

July 4, 1961

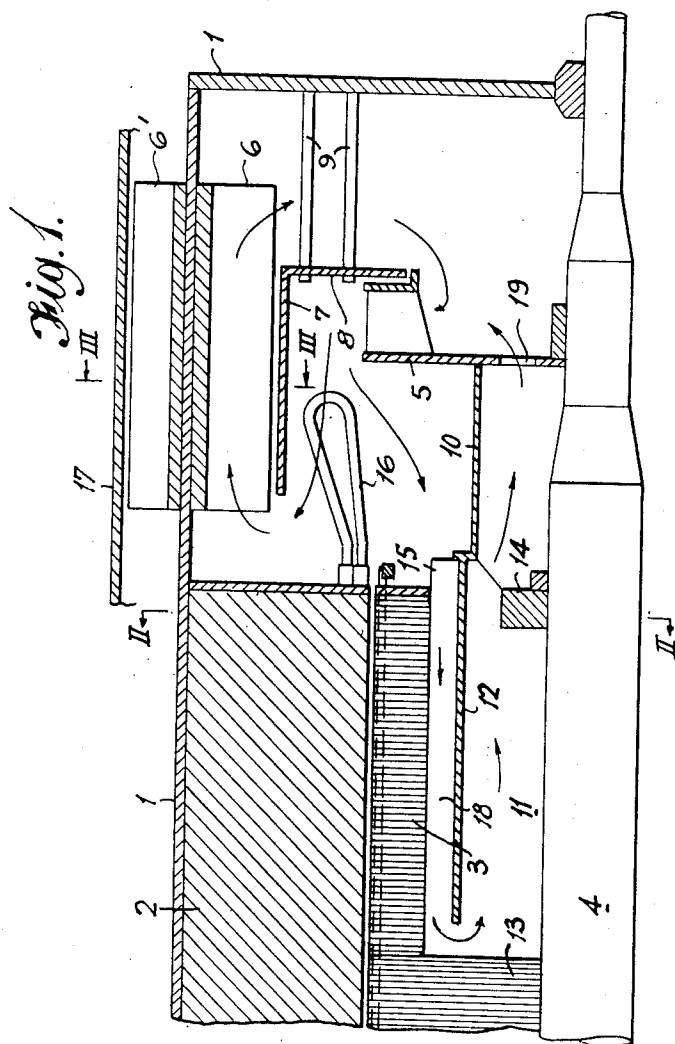
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2,991,377

COOLING OF FLAME PROOF MOTORS

Filed Jan. 22, 1958

5 Sheets-Sheet 1



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5 Sheets-Sheet 2

Fig. 3.

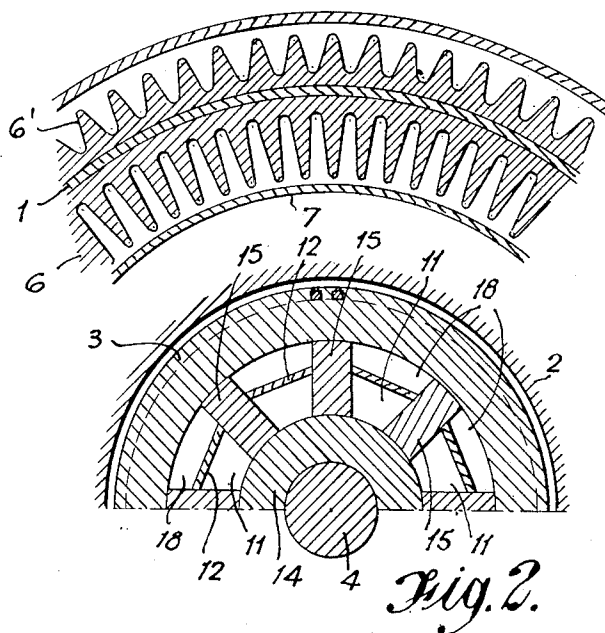
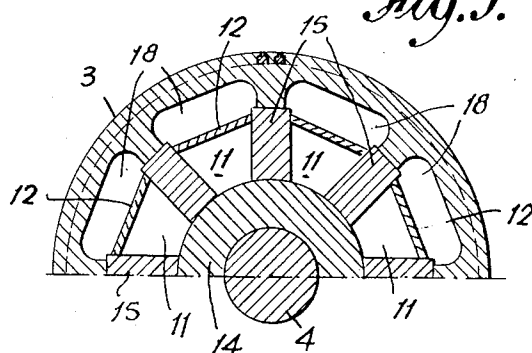


Fig. 5.



July 4, 1961

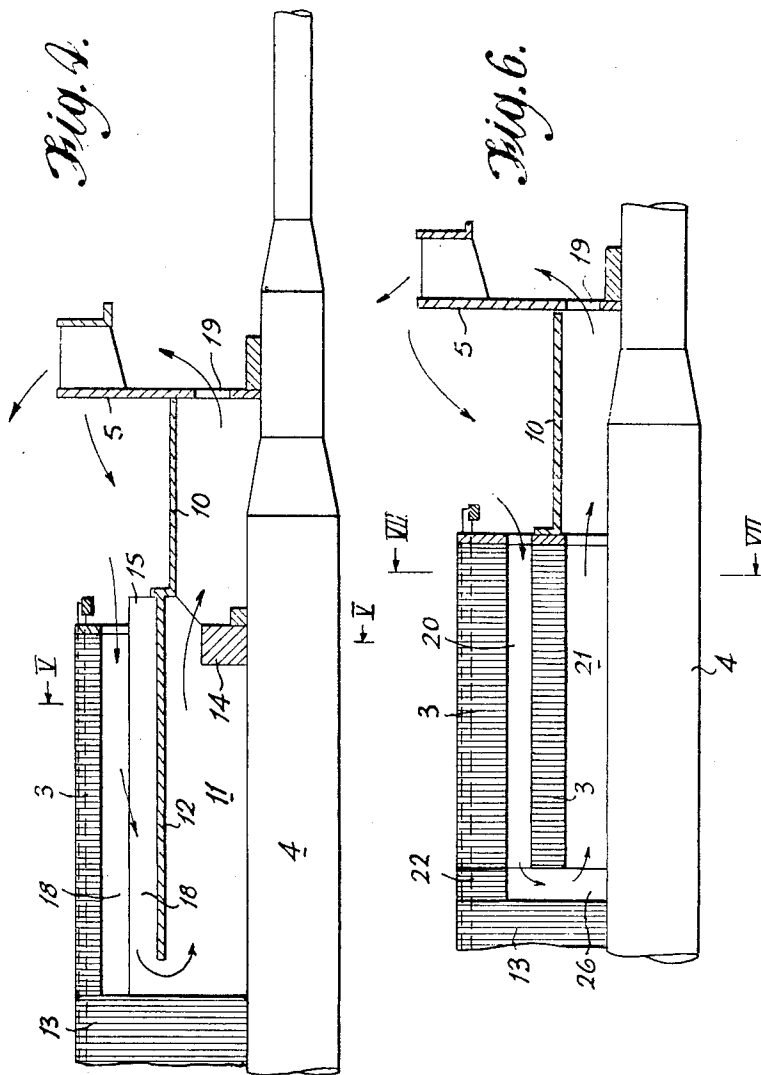
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5 Sheets-Sheet 3



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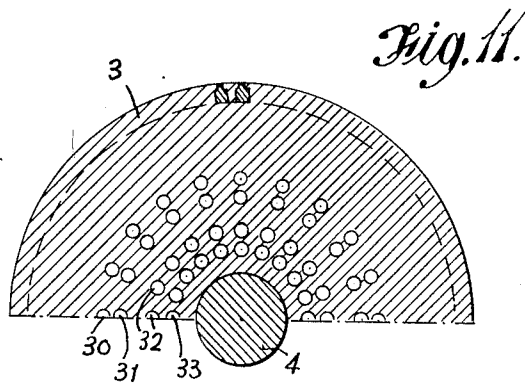
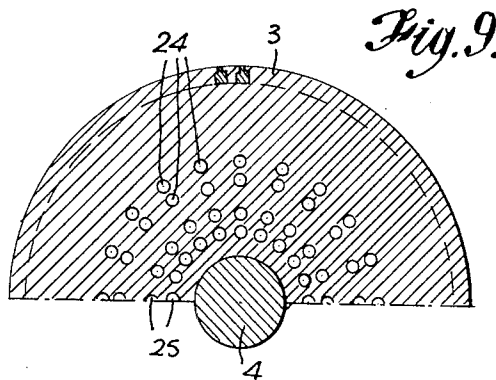
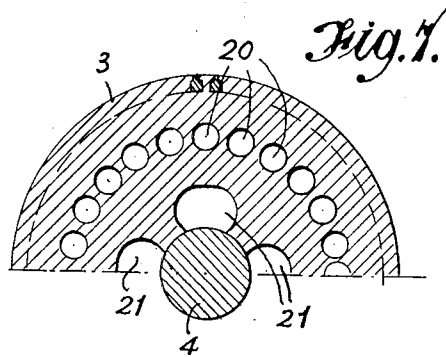
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5 Sheets-Sheet 4



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COOLING OF FLAME PROOF MOTORS

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5 Sheets-Sheet 5

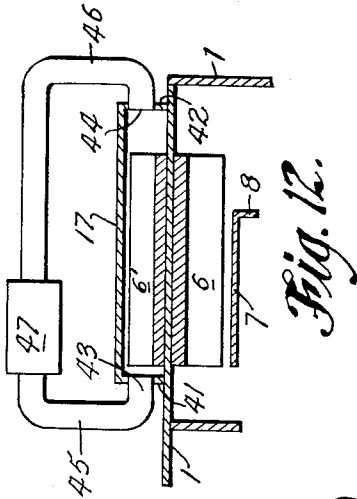


Fig. 12.

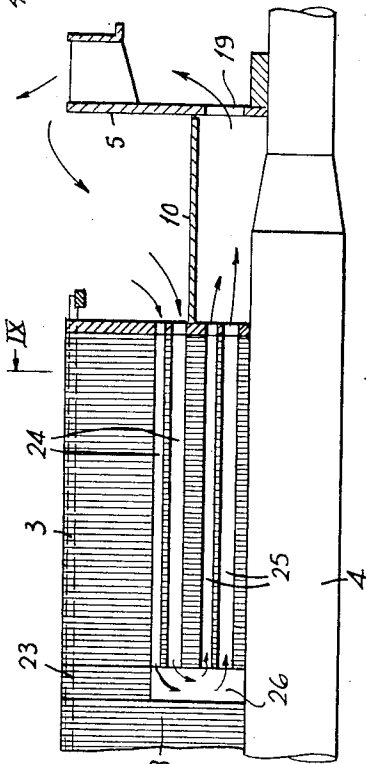


Fig. 8.

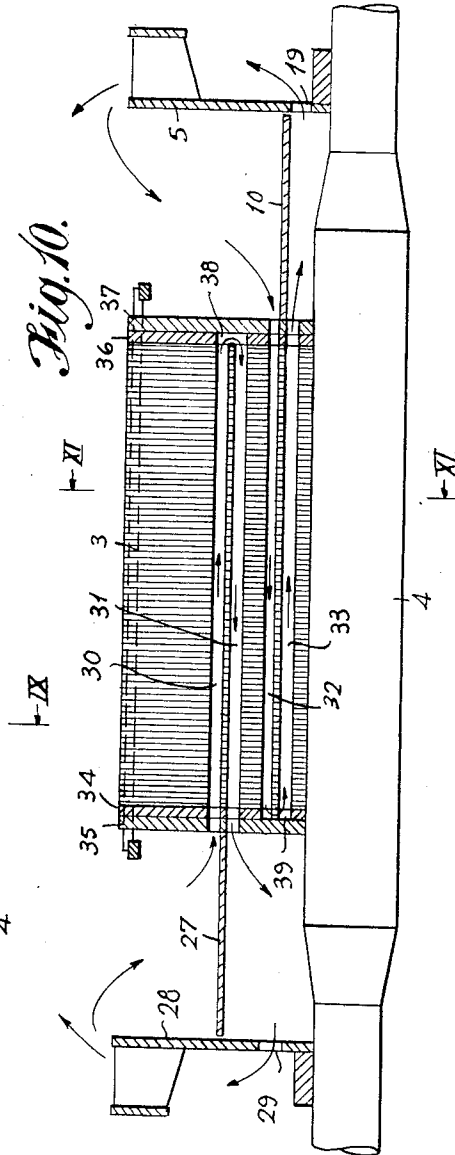


Fig. 10.

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1

2,991,377

COOLING OF FLAME PROOF MOTORS

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3 Claims. (Cl. 310-61)

The present invention relates to totally enclosed flame proof motors or explosion proof motors and is concerned with the cooling of such motors.

When two chambers are connected by passages of small cross-sectional area, if an explosion occurs in one chamber the flame resulting from that explosion will travel through the connecting passage to the other chamber where it will cause burning with detonation of gases already compressed by the pressure wave preceding the flame.

It is known to cool motors by passing the cooling fluid through ducts cut axially in the rotor but if this method is used in flame proof motors the conditions for easy ignition of the gas masses at each end of the rotor as described above are obtained.

The object of the present invention is to cool the rotors of flame proof machines without introducing conditions which will cause easy ignition of combustible gases which exist in the motor and thereby damage to the machine.

According to the present invention the rotor of a totally enclosed flame-proof machine has a cooling system comprising a plurality of ducts extending longitudinally in the core of the rotor, each duct having an exit and an entry aperture at the same end of the rotor, means for passing a primary cooling fluid through the cooling ducts and means for cooling said primary cooling fluid after it has emerged from the ducts.

In a particular embodiment of the invention the cooling system comprises a heat exchanger associated with each end of the rotor, means for passing the primary cooling fluid after it has emerged from the ducts through the heat exchanger associated with that end of the rotor from which the fluid has emerged and a supply of a secondary cooling fluid for removing heat from said heat exchangers.

The present invention utilises cooling ducts in the rotor of a machine but since these ducts have entry and exit apertures at the same end of the rotor there is no narrow neck connecting the two ends of the rotor thereby allowing the passage of a pressure wave and a flame from one end of the motor to the other. This avoids the dangerous conditions as detailed above because the air gap between the stator and the rotor is too small to allow passage of a pressure wave and a flame. The cooling system according to the invention is therefore suitable for use where gases of group III (that is ethylene and the like) may be present in the coolant fluid.

The invention will now be described with reference to the drawings accompanying this specification in which:

FIG. 1 is a longitudinal section of a portion of a rotor of a flame proof machine with cooling ducts therein and a fan and heat exchanger for the cooling fluid;

FIG. 2 is a cross-section of the portion of the rotor taken on the line II-II of FIG. 1;

FIG. 3 is a cross-section of a portion of the heat exchanger in FIG. 1 along III-III;

FIG. 4 shows an alternative form of cooling ducts in a rotor;

FIG. 5 is a cross-section of the rotor in FIG. 4 along V-V;

FIG. 6 shows another alternative form of cooling ducts in a rotor of a flame proof machine;

2

FIG. 7 is a cross-section of the rotor in FIG. 6 along VII-VII;

FIG. 8 shows another alternative form of cooling ducts in a rotor of a flame proof machine;

FIG. 9 is another cross-section of the rotor in FIG. 8 along IX-IX;

FIG. 10 is another alternative form of cooling ducts in a rotor of a flame proof machine;

FIG. 11 is a cross-section of the rotor in FIG. 10 along XI-XI, and FIG. 12 is a cross-sectional view of one of the heat exchangers with means for circulating the secondary cooling fluid therethrough.

With reference to FIGS. 1 and 2, a flame proof motor has frame 1 and stator windings and laminations 2 and rotor end windings and laminations 3. The central windings and laminations of the rotor are represented by 13. The shaft 4 of the rotor has a fan 5 mounted on it. 6 and 6' are the fins of a heat exchanger attached to the circumference of the frame 1 extending radially inwards and outwards. 7 is a cylindrical baffle attached to 8 which is an annular baffle supported from the end of the frame 1 by arms 9. A cylindrical baffle 10 is attached to the end of the rotor. 14 is a ring attached to the shaft 4 and welded to said ring are a plurality of arms 15 extending axially along the shaft as far as the laminations 13, and radially as far as and supporting the laminations 3. The laminations 13 are in the centre of the rotor and have no apertures therein. The flat bars 12 are welded between successive arms 15 and form ducts 11 and 18 which extend axially as far as the laminations 13. The stator end windings are represented by 16. A series of holes 19 are formed in the disc of the fan 5.

With reference to FIG. 3 the fins 6 and 6' of the heat exchanger extend radially inwards and outward from the frame 1 of the stator. 17 is a cylindrical plate situated encircling the stator frame and adjacent to the outer fins 6' and cooling fluid is passed between 6' and 17 to remove the heat from the fins. The cylindrical baffle 7 is situated adjacent to the ends of the fins 6.

The operation of the cooling system is as follows. The fan 5 rotates with the shaft and causes circulation of cooling fluid along paths as indicated by the arrows. Two alternative paths are shown, the first through each of the cooling ducts 18 and 11 in the rotor and out through the holes 19 and back to the blades of the fan and the second over the stator end windings 16 along the fins 6 of the heat exchanger where heat is given up to the fins and deflected by the baffle 8 back to the blades of the fan.

The cooling fluid absorbs heat from the rotor in the ducts 18 and 11 and from the stator end windings and gives it up to the heat exchanger by passing along fins 6. The second cooling fluid on passing between 17 and the outer fins 6' removes heat from the latter.

The figure shows only one end of the rotor and it is assumed that the other end of the rotor is cooled by a similar method, the cooling ducts extending as far as the rotor laminations 13.

There has been described above a method of cooling the rotor of a totally enclosed flame proof machine by forming ducts within the rotor and passing cooling fluid through the ducts and removing heat from the cooling fluid by a heat exchanger which forms part of the frame of the motor without introducing dangerous conditions leading to detonation of large masses of gas at high pressure, thereby endangering the integrity of the flame proof enclosure.

FIGS 4-11 illustrate four alternative ways of forming the cooling ducts in the rotors of such machines. Corresponding items have been given the same numbers in each figure. It is assumed that a heat exchanger simi-

lar to that shown in FIGS. 1, 2 and 3 will be incorporated in each of these cooling circuits.

With reference to FIGS. 4 and 5 the ducts 18 have been increased in size and extend further radially into the laminations 3 as shown.

The paths for the cooling fluid are the same as in FIG. 1. Increased cooling is obtained as a greater area of pressings is exposed to the cooling fluid but a certain amount of rigidity of the rotor is lost.

With reference to FIGS. 6 and 7 the ducts in the rotor are 20 and 21. 20 consists of a series of cylindrical axial ducts in the laminations 3, and 21 consists of a series of larger ducts extending axially adjacent to the rotor. These two sets of ducts are joined by suitable slots 26 in laminations 22, which pressings are situated between 3 and 13. The cooling fluid flows through 20 and 21 and then back through holes 19 in the fan disc.

With reference to FIGS. 8 and 9 the ducts are 24 and 25 joined by slots 26 in laminations 23. Ducts 24 consist of a series of cylindrical axial ducts arranged radially in pairs and ducts 25 consist of another series of cylindrical axial ducts also arranged radially in pairs on a smaller radius than 24.

These ducts extend axially through the laminations 3 and are joined by slots 26 formed in laminations 23 which are situated between 3 and 13.

The cooling fluid flows in through ducts 24 through slots 26 and out through ducts 25 and through holes 19 in the fan disc as before.

With reference to FIGS. 10 and 11 these show a section of a complete rotor. Ducts extend along the whole length of the rotor and comprise a series of pairs of ducts 30, 31, and 32, 33. The two sets of ducts are quite independent, and extend respectively from either end of the motor. Considering the right hand end of the motor, with reference to FIG. 10, the end plates 36 and 37 have pairs of holes therein corresponding with the ducts 32 and 33, and the end plate 34 has a series of slots 39 connecting pairs of ducts 32 and 33. The cooling fluid flows from fan 5 into the rotor through ducts 32, through slots 39, out through ducts 33, and through holes 19 back to the fan. Considering the left hand end of the rotor, end plates 34 and 35 have pairs of holes therein corresponding with the ducts 30 and 31, and the end plate 36 has slots 38 connecting pairs of ducts 30 and 31. The cooling fluid flows from fan 28, is deflected from cylindrical baffle 27 into ducts 30, through slots 38, out through ducts 31, and through holes 29 back to the fan.

By an arrangement as detailed in FIGS. 10 and 11 cooling ducts are introduced throughout the length of the rotor without producing the dangerous conditions as described above.

FIG. 12 shows a particular method of circulating the secondary cooling fluid, through one of the heat exchangers. The fins 6' are surrounded by a cylindrical plate 17 and the ends of this plate are closed by two annular plates 41 and 42. These two annular plates have apertures 43 and 44 and to these apertures are respectively attached two pipes 45 and 46 as shown. At their remote ends these pipes are connected to a fan or pump 47. Operation of fan 47 causes secondary cooling fluid to be circulated through the pipes 45 and 46 into the annular chamber formed by plates 17, 41 and 42 and the outside of the stator frame 1, and over the fins 6'. The secondary cooling fluid will in its turn be cooled by passage through the pipes which are exposed on their outside to the surrounding atmosphere.

Even though a particular type of heat exchanger has

been described it will be appreciated that it is possible to use any of the arrangements of rotor cooling ducts as described above with another suitable heat exchanger.

What we claim is:

1. A totally enclosed flame proof machine comprising a rotor having a core and disposed within an enclosing casing defining a chamber, means providing surfaces defining a plurality of ducts extending longitudinally within the core of the rotor of said machine and terminating at their inner ends within said core, and means for connecting together the inner ends of said ducts in groups so as to form a plurality of discrete U-shaped passages of substantially constant cross sectional area for the passage of a cooling fluid, said surfaces terminating at their outer ends at the ends of the rotor core and defining therein a plurality of entry and exit apertures for said passages connecting directly with the chamber defined by said casing, the arrangement being such that each passage has an entry aperture and an exit aperture at the same end of the rotor.

2. A totally enclosed flame proof machine comprising a rotor having a core and disposed within an enclosing casing defining a chamber, means providing surfaces defining a plurality of ducts extending longitudinally from either end within the core of the rotor of said machine and terminating at their inner ends within said core, and means for connecting together the inner ends of said ducts in groups so as to form a plurality of discrete U-shaped passages of substantially constant cross sectional area extending from each end of said rotor core for the passage of a cooling fluid, said surfaces terminating at their outer ends at the ends of the rotor core and defining therein a plurality of entry and exit apertures for said passages connecting directly with the chamber defined by said casing, the arrangement being such that each passage has an entry aperture and an exit aperture at the same end of the rotor.

3. A totally enclosed flame proof machine comprising a rotor having a core and disposed within an enclosing casing defining a chamber, means providing surfaces defining a plurality of ducts extending longitudinally from either end within the core of the rotor of said machine, extending substantially over the whole length of the core and terminating at their inner ends within said core, and means for connecting together the inner ends of said ducts in groups so as to form a plurality of discrete U-shaped passages of substantially constant cross sectional area extending from each end of said rotor core substantially over the whole length of the core for the passage of a cooling fluid, said surfaces terminating at their outer ends at the ends of the rotor core and defining therein a plurality of entry and exit apertures for said passages connecting directly with the chamber defined by said casing, the arrangement being such that each passage has an entry aperture and an exit aperture at the same end of the rotor.

References Cited in the file of this patent

UNITED STATES PATENTS

1,700,840	Gay	Feb. 5, 1929
2,159,087	Jeffrey	May 23, 1939
2,214,592	Mueller	Sept. 10, 1940
2,692,956	Kaczor et al.	Oct. 26, 1954

FOREIGN PATENTS

16,590	Great Britain	of 1914
337,334	Great Britain	Oct. 30, 1930