

Feb. 7, 1939.

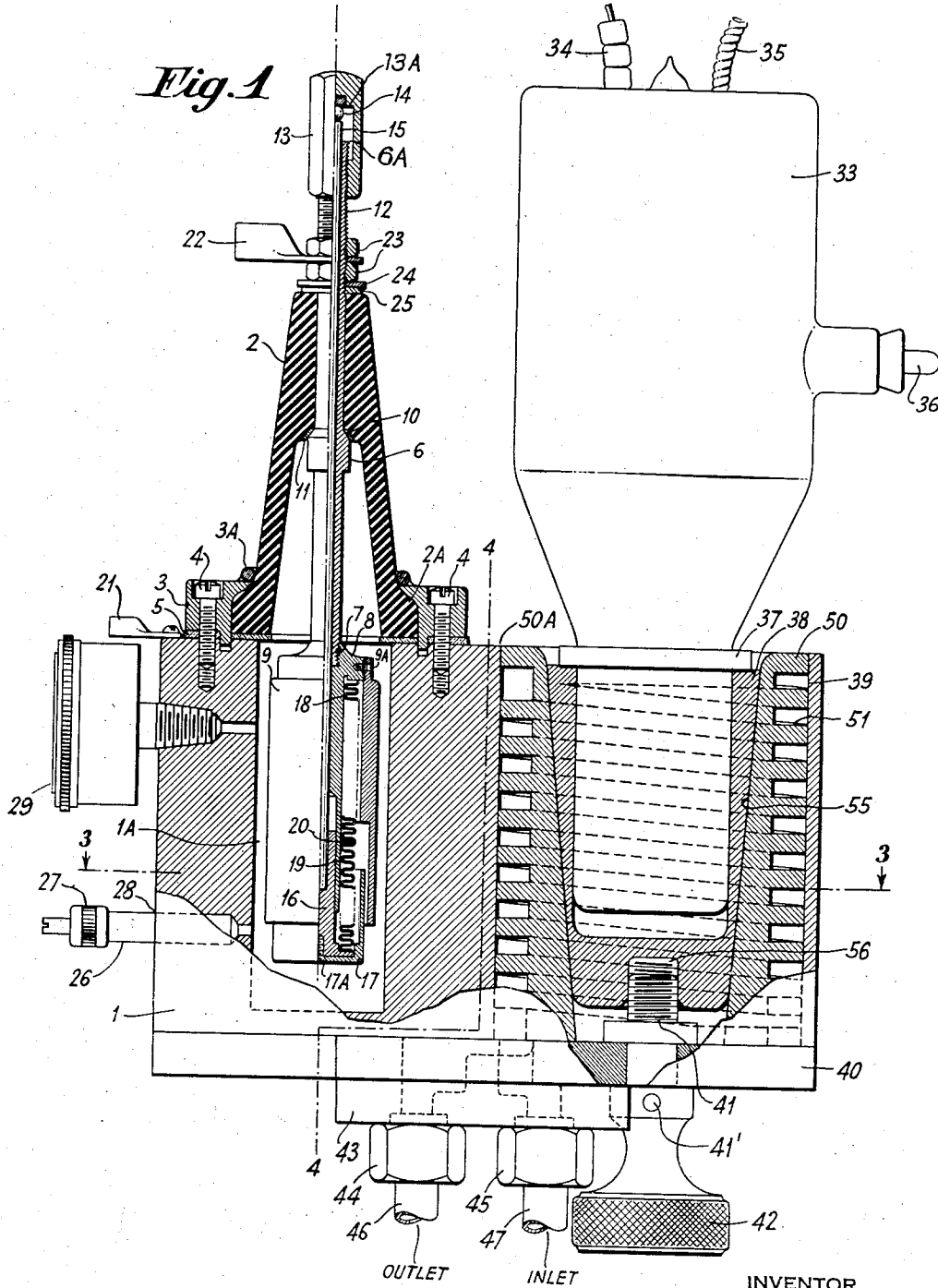
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2,146,541

COMBINED FLUID-COOLED VACUUM TUBE AND COOLING BLOCK

Filed July 30, 1936

6 Sheets-Sheet 1



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Fig. 2

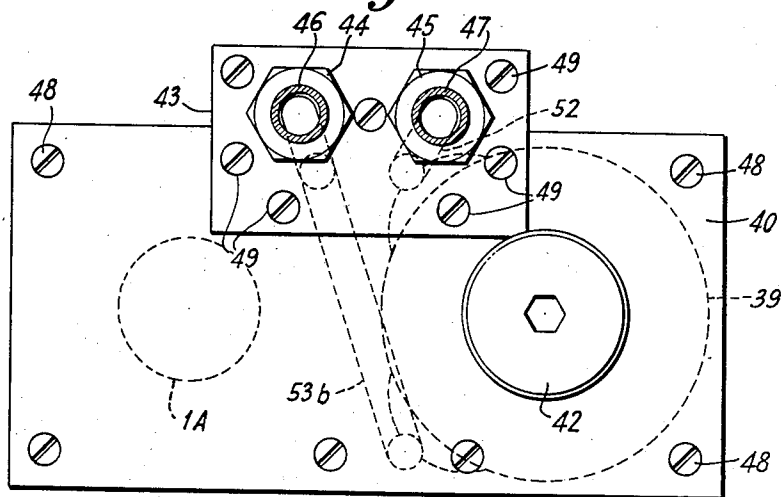
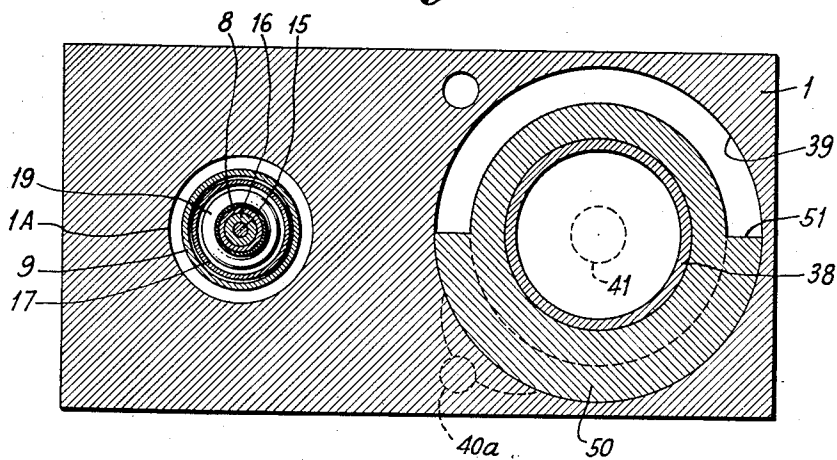


Fig. 3



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6 Sheets-Sheet 3

Fig. 4a

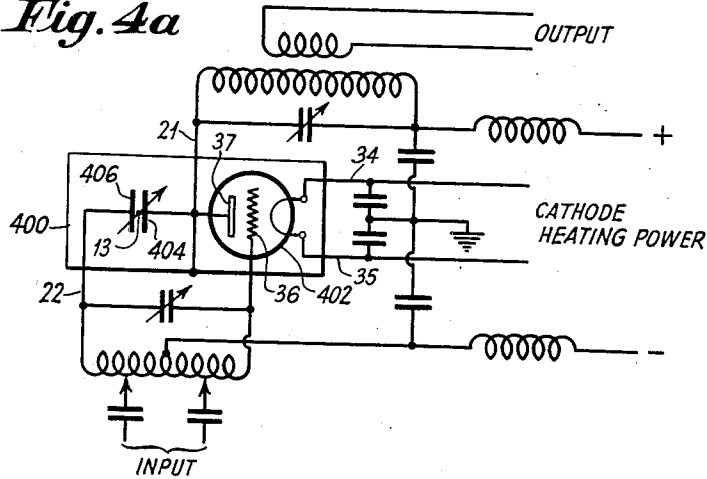


Fig. 4b

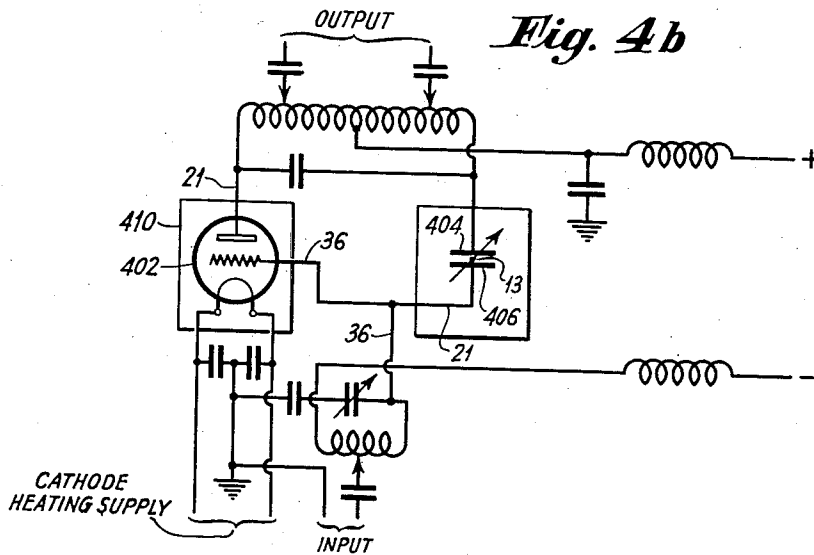
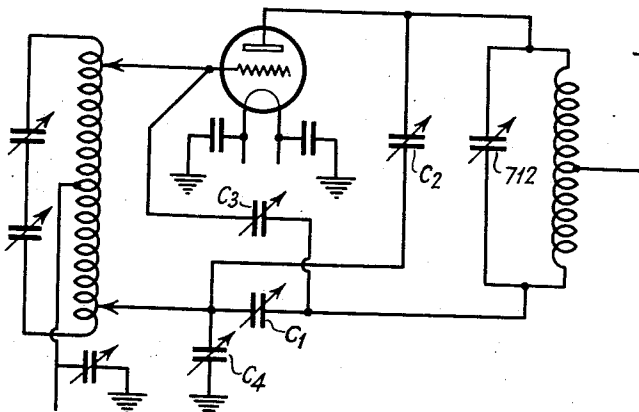


Fig. 6



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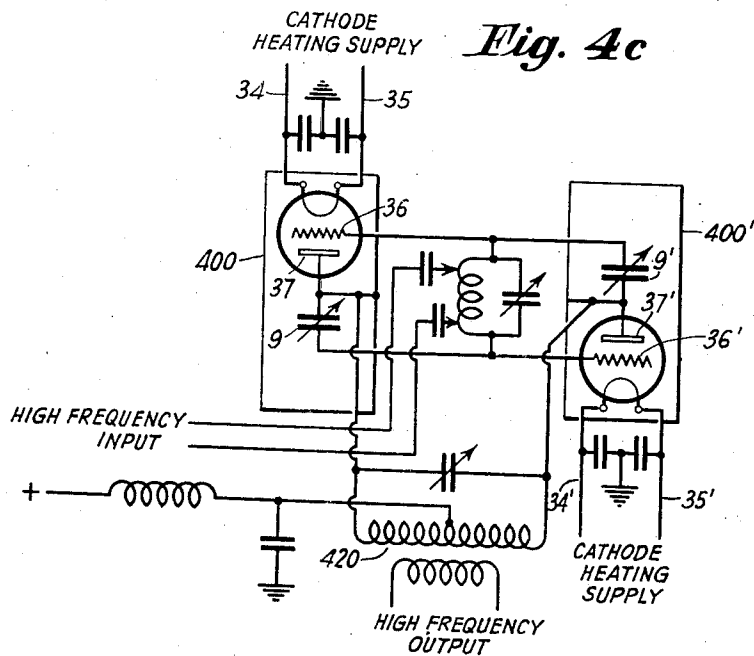
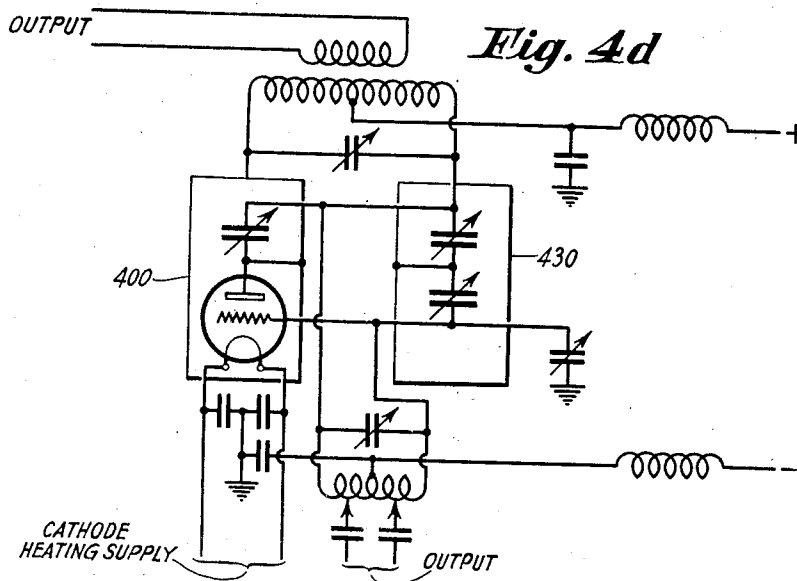
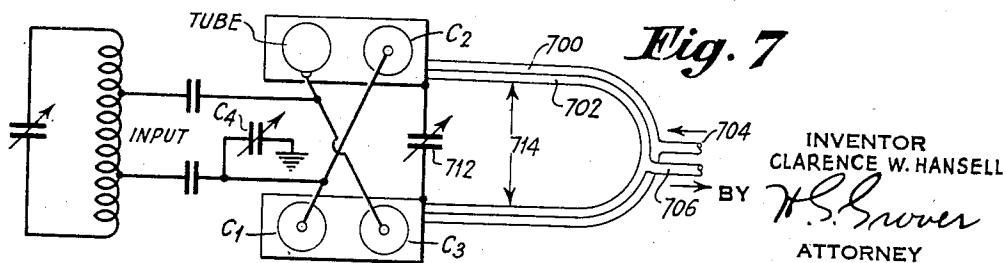
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Fig. 5

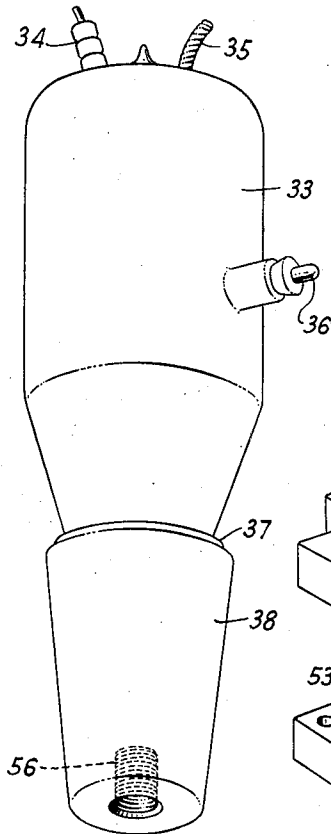


Fig. 8

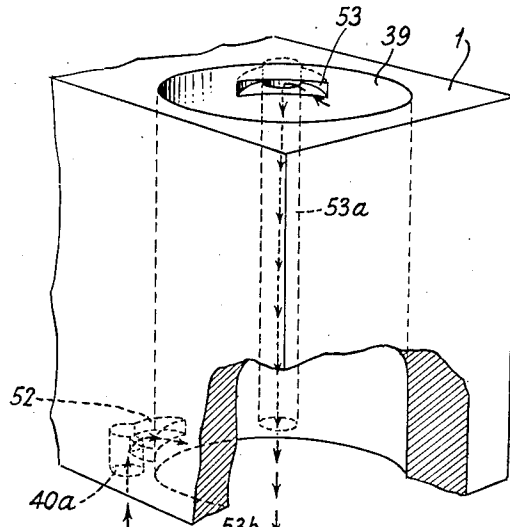


Fig. 8a

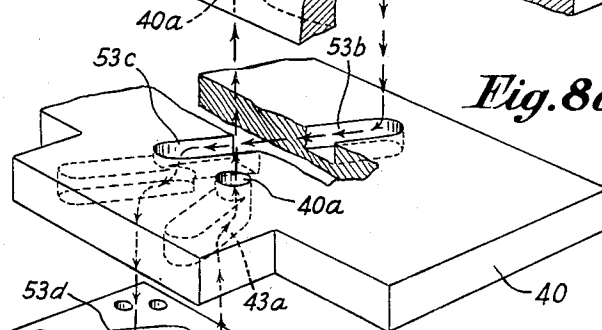
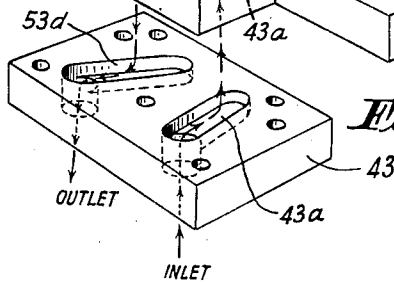


Fig. 8b



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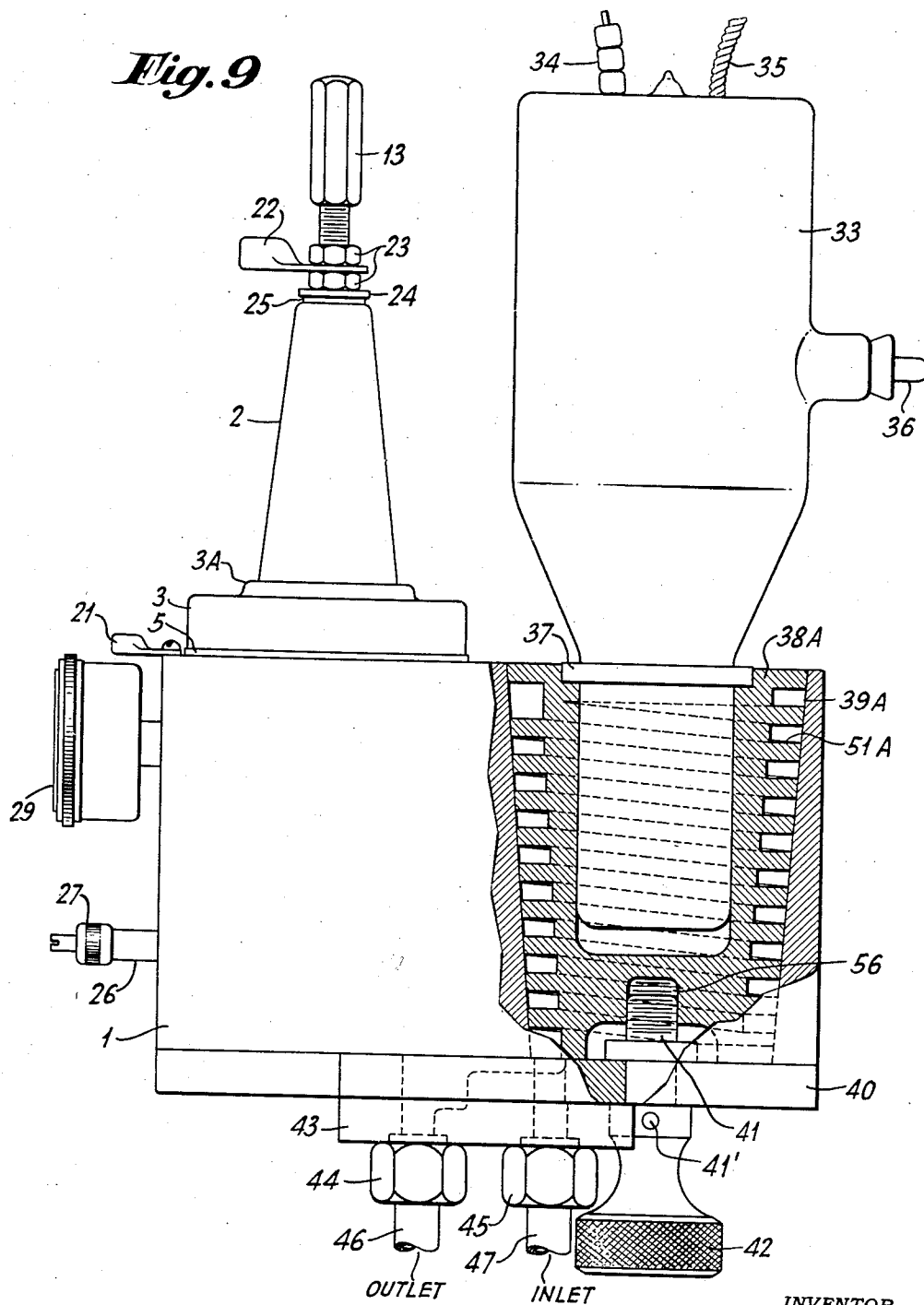
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Fig. 9



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UNITED STATES PATENT OFFICE

2,146,541

COMBINED FLUID-COOLED VACUUM TUBE
AND COOLING BLOCKClarence W. Hansell, Port Jefferson, N. Y., as-
signor to Radio Corporation of America, a cor-
poration of Delaware

Application July 30, 1936, Serial No. 93,393

12 Claims. (Cl. 250—17)

This invention relates to an improved means for cooling the anodes of liquid cooled vacuum tubes and to a combined fluid cooled radio transmission tube and cooling block which is particularly adapted for use in a short wave transmitting circuit or for amplifiers and modulators which require relatively high power dissipation.

In the prior art, the anode surface of the radio transmission tube was usually surrounded by a body of cooling fluid such as water or oil contained in a reservoir having inlet and outlet pipes to supply the circulating cooling fluid. Frequently, when tubes such as the RCA—846 and 207 have been operated in short wave circuits, or when tubes such as the RCA—848 and 207 have been used as audio amplifiers or as modulators in the Heising modulating circuit, the temperature rise in the cooling fluid was such that there was danger of the cooling solution boiling at the contact surface of the anode. By this invention, an increase in the permissible power dissipation without danger of boiling at the anode surface, is obtained.

An object of this invention is to improve fluid cooled transmitting tubes for use in ultra-high frequency circuits or in amplifiers, modulators, etc., over those of the prior art.

Another object of this invention is to improve the overall power converting ability of fluid cooled electron discharge devices, so that higher power inputs and higher power outputs can be obtained than was previously possible when devices of the prior art were used in short wave transmitting circuits.

Other objects of this invention are to permit a reduction in the rate of cooling fluid flow to the tubes and/or to permit higher temperatures of the fluid supply, thus decreasing the size and cost of the cooling systems and facilitating the use of radiators for cooling the supply fluid. Incidentally, the higher temperatures facilitate use of the energy carried away from the tubes in heating the building in which the tubes are used.

A further object of this invention is to provide means permitting the use of an anti-freeze cooling solution, which has a tendency to reduce the boiling point of the cooling liquid for a transmitting tube. Heretofore, for example, the use of alcohol in the water to reduce the freezing temperature has not been feasible because of the high operating temperatures required by the cooling liquid adjacent the tube. The vacuum tubes may be operated in unheated rooms or buildings, bringing about considerable economies, if the cooling liquid is made safe from freezing.

Still other objects of this invention are to provide means for changing from one tube to another without opening of the fluid cooling system, as was previously necessary, and also to provide a combined vacuum tube and neutraliz-

ing condenser block arrangement which lends itself to compact and efficient design of high frequency circuits.

Features of this invention reside in the provision of a tapered anode sleeve, corresponding to a tapered aperture in a cooling block, to facilitate making intimate contact between the sleeve and the block for increasing the cooling of and heat conduction from the anode, by securely maintaining the tapered surfaces in intimate contact with each other. The increased thickness of metal, provided by addition of the tapered sleeve to the anode, serves to conduct heat away from spots on the anode where dissipation is relatively high and this, combined with greater area of contact between metal and cooling liquid, eliminates boiling in spots, which occurs when tubes are cooled by bringing the cooling liquid into direct contact with the anode.

Another feature is the provision of a novel and combined casing arrangement whereby a vacuum tube is located along the side of a compressed air neutralizing condenser of the type disclosed in the copending joint application of Hansell, Usselman and Latimer, Ser. No. 27,678, filed June 21, 1935.

Still another feature of my present invention resides in an arrangement wherein when a tube is installed, the tapered portion of a vacuum tube anode is securely drawn into the corresponding taper in a cooling block, so that the surfaces are locked in intimate contact, thus reducing surface contact resistance to a minimum. The same arrangement serves to force the tube out of the tapered block when it is desired to remove it.

My present invention will be further described with specific reference to the accompanying drawing, in which:

Fig. 1 is a longitudinal section partly in elevation of the compressed air condenser, vacuum tube and cooling block;

Fig. 2 is a bottom view of Fig. 1;

Fig. 3 is a detailed cross-sectional view taken on line 3—3 of Fig. 1, of the combined vacuum tube block;

Figs. 4a, 4b, 4c and 4d are schematic diagrams of three different forms of high frequency circuit in which the indirectly cooled vacuum tube and the combined tube and condenser of this invention may be used;

Fig. 5 is a perspective view of a spare vacuum tube;

Fig. 6 is a schematic circuit diagram of still another balanced circuit employing the water structure of my present invention; and

Fig. 7 shows schematically the mechanical arrangement of the cooling parts of the wiring diagram 4d showing particularly the input of the cooling circuit for the system; while

Figs. 8, 8a and 8b are perspective views of members 1, 40 and 43, respectively.

Fig. 9 is an elevation of a condenser, vacuum tube and cooling block, the tube anode cooling portion being shown in section.

Referring now in detail to Figs. 1, 2 and 3 of the drawings, 1 indicates the combined compressed air condenser and vacuum tube cooling block or casing of relatively heavy metallic walls of good heat and electrical conductivity, to facilitate rapid heat radiation, such as copper, aluminum or brass. It will be noted that the cross-sectional area of the casing is greater than the internal aperture 1A, the internal aperture or bore 1A being accurately finished and polished so as to provide one of the condenser electrode surfaces. The upper portion of the casing 1 is provided with a cone-like insulator 2 which is composed of a good insulating material, such as "Isolantite", "Steatite", "Pyrex", porcelain or any suitable material having the necessary and requisite mechanical strength and insulating qualities. The lower end of the insulator 2 is provided with an enlarged section 2A over which a metallic ring 3 securely fastens the insulator to the casing 1 by suitable screws 4. To provide a gas-tight seal and to prevent breakage of the insulator, a lead, varnished silk, rubber or other suitable gasket material 5 is employed between members 1, 2 and 3. The member 3 is provided with a rounded ridge 3A which acts as a corona shield to prevent the insulator from arcing over due to the high voltage. Within the central portion of insulator 2 a long hollow stem 6 is located, the lower portion being provided with threads 7 to secure the guide 8 for securing and guiding the main portion of the inner electrode 9. The center electrode 9 is arranged to be removable by means of threads and screws 9A so that it may be interchanged with other electrode members of different lengths and diameters, so that the capacity of the condenser may be easily changed, as required, by changing the dielectric space between electrodes 1 and 9.

A shoulder 10 retains stem 6 against the shoulder gasket 11 within the insulator 2. The upper portion of stem 6 is threaded with a fine thread 12, by means of which the adjustable lower portion of the central electrode is raised or lowered within the aperture 1A, with the aid of and against the internal fluid pressure, by means of adjusting nut 13. The adjustable portion of the central electrode is maintained in the desired position by means of the internal fluid pressure forcing the adjustable portion of the central electrode assembly up against a rod 15. The upper portion of adjusting nut 13 is arranged to retain a small hardened steel ballbearing 14 which actuates a metallic rod 15 that passes through the stem 6, and terminates in a follower 16 upon which is mounted the adjustable lower portion 17 of the inner electrode 9. The lengths of the push rod 15 and stem 6 is made such that the downward movement of the bellows is limited by the internal shoulder 13A striking at 6A. This prevents the bellows from being damaged by stretching. It also limits the reduction of dielectric thickness or fluid space at the lower end of the bellows to such an amount that the condenser cannot arc-over or short-circuit. This lower portion 17 is likewise arranged to be easily removable by means of screw 17A so that it may be interchanged with other members of different length and diameter. In order to provide a sensitive and accurate adjustment of electric capacity between the inner and outer electrodes, a novel arrange-

ment is provided wherein metallic flexible bellows 18-19 are employed which are united by a suitable ring-like guide bushing 20, the bellows 18 being soldered to the lower portion of the ring-like bushing 20 and the follower 16. The bellows 19 is soldered to the upper portion of ring-like guide bushing 20 and the guide member 8. The guide member 20 has its internal and external peripheries rounded over so that the bellows 18-19 are prevented from bowing out of line or binding as it moves up and down the outside wall 8' of guide 8.

The outer casing 1, especially that portion to the left of the dot and dash line 4-4, ordinarily acts as the outer electrode and is an integral part of the transmitting circuit assembly as shown for example by Fig. 4a. However, it may be provided with a terminal or lug 21, the central electrode being also provided with a terminal lug 22 which is retained in place by means of nuts 23. The lower nut 23 also acts to retain the stem 6 in place within the insulator by being tightly clamped against the washer 24 and the washer or gasket 25.

The casing 1 is provided with an air valve 26 and a cap 27, the valve 26 being securely soldered to casing 1 at a point 28 to prevent leakage. In order that the pressure of the fluid, which may be air, gas, or a compressed liquid, under pressure within the casing, may be accurately determined, a pressure gauge 29 is provided, it having a scale usually indicating from zero to 300 pounds pressure.

The transmitting vacuum tube 33 has cathode leads 34 and 35 located at the upper portion of the envelope and a grid lead 36 on the side of the envelope. The anode 37 is provided with a relatively heavy tapered sleeve 38 which is preferably made of copper. The vacuum tube portion of casing 1, which is that portion to the right of the dot and dash line 4-4, is provided with an aperture 39, a base plate 40, clamping stud 41 and knurled thumb nut 42. Securely fastened to base plate 40 is a water inlet and outlet plate 43 which terminates in unions 44 and 45 for coupling inlet pipe 47 and outlet pipe 46. Plate 40 is secured to block 1 by suitable screws 48, block 43 being secured to plate 40 by screws 49.

Within the aperture 39 in block 1 there is located a water passage spiral member 50, preferably made of copper, which is of substantially the same outside diameter as the inside diameter of aperture 39 and soldered to block 1 at point 50A. Around the outside of member 50 is cut a rectangular helical thread 51 or fluid cooling duct of approximately three turns per inch, the depth being about three-eighths of an inch. The spacing between the threads may be about equal to the width of the thread.

If desired, as shown by Fig. 9, aperture 39 may have tapered side walls 39A instead of the straight side walls shown by Fig. 1. Also, the tapered sleeve 38A may be provided with an externally located helical thread 51A to form a fluid cooling duct and positioned in aperture 39A so as to be in fluid communication with the inlet 47 and outlet 46.

The circulating liquid passage is more clearly indicated by Figs. 8, 8a and 8b which show members 1, 40 and 43, respectively, in perspective. Figs. 8 and 8a are cut to show only the fluid cooling duct portion. They are additionally cut in section to make the fluid passage more lucid. The arrows pointing upward indicate the inlet flow of the fluid first vertically upward and

then horizontally along the slot 43a cut to approximately one half its depth in block 43. Upon entering plate 40, the fluid passes vertically upward through the aperture 40a and then into the inlet aperture 52. The lower end of the spiral thread 51 is so located that the lower end portion of the threaded duct 50 comes in line with inlet 52. The upper end of threaded duct 50 is arranged to line up with outlet aperture 53 in block 1, the fluid passage then going vertically down the hole 53a in block 1, to plate 40, where it then runs horizontally along slot 53b to aperture 53c to the horizontal slot 53d and then vertically out through outlet pipe 46.

Water may be fed into either pipe 46 or 47 and withdrawn from either 47 or 46. Assuming water is fed into pipe 47, it flows into the inlet aperture 43a at the bottom of the spiral and then spirals around through the spiral conduit formed between the aperture 39 and the threaded member 50 to the outlet opening 53 through conduit 53a and out through pipe 46. Plate 40 may be designed with water passages 43a and 53b reversed to provide for locating tube 33 to the left instead of to the right of the condenser as is shown in Fig. 1.

Anode sleeve 38 is preferably cut with a taper of about two inches per foot and a corresponding tapered aperture 55 is preferably cut in the water passage member 50. The depth of the tapered aperture 55 is slightly greater than the length of the sleeve 38. The arrangement shown in Figs. 1, 2 and 3 is with the tube located on the right hand side of Fig. 1. However, this arrangement may be reversed by reversing the inlet and outlet slots in plate 40. The central lower portion of sleeve 38 is threaded with a substantially coarse thread 56 to receive the threaded spindle or stud 41 which is provided with a knurled knob 42 for securely drawing the tapered contact surface together, so as to provide intimate contact and reduce all tendency of contact resistance and for ejecting the tube and tapered block when it is to be removed. This is made possible by virtue of the fact that a knurled knob 42 is pinned by means of pin 41' to the stud 41. The entire outer surface of this device is preferably heavily plated with silver to reduce the surface resistance of the high frequency currents.

Fig. 4a shows a single tube and condenser in a circuit employing a split or balanced input circuit in order to facilitate balancing or neutralization of the capacity coupling between input and output circuits. The rectangle 400 includes all of the apparatus shown in Fig. 1, the circle 402 corresponding to the tube 33 of Fig. 1. Reference numeral 400 may also be used to indicate the cooling block 40 of Fig. 1, it being noted that the anode 37 is illustrated as being directly connected thereto. The grounded plate 404 of the neutralizing condenser corresponds to the wall 1a of Fig. 1, and the other plate 406 of the condenser corresponds to the electrode of the neutralizing condenser of Fig. 1, including parts 17a, 17, 9, etc. The neutralizing connection 22 of Fig. 1 is shown on Fig. 4a, as are also the grid connection 36, filament leads 34, 35 and the plate connection 21. The plate connection may be made if desired through metallic inlet pipes 47, 45 which may be ground together for bifilar conduction of cooling water thereto as described in the patent to H. E. Hallborg, #1,963,131.

Fig. 4b is similar to Fig. 4a, except that it employs a split or balanced output circuit for fa-

cilitating balancing or neutralizing of capacity coupling between input and output circuits. In Fig. 4b, it is to be noted that the tube structure 402 is provided with a separate block 410 and a separate block 412 is provided for the neutralizing condenser 404, 13, 406. In other words, block 410 includes all of the apparatus to the right of line 4-4 of Fig. 1 and block 412 of Fig. 4b includes all of the apparatus to the left of line 4-4 of Fig. 1. Obviously, the two blocks 410 and 412 cannot be connected together for that would cause short-circuiting of the output circuit. It is believed that Fig. 4b is self-explanatory in view of the discussion of the preceding figures and in view of the legends and the reference numerals indicated thereon.

Fig. 4c illustrates a wiring diagram of two tube and condenser assemblies in a circuit of which both input and output circuits are split or balanced to facilitate balancing or neutralizing of capacity coupling between input and output circuits. The rectangles 400 and 400' each contain all of the apparatus shown in Fig. 1, the primed letters indicating the corresponding corrections or parts which are duplicated as required by the circuits of Fig. 4c. I prefer in the apparatus shown in Fig. 4c to make the output coil 423 of copper tubes ground together and fed at their midpoints with cooling fluid as described more fully in the patent to H. E. Hallborg #1,963,131. The ends of the tubes 420 are connected to or correspond to the pipes 46, 47 of Fig. 1, in the Hallborg patent, it being noted that the corresponding points are indicated by reference numerals 34, 36.

Fig. 4d shows a single tube circuit in which both input and output circuits are split or balanced, and in which provision is made to balance or neutralize capacity coupling between input and output circuits. Rectangle 400 as described before contains all of the apparatus used in Fig. 1, whereas rectangle 430 has its vacuum tube replaced by another variable condenser which may simply be inserted in place of the tube 33 of Fig. 1, that is to say the tube 33 would be removed and in its place a structure such as the neutralizing condenser structure 13, 2, 6, etc. of Fig. 1 substituted. In this event, one of the condenser structures will be cooled but this is not objectionable, or if desired, the cooling inlet and outlet pipes may simply be blocked off, if cooling of one of the condensers is found undesirable for any reason.

In practice, I prefer to use the circuit of Fig. 4d for single tube circuits and that of Fig. 4c for two-tube circuits. These circuits are well adapted for use in cascaded amplifier and frequency multiplier stages of transmitters. They facilitate balanced couplings from one stage to the next and reduce the tendency for uncontrolled oscillations to take place due to feedback from one stage to another.

The circuit of Fig. 4d is shown in a somewhat more simplified form in Fig. 6 and a mechanical arrangement is given in somewhat more extended form in Fig. 7.

As before explained, in radio frequency circuits, especially at the higher frequencies, it is essential that the input circuits be balanced to ground as nearly as possible and the output (plate) circuits should also be balanced. In order to perform this balance in practice, it is essential that there be mechanical symmetry of the circuits. In a circuit where it is desirable to use a single tube for a radio frequency oscillator or radio

frequency amplifier circuit, the problem of mechanical symmetry becomes a more difficult problem.

It may be noted that one outstanding advantage of the circuit and arrangement of Figs. 6 and 7 is that it is very well adapted to use in transmitters where some amplifier stages have one tube and some have two tubes.

As shown in Fig. 7, compressed air variable condensers in blocks of the same size as the tube cooling blocks provide a mechanically and electrically symmetrical balanced arrangement.

Turning to Fig. 6, which shows a schematic diagram of the arrangement and the position in the circuit of the balancing condensers, capacity C_1 is a variable capacitor, and is approximately equal to the grid-plate capacity of tube C_2 may be considered the neutralizing capacity and should be adjustable and C_3 is another neutralizing or balancing condenser which balances the voltage that is impressed across C_1 . C_4 is a small condenser which is approximately equal to the tube grid to ground, or grid to cathode, capacity. By using equal size blocks on both sides, the block capacity to ground of both sides of the plate circuit is balanced.

The layout as shown in Fig. 7, shows compressed air neutralizing condensers. However, with different mechanical arrangements, types of balancing condensers other than compressed air may be used. The balancing condenser shown as C_4 in Fig. 6 may in some cases not be needed to form a sufficiently balanced circuit, or it may be affected by making one of the grid leads have a larger capacity to ground than the other, thus affording the necessary capacity balance without adding a condenser (as such) to the circuit.

Although the circuit shown in Fig. 6 applies to a single tube amplifier circuit, it is within the scope of this invention to use more than one tube, on one side (tubes parallel) and by selecting the proper size of balancing condensers, have the same balanced symmetry of a single tube. The method used in balancing the amplifier tube as shown in Fig. 6 could also be applied to oscillator circuits, and condensers C_2 and C_3 would be used to control the regeneration of feedback voltage rather than neutralizing condensers.

It is to be noted that the output circuit consists of the two parallel arranged contacting pipes or tubes 789, 792, into one of which through inlet 784 water is fed and from the other of which through outlet 786 water is removed. The pipes 790, 792 are connected to the pipes 47, 46 shown more fully in Fig. 1, for the tube block 788 of Fig. 7. The pipes 789, 792 are also connected to the corresponding pipes or inlet ports 47, 46 for the condenser block 710 of Fig. 7. In this case, one of the condensers which replaces the vacuum tube of the tube block 710 will be found water-cooled, but this is advantageous as maintaining the dimensions of the tube blocks substantially alike and thereby maintaining the circuit symmetrical despite the temperature of the cooling water or fluid used.

The pipe system 790, 792 may be tuned by connecting the condenser such as 712 thereacross and/or by means of a sliding short-circuiting strap 714.

The doubly grounded cooling fluid system 790, 792 is more fully described and claimed in the Hallborg patent above referred to and the circuit of Figs. 6 and 7 is described and claimed in the

copending application of Hansell and Goldstine, Ser. No. 191,854, filed Feb. 23, 1938.

In the operation of this device of Fig. 1, as before explained, inlet and outlet pipes 46 and 47 are connected to the circulating pump of the transmitter and no further opening in the cooling system is necessary when the tubes are changed, as a spare tube shown in Fig. 5 may always be kept on hand which has the standard tapered sleeve 8 so that when it becomes necessary to replace a tube the change can be made by merely turning the knurled nut 42, removing tube 33 in its entirety, and placing the spare tube in its place, it being securely clamped by means of tightening knurled nut 12. Other liquids, fluids and gases, such as air, hydrogen, oil, prestone, carbon tetrachloride, etc., may be pumped through the system for cooling purposes. In practice, I prefer to pass the cooling fluid through the output tuning coil conductor according to the invention of H. E. Hallborg, U. S. Pat. #1,963,131. In other words, I contemplate and envision within the scope of this invention the combination of my novel tube and block system as described herein with any of the circuits shown in the Hallborg patent, and conversely contemplate utilizing the cooling system of the Hallborg patent in any of the apparatus herein described. Furthermore, it may be found desirable to use a series of block systems employing only condensers rather than a condenser and tube and also to water cool one or more of the condensers as described herein. This and other combinations of features are obviously within the scope of my present invention which accordingly is not to be considered limited in scope.

So far, I have described the indirectly cooled vacuum tube and fluid cooled block in arrangements most suitable for high frequency operation. However, it may be used just as advantageously in low frequency amplifying or modulating arrangements. The improved cooling, prevention of boiling and prevention of excessive heating of spots on the anode due to boiling greatly increase the permissible power dissipation at the anode. In class "A" audio amplifiers, and in modulators used in the Heising modulation system, the limiting anode dissipation usually sets a fundamental limit in the power input and output of each tube. By means of my improved cooling arrangement, the permissible power dissipation per tube may be greatly increased and this makes possible a great reduction in the number of amplifiers or modulator tubes required. In radio telephone broadcast transmitters, for example, class "B" modulators have been generally adopted with a consequent loss in quality of modulation and ease of operation in order to reduce the number and cost of modulator tubes. With tubes of increased power dissipation, according to this invention, the number of modulator tubes required for the Heising constant current modulating system may be reduced to about one-half or one-third of the number formerly required and the advantages of the Heising system retained without excessive tube costs. I have not shown schematic circuit diagrams of low frequency amplifiers and modulators employing the indirectly cooled tubes since these circuits are so well known as to be obvious to one skilled in the art.

It is to be distinctly understood that this invention is not limited to the apparatus illustrated but is to be construed broadly.

What is claimed is:

1. In combination, a vacuum tube and a con-

denser, a metallic block having a tapered aperture, a second aperture forming one electrode of said condenser and located in the same plane as said tapered aperture, a tapered metallic sleeve fitted within said tapered aperture, said tapered sleeve having a helical cooling fluid channel cut on the outside of said sleeve, a vacuum tube mounted within an opening in said sleeve, means for circulating a cooling fluid through said channel, and means for clamping said tube within an opening in said block.

2. A transmitting device having common electrodes for the anode of a transmitting tube and a condenser comprising a metallic block having a cylindrical aperture to receive a cooling duct member for the anode of said tube, a second cylindrical aperture adjacent said first aperture acting as one of the electrodes of said condenser, and cooling means connecting said duct member in said block with a fluid supply source for cooling both the tube and the condenser.

3. A transmitting device having common electrodes for the anode of a transmitting tube and a condenser comprising a metallic block having a cylindrical aperture to receive a cooling duct member for the anode of said tube, a second cylindrical aperture adjacent said first aperture acting as one of the electrodes of said condenser, a second condenser electrode insulatingly secured to said block, and cooling means connecting said duct member in said block with a fluid supply source for cooling both the tube and the condenser.

4. A transmitting device having common electrodes for the anode of a transmitting tube and a condenser comprising a solid metallic block having a cylindrical aperture to receive a cooling duct for the anode of said tube, a second cylindrical aperture located in the same plane with and adjacent said first aperture acting as one of the electrodes of said condenser, cooling means connecting said duct member in said block with a fluid supply source for cooling both the tube and the condenser.

5. A combined vacuum tube and compressed air condenser comprising a cooling block of substantially heavy metal, a metallic sleeve for at least one of the electrodes of said tube, said metallic cooling block having liquid cooling means wherein the flow of the liquid enters from the bottom of said block and having its outlet in fluid communication with the upper portion of said block, said block having a cylindrical aperture for receiving the sleeve of substantially the same periphery as that of the sleeve of said tube electrode, and a second cylindrical aperture in said block which acts as an electrode for said condenser.

6. A transmitting device having a common electrical connection for the anode of a transmitting tube and one electrode of a condenser comprising a metallic block having an aperture to receive the anode of said tube, a second aperture adjacent said first aperture acting as one of the electrodes of said condenser, cooling means in said block for both the tube and the condenser, and clamping means comprising a threaded stud and a thumb nut for clamping said tube in intimate contact within said block.

7. In combination a vacuum tube and condenser comprising a tapered sleeve which surrounds the anode electrode of said tube, a solid

metallic cooling block having an aperture of substantially the same periphery as that of said tapered sleeve for said anode electrode, a second aperture in said block forming one electrode of said condenser, the cross-sectional area of said block being substantially greater than the cross-sectional area of said aperture, and a fluid cooling duct located adjacent said first mentioned aperture to provide cooling means for said anode electrode.

8. In combination a vacuum tube and condenser comprising a tapered sleeve surrounding the anode electrode of said tube, a solid metallic cooling block having an aperture of substantially the same periphery as that of the tapered sleeve for the tube electrode, a second aperture in said block forming one electrode of said condenser, and means comprising a cooling duct cut around the outside of said sleeve and connected to a fluid supply source for circulating cooling fluid through said cooling block.

9. In combination a vacuum tube and a condenser, a metallic block having a tapered aperture, a tapered metallic sleeve fitted within said aperture, a second aperture in said block forming one electrode of said condenser, said tapered sleeve having a cooling fluid channel helically cut around the outside periphery thereof, said vacuum tube being mounted within an opening in said sleeve, and means connecting said fluid cooling channel with an external fluid supply source for circulating cooling fluid through said channel.

10. In combination a vacuum tube and a condenser, a metallic block having a tapered aperture, a tapered metallic sleeve fitted within said aperture, a pair of electrodes for said condenser located within said metallic block, said tapered sleeve having a cooling fluid channel helically cut around the outside of said sleeve, said vacuum tube mounted within an opening in said sleeve, and means for connecting said fluid channel with a fluid supply source for circulating a cooling fluid through said channel.

11. A transmitting device having a common electrical connection for the anode of a transmitting tube and one electrode of a compressed air condenser comprising a metallic block having an aperture to receive the anode of said tube, a second aperture adjacent said first aperture acting as one of the electrodes of said condenser, an insulator located over said second aperture for supporting the other condenser electrode, cooling means in said block for both the tube and the condenser, and clamping means for clamping said tube in intimate contact within said block.

12. A transmitting device having a common electrical connection for the anode of a transmitting tube and one electrode of a compressed air condenser comprising a metallic block having an aperture to receive the anode of said tube, a second aperture adjacent said first aperture acting as one of the electrodes of said condenser, an insulator located over said second aperture for supporting the other condenser electrode, cooling means in said block for both the tube and the condenser, a plate secured to the lower portion of said metallic block having coupling means for coupling a fluid duct which is located adjacent said first mentioned aperture with a fluid supply source for cooling the anode of said tube.

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