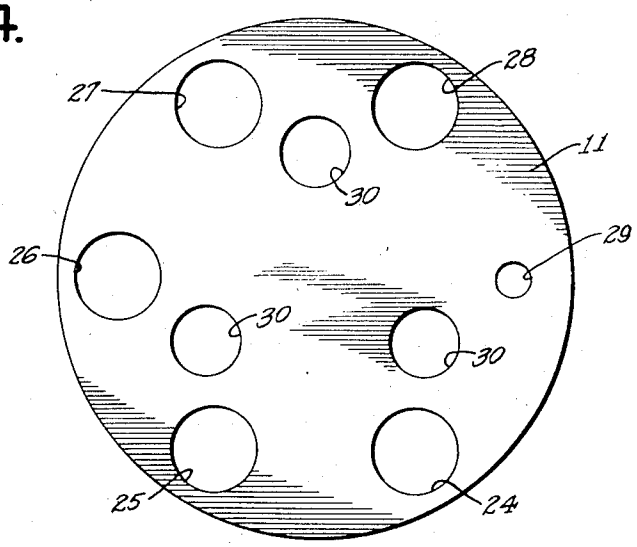
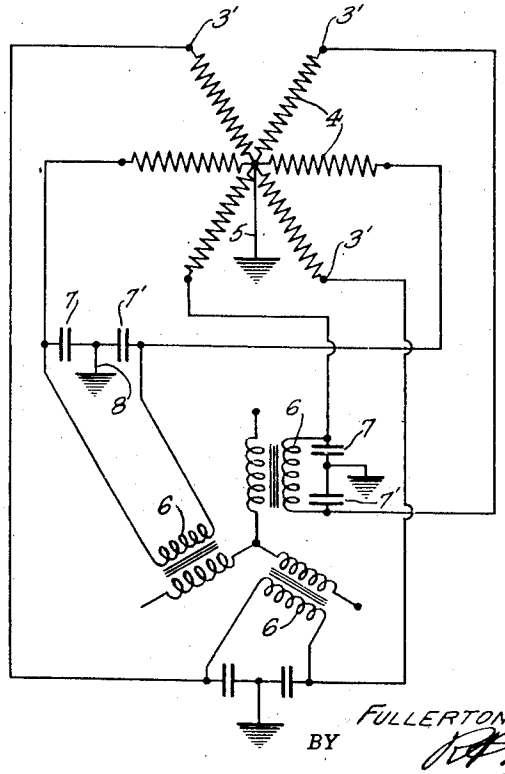


FIG.5.



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CONDENSER AND CIRCUIT THEREFOR

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Application January 22, 1942, Serial No. 427,761

3 Claims. (Cl. 250—16)

This invention relates to electrical condensers and has for its object to provide a condenser arrangement for connecting to ground the cathodes of vacuum tubes.

It is well known that parasitic voltages and currents tend to develop in the filament circuits of vacuum tubes at high frequencies; and there create undesirable effects, such as parasitic oscillations. It is also well known that if the tube cathode is placed at radio frequency ground potential, the tendency toward parasitic osoillation is greatly reduced, owing to the fact that the leads to the cathode are effectively eliminated from the radio frequency circuits.

According to this invention, a small, compact by-pass condenser is mounted directly adjacent the tube terminals and connected directly between the terminals and ground; and means may be provided for connecting the power leads to the condenser. A feature is an arrangement of a condenser unit which may be used with a polyphase filament to connect each filament terminal with ground. A related feature is a condenser assembly which may be placed as a unit between the tube terminals and the power leads which supply the heating current.

Referring to the drawings,

Fig. 1 is an elevation view of a condenser attached to the cathode or heater terminals of a vacuum tube and to power leads, according to this invention;

Fig. 2 is a plan view of the condenser taken at line 2—2 of Fig. 1;

Fig. 3 is a view from the bottom of the condenser taken at line 3—3 of Fig. 1;

Fig. 4 is a plan view of one of the condenser plates;

Fig. 5 is a wiring diagram showing a manner of connecting the condenser with a six-phase filament of a vacuum tube.

In Fig. 1 there is shown a vacuum tube having a metallic base portion 1, and part of a wall 2 which may be of glass. A plurality of cathode or filament terminals 3 protrude upwardly through the base, and electrically insulated therefrom, in a well-known manner. There are shown six of these filament terminals, which is the number required for a six phase filament; although it will be understood that the number of terminals will be dependent upon the type of filament or cathode employed.

There is shown in Fig. 5 a wiring diagram of a six phase filament which might be used in the tube. This comprises the six filaments 4 arranged in a star connection which might be used in a large tube such as a water-cooled type. The electrical center of the star connection is grounded at 5 and the ungrounded terminals 3' of each filament are to be connected to the terminals 3 in Fig. 1. The filaments are energized by current supplied from the secondary coils 6 of a star-connected power transformer, each transformer secondary having its terminal connected to opposite pairs of filament terminals 3'. In order to ground the filaments with respect to high-frequency currents, there should be connected across each pair of filaments receiving power from a secondary coil 6, a pair of condensers 7 and 7' arranged in series and connected to ground between them at 8. These condensers are preferably of equal capacity and of a relatively low high frequency impedance.

The group of by-pass condensers 7, 7' is efficiently and compactly provided by the condenser unit arrangement illustrated in Figs. 1 to 4, which is constructed and arranged with reference to the vacuum tube terminals to provide the desired by-pass capacities with very short electrical connections from the tube. The condenser is arranged as a multiple unit comprising a plurality of metallic plates 9 sandwiched between insulating plates or sheets 10. Between each adjacent pair of these insulating sheets, there is placed a metallic sheet 11, which is preferably thicker than the thinner metallic sheets 9. There is placed against each outer insulating sheets 10 a relatively heavy metallic sheet 12. The conducting sheets 9 and 12 are electrically connected and bound together at the edges of the stack by metallic members 13 which are preferably soldered or otherwise suitably fastened to these plates 12 and 9. The remaining conducting plates 11 which alternate with the plates 9 in the stack, are of smaller diameter than plates 9 and are not contacted by members 13 or plates 9 and 12 and are insulated therefrom. The stack is securely held together by means of a number of bolts such as 14, equally spaced which pass through the stack from top to bottom and have the nuts 14' suitably tightened up. The plates 12 and 9 are attached to a suitable supporting wall such as 15 which may be done by suitable means such as a rigid bar 16 fastened to the upper plate 12 by a nut and bolt arrangement 17 and to the wall 15 by a suitable angle piece 18 and bolts 19 and 20. The assembly of connected plates 9 and 12 is directly grounded to the grounded base 1 of the tube by a connector 21 which may be bolted to the bottom plate 12 by nut and bolt 14, 14' and attached at its

opposite end by a suitable clip 22 to a bolt or protuberance 23 protruding from base 1.

In this arrangement each ungrounded plate 11 provides capacity through the adjacent insulating plates 10 to the grounded plates 9 (or 12) on either side. It is accordingly required that plates 11 to be insulated from the grounded plates and from all grounded bolts, and also that provision be made for providing connecting terminals to the plates 11. For this purpose, the plates 11 are constructed as shown in Fig. 4. They are provided with a set of six holes 24, 25, 26, 27, 28 and 29 equally spaced around the circumference. They are also provided with a number of holes 30 within the outer circle of holes, the holes 30 being for the passage of the binding bolts 14. Holes 24 to 28, and also holes 30 are clearance holes so that bolts or studs may pass through without touching the plate. They are accordingly made large. Hole 29 is provided for attachment with a terminal stud and accordingly is made small.

The condenser unit illustrated contains a total of seven grounded plates 9 and 12, this total being one more than the six of the plates 11, corresponding as this corresponds with the number of the filament terminals in the six phase connection; and all these plates 11 are made identical so that the holes of all the plates will overlie each other, except that each separate plate has a different one of the outer six holes 24 to 29 made small. Thus the second plate will have hole 24 made small and holes 25 to 29 large, and the third plate will have hole 25 small and holes 26 to 29 and 24 large. Holes 30 are of the same size in each plate.

The grounded plates 9 and 12 will be made identical to plates 11 except that in plates 9 and 12 all of the outer circle of holes corresponding to holes 24 to 29 in Fig. 4 will be made large for clearance, and there will be no small hole such as 29. Plates 9 and 12 are of greater diameter than plates 11, also holes 30 of plates 9 and 12 are made small for clearance of bolts 14.

The ungrounded condenser terminals are provided by studs 31, the shank portion 32 at the head and being of relatively large diameter and the threaded portion 33 at the other end being of smaller diameter than the shank. Each stud is provided with a nut 34 which is preferably of the same circular cross section and diameter as shank 32. The nuts 34, have connected to them as by sweating, suitable electrical leads 35 which are the filament power leads. The terminal studs 31 and their nuts 34 preferably all have the same overall length, but the relative lengths of the nut to the shank varies from one stud to another, as shown in Fig. 1, to allow connection to different ones of the ungrounded plates 11. The stack is arranged so that all the clearance holes 24 to 30 overlie each other. The first of the studs will then be placed through the alined holes, all of which will be clear of the stud, except the one having the small hole 29 (Fig. 4) which may be the upper plate 11 as shown in Fig. 1. The nut 34 will then be tightened down against this plate to grip it between the nut and the shank, thus providing a terminal connected to this plate 11 but not connected to any other plate or grounded member. The next terminal stud will similarly pass through another of the holes, for example holes 28 of which the one in second plate from the top may be the small hole to which the stud may be attached. In this manner a different stud is fastened to a different one of plates 11, and is insulated from all the others.

The bolts 14 which bind the unit together are suitably insulated from all the plates 11 by reason of the clearance provided by hole 30, through which the bolts pass. The remaining plates 9, 10 and 12 must also have their clearance holes alined with holes 24 to 29 so that none of the studs touch these grounded plates; and the insulating sheets will also have holes alined. These grounded plates and insulating sheets must likewise have holes corresponding to and alined with holes 30, but it is immaterial whether they be made large enough to clear the bolts 17 which pass through them and bind the stack.

Suitable leads 36 are connected with the studs 31 and these are preferably made flexible and connected with a suitable clamping unit 37 for connecting with the corresponding filament terminals 3. Clamps 37 may be of any suitable design; for example, they may comprise a slotted member 38 which passes over the filament terminal and is clamped tightly by screws 39. As a different one of the leads 36 is connected to a different one of the tube terminals the condenser connections to these tube terminals and ground will be as shown in Fig. 5.

By reason of this construction and connection arrangement there is provided a compact, multiple condenser unit which connects each filament terminal by a very short lead through a condenser to ground, thus minimizing the length of the radio frequency path to ground, and reducing the tendency toward parasitic currents. There is furthermore provided a ready means for connecting the power supply leads without any long connections between the tube terminals and the condensers and which do not need to be disconnected to change tubes. This is of much importance in the use of high power tubes such as the water cooled type where the power leads are heavy and cumbersome.

It may sometimes be desirable not to ground the filaments, as for example when it is desired to place a biasing voltage on the filaments. In such case, there should not be used a direct connecting link 21 between the base ring 1 and the grounded part of the condenser. Instead, the connector 21 may be broken and a by-pass condenser connected between the broken ends thereof. This will have the effect of placing the condenser in the lead 5 of Fig. 5, between ground and the filament midpoint, inasmuch as the filament midpoints are connected to the ring 1. The high frequency currents will still, in effect, be at ground potential inasmuch as the condenser to be placed in lead 21 should be of sufficiently low reactance to form a low impedance path to ground. If desired, the condenser which would be connected in lead 21, in this manner, may be built into the unitary condenser itself simply by adding another plate 11 and accompanying plate 10. In such case, there would be placed a seventh terminal around the circumference of the unit and seven holes instead of six holes around the circumferences of plates 10, 11 and 12. The conductor 21 from terminal 23 would then be connected to the seventh terminal of the condenser to provide the condenser connection from ring 1 to the grounded frame 15.

The use of the unit is very convenient as when it is desired to change a tube, all that is required is to loosen clamps 37 and clip 22, remove bolt 19, and lift the condenser assembly and swing it

to one side. The tube can then be replaced and the condenser swung back and assembled.

Although the particular arrangement described is adapted for use with six-phase filaments, it will readily be understood that the arrangement could just as easily be made to be adapted to a tube having a different number of filament terminals.

What is claimed is:

1. A multiple condenser unit for grounding the terminals of a polyphase filament for a vacuum tube, said unit comprising a plurality of conducting laminations separated by insulating laminations, alternate ones of the conducting laminations being connected together and totaling one more than the number of the other alternate conducting laminations, a separate filament connector terminal stud connected individually with each of said other alternate ones of the conducting laminations, each of said studs comprising a shank portion and a binding member for binding the stud to its respective conducting lamination, there being corresponding clearance holes through all of the conducting laminations to which the stud is not connected, through which said stud protrudes from both sides of the condenser stack.

2. In combination, a vacuum tube having a polyphase filament having a terminal individual to each phase of said filament, each said terminal protruding from said tube and a multiple condenser comprising a plurality of conducting laminations separated by insulating laminations, alternate ones of the conducting laminations being connected together and totaling one more than the number of other alternate conducting laminations, a separate terminal stud connected individually with each of said other alternate ones of the conducting laminations, each of said studs comprising a shank portion and a binding member between which the respective conducting lamination is bound to the stud, all of the conducting laminations to which the stud is not connected having a corresponding clearance hole through which the stud protrudes from both sides of the condenser stack, said studs being connected from one side of said stack to said filamentary terminals, and the connection from the first alternate conducting laminations being connected to a grounded portion of said tube.

3. In combination, a vacuum tube having a polyphase filament having a terminal individual to each phase of said filament, each said terminal protruding from said tube and a multiple condenser comprising a plurality of conducting laminations separated by insulating laminations, alternate ones of the conducting laminations being connected together and totaling one more than the number of other alternate conducting laminations, a separate terminal connected individually with each of the other alternate ones of the conducting laminations, all of the conducting laminations to which a terminal is not connected having clearance holes aligned so that the stud protrudes from both sides of the stack without touching any of the conducting laminations other than that to which it is connected, a connection from said filament terminals to the studs protruding from one side of the stack, and filament voltage supply leads connected to the studs protruding from the other side of the stack, the connections from said filament terminals to said studs being sufficiently short so as to position said multiple condenser sufficiently close to said filament terminals to serve as a shield for the latter.

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