Jan. 16, 1940. P. F. BRADEN 2,187,011

COOLING MEANS FOR AN ELECTRICAL APPARATUS

Filed March 13, 1937 3 Sheets-Sheet 1

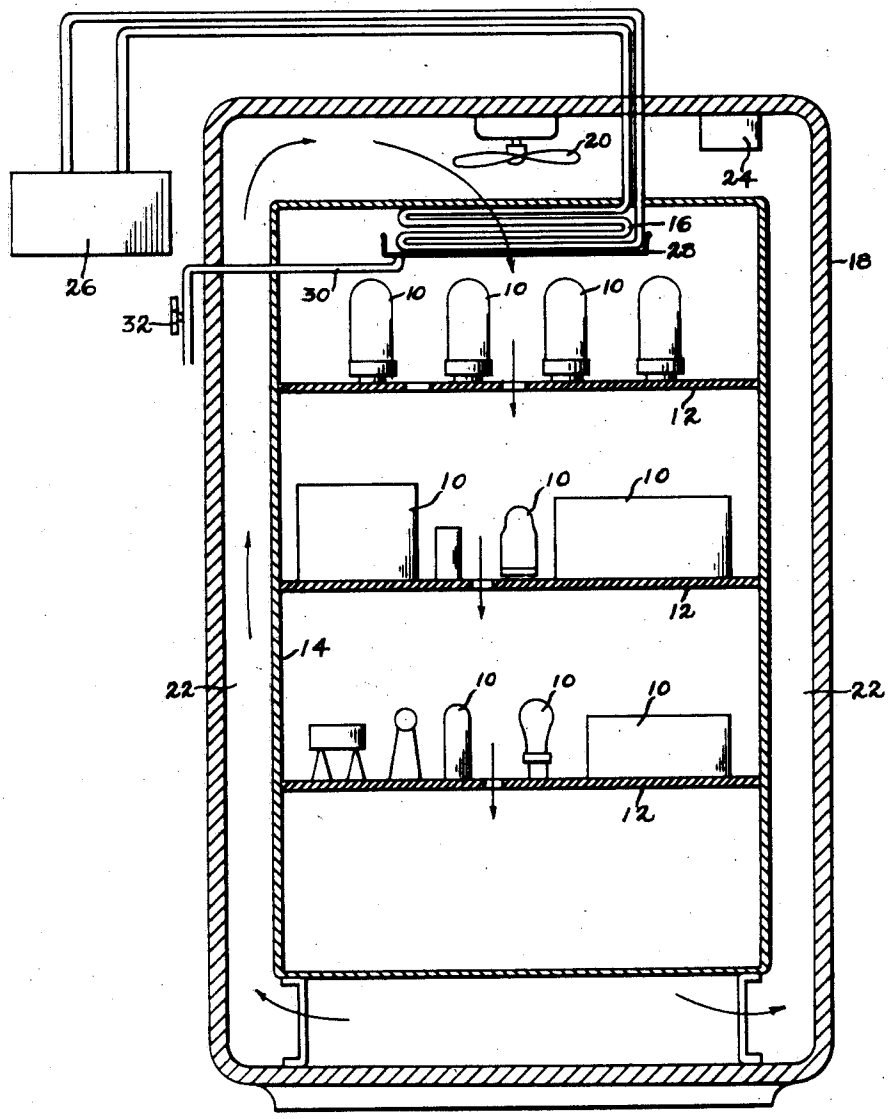


Fig. 1

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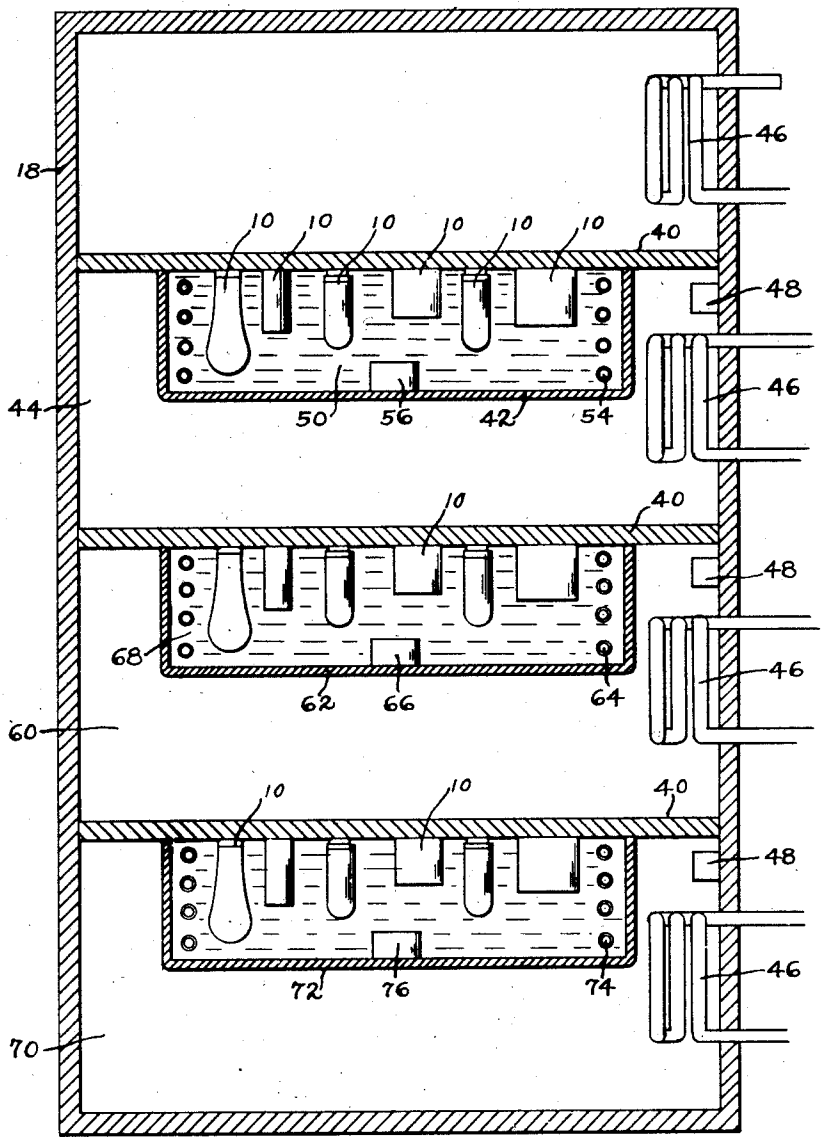


Fig. 2

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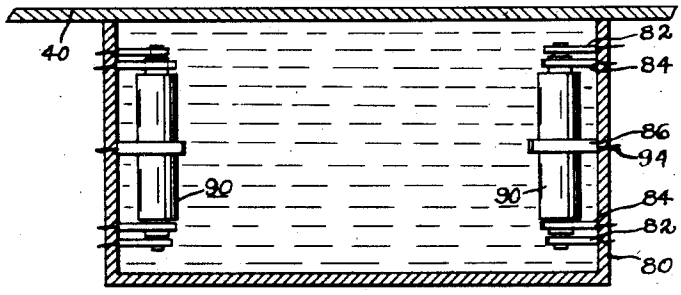


Fig. 3

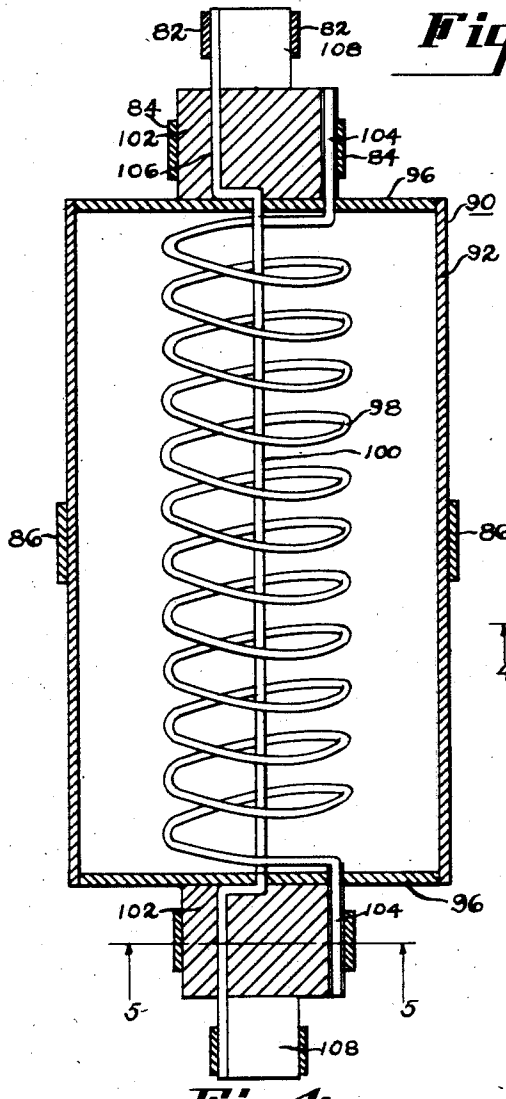


Fig 4

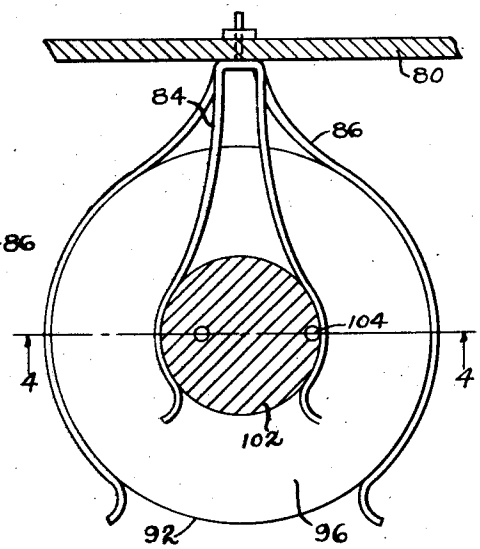


Fig. 5

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UNITED STATES PATENT OFFICE

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COOLING MEANS FOR AN ELECTRICAL APPARATUS

Paul F. Braden, Dayton, Ohio

Application March 13, 1937, Serial No. 130,732

1 Claim. (Cl. 62—89)

This invention relates to a transmitting device and in more particular to a temperature controlled transmitting device.

An object of this invention is to control the temperature surrounding the elements of a transmitting device.

Another object of this invention is to provide a thermostatic control means for regulating the temperature of the transmitting device.

Another object of this invention is to provide a temperature controlling device for each stage used in the transmitting device.

Another object of this invention is to keep foreign matter such as moisture and dust away from the transmitting device.

Another object is to provide a thermionic vacuum tube that is efficient, dependable and long lived.

Other objects and advantages reside in the construction of parts, the combination thereof and the mode of operation, as will become more apparent from the following description.

Fig. 1 is a schematic disclosure of the preferred embodiment.

Fig. 2 is a perspective view of another modification.

Fig. 3 shows a fragmentary cross sectional view of another modification.

Fig. 4 shows a cross sectional view taken substantially on the line 4—4 of Fig. 5, disclosing a cross section of the thermionic vacuum tube.

Fig. 5 is a cross sectional view taken substantially on the line 5—5 of Fig. 4.

In the past it has been common practice to mount the condenser, the resistors, inductances, vacuum tubes, etcetera used in a transmitting device upon a suitable frame that is open to the surrounding air. This results in the rapid changing of temperature of the air surrounding the transmitting device, the accumulation of dust and the condensation of moisture, all of which influence the operation of the transmitting device. The dust accumulating on condensers and coils, especially in the presence of moisture, creates a leakage current, which changes the circuit constants such as the capacities, the inductances and resistances. Eventually, this will result in a breakdown of the insulation, causing a short circuit. Any of the electrical devices may fail in this matter. This requires replacement.

Transmitting devices used in this country are assigned a certain frequency. It is necessary to keep within a certain tolerance of this frequency. Short circuits or leakages of currents result in a change of constance of the circuit, resulting in a variation of the wave length and the efficiency of the transmitter. Furthermore, variations in temperature result in expansion and contraction of the resistances, capacities and inductances of the circuit.

By eliminating dust, moisture and fluctuations in temperature, the transmitting device becomes more accurate, more dependable and lasts longer. This has been accomplished by enclosing the transmitting device in a cabinet containing suitable cooling coils thermostatically controlled and possibly a device for circulating the medium surrounding the apparatus of the transmitting device, so as to prevent the accumulation of dust, eliminate the moisture in the air, or substantially so, and maintain a substantially constant temperature around the transmitting device. This will also eliminate harmful substances from the air in the cabinet, such as found in tropical climates.

In the past it has been necessary to mount the various parts of the transmitting device in spaced relation due to the generation of heat by the thermionic vacuum tubes and the heating of resistors. By providing cooling coils, it is possible to mount the elements much closer together, thereby conserving space and permitting the enclosure thereof by a suitable cabinet.

By the use of refrigerating means for each stage, it is possible to maintin the stages at different controlled temperatures. Furthermore, by the use of a metallic tube having the plate exposed, greater efficiency is obtained.

Referring to Fig. 1, the elements 10 of the transmitting device, such as vacuum tubes, condensers, resistors, transformers, inductances, etcetera, are mounted upon a series of shelves or supports 12 suitably supported in a shell 14 provided with a cooling coil 16 near an opening at the top of the shell and housed within an insulated cabinet 18 provided with a suitable door not shown. An electric fan 20 is located directly above the cooling coil 16, so as to circulate the cold air downwardly past the element 10 to the bottom of the cabinet 18, where the air passes through the space 22 between the cabinet 18 and the shell 14, so as to return to the cooling coil 16 for further cooling. A thermostat 24 controls the electrical refrigerating apparatus so as to shut off the compressor 26 whenever the fluid or air drops to a predetermined temperature. This thermostatic control may be similar to those used in electrical refrigerating apparatus. By keeping the door closed, the air is recirculated, the moisture being absorbed by the cooling coil 16 and

drained into a pan 28 provided with a suitable drain 30, which may be opened by a suitable valve 32 which drains the pan 28. This results in dry air being circulated around the elements 10 in the absence of dust and foreign particles in the air, excepting dust and particles found in the air that is originally found in the cabinet. By this arrangement, dry, cold air is circulated around the elements 10, which air is maintained at a substantially constant temperature, thereby increasing the life of the transmitting device, increasing the efficiency thereof and eliminating several chances of shifting of the broadcast frequency.

In the modification disclosed in Fig. 2, the cabinet 18 supports a plurality of shelves 40 arranged in suitable spaced relation, dividing the cabinet 18 into a plurality of spaces separated from each other. The several stages of the transmitting apparatus have also been separated. For example, the oscillating circuit may be housed within the case 42, supported by the upper shelf 40 on the under side thereof, so as to be located within the compartment 44.

A cooling coil 46 cools the air within the compartment 44. Each cooling coil 46 is preferably thermostatically controlled by a suitable thermostat 48.

All of the electrical apparatus used in the oscillating stage is mounted in the case 42 and submerged in a suitable heat conducting fluid 50, such as a heat conducting oil, alcohol, glycerin or a suitable gas. The cooling coils 54 cool the fluid, so as to maintain all of the elements of the oscillating circuit at a constant temperature, the cooling coils being thermostatically controlled by a thermostat 56. By maintaining as many of the elements as possible submerged in the fluid that is maintained at a constant temperature, there is no cause for variations in the frequency of the output of the oscillator. If the temperature can be properly regulated it should be possible to eliminate the use of the crystal having the assigned frequency to maintain a constant output of the frequency of the oscillator.

The audio signals may be amplified before modulation and the modulated signals may also be amplified. One of these amplifiers may be mounted in a compartment 60 and as far as possible within the case 62 suspended from the second shelf 40 within the cabinet 18. This cabinet containing a suitable heat conducting fluid 68 having high electrical resistance is cooled by suitable cooling coils 64 thermostatically controlled by thermostats 66. The temperature within the case 62 and within the compartment 60 may not be maintained at the same temperature as that in the compartment 44 and the case 42. The temperature in 62 may be either higher or lower or the same as in 42. This depends entirely upon the type of electrical elements used and the temperature at which the elements operate at the best efficiency.

A similar stage may be mounted in the compartment 70, wherein the fluid filled case 72 houses another stage of amplification, together with suitable coils 74 thermostatically controlled by a thermostat 76. The cooling coils 46 found in the compartments 60 and 70 cool the air within the respective compartments. The thermostats 48 for these compartments are preferably adjusted so as to maintain the temperature of the air surrounding the cases 62 and 72 at the same temperature as found in the cases 62 and 72 respectively.

In addition to the oscillating circuit and the amplifying circuits, the power pack may be cooled in the same cabinet, also the control elements of the circuit. In some installations, part of the apparatus may be mounted in the cabinet and other parts outside or in separate cabinets.

Although two stages of amplification have been shown, any number of stages of amplification may be used. Likewise, one or more stages of amplification may be located within the same compartment. For example, if there are three stages of audio amplification, these three stages of amplification may be mounted in the same compartment in the same case, submerged in the same fluid bath, maintained at a constant temperature. Likewise, if there are several stages of amplification of modulated carrier current, these may be mounted within a common compartment and within the same case. The compartment containing one stage and the compartment containing another stage are preferably separated by a suitable electrical shield, that is, the various stages are screened from each other. The shelf itself may constitute the screen.

Another modification has been disclosed in Fig. 3. In this modification the oil case 80 has suitable clips 82, 84 and 86 suitably attached to the case 80 supporting a metallic tube 90, of which the outside constitutes a plate. These tubes ar submerged in the fluid used in the case 80.

In Figs. 4 and 5 the structure of this tube has been more fully shown. It consists of an outer cylindrical shell 92 of suitable metal that forms a plate. This is supported in the clip 86 terminating in a lead connected to the plate circuit 94. The ends 96 of the tube are preferably made of suitable dielectric material.

Housed within the cylindrical shell 92 is found a grid 98 and a filament or cathode 100. In the disclosure in Fig. 4 the grid 98 has been shown as a helical member. This permits the use of the grid as an inductance element in the circuit, as will be described more fully later.

Each end 96 of the tube supports a cylindrical member 102 preferably made of insulated material, along one side of which a lead 104 connected to the grid is embedded. The filament terminal 106 also passes through the cylindrical member 102 in spaced relation from the periphery thereof, and diametrically disposed with respect to the lead 104. The lead 106 extends beyond the outer end of the cylindrical member 102 and is embedded in the periphery of another cylindrical member 108 of reduced diameter. The lead 106 is located in the surface of the cylindrical member 108.

The grid terminal 104 contacts the clip 84 and the cathode terminal 106 contacts the clip 82. The terminals 104 and 106 as soon as they emerge from the tube are separated diametrically disposed, so to speak, so as to reduce the capacity effects between these terminals. Instead of showing a triode tube, a screen grid tube could be constructed in a similar manner, or a pentode.

The grid leak circuit may be connected to one terminal of the grid and the input circuit may be connected to the other. Being both ends of the grid are available from the outside of the tube, the inductance of the grid may be utilized in the circuit. For example, the inductance of the grid can be so selected that it, together with either an internal or an external condenser,

forms a tuned or resonating circuit. Thus, the grid in this modification has a dual function, the one as an electrode of the tube and the other as a reactance in the circuit. In fact, by proper grid construction it may be possible to neutralize the internal capacities within the tube, if this is desired.

For some tubes it may be desirable to provide a non-inductive grid. If so, the grid may be made from suitable mesh material having very little inductive reactance.

The positive terminal of the cathode circuit can be connected to one terminal 106 of the filament 100 and the negative connected to the other terminal 106 of the filament or the cathode.

In some installations it may be desirable to provide an insulated jacket for the tube. This may be accomplished by enclosing the tube in suitable insulating material, preferably insulating material that lends itself to rapid cooling of the tube. For example, a glass jacket may be used, which is arranged in close proximity to the plate. It is conceivable that a vitreous coating, or other coating, may be deposited directly on the outer surface of the plate and other portions of the tube to insulate the same. If oil or other heat transfer medium is used, the oil or the heat transfer medium would then come in contact with the jacket, without coming into direct contact with the anode of the tube.

Although the preferred modification of the device has been described, it will be understood that within the purview of this invention various changes may be made in the form, details, proportion and arrangement of parts which generally stated consist in a device capable of carrying out the objects set forth, in the novel parts, combination of parts and mode of operation, as disclosed and defined in the appended claim.

Having thus described my invention, I claim:

A refrigerator for use in cooling articles to be cooled, said refrigerator including a heat insulated cabinet, a shell including side, bottom and top walls mounted within the cabinet, said shell in its entirety being arranged in spaced relation to the corresponding walls of the cabinet so as to provide an air chamber between the shell and the cabinet, said shell having air passage openings in the top and in the bottom thereof, shelves mounted within the shell for supporting the articles to be cooled; a cooling coil associated with the top of the shell and located within the cabinet for cooling the air circulating down through the shell and returning around the shell so as to maintain a lower temperature within the shell than the temperature of the air in the chamber found between the shell and the cabinet, means arranged to collect moisture condensing on said cooling coil and interposed between the cooling coil and the uppermost shelf and means for conducting the condensate from said collecting means to a point outside said cabinet.

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