Feb. 28, 1956 V. A. HOOVER 2,736,826

VENTILATED EXPLOSION-PROOF DYNAMO-ELECTRIC MACHINE

Filed April 13, 1953

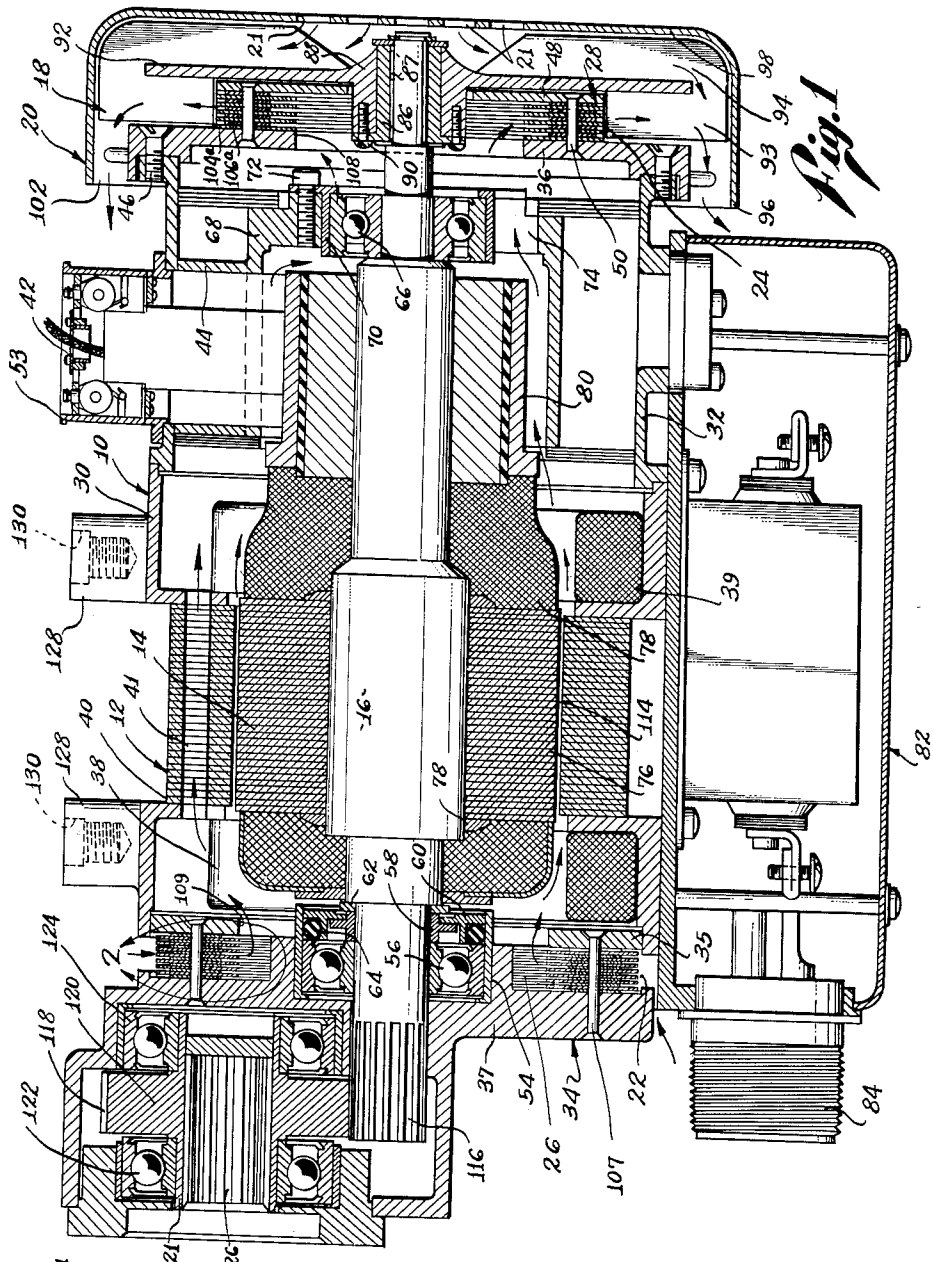

Fig. 1

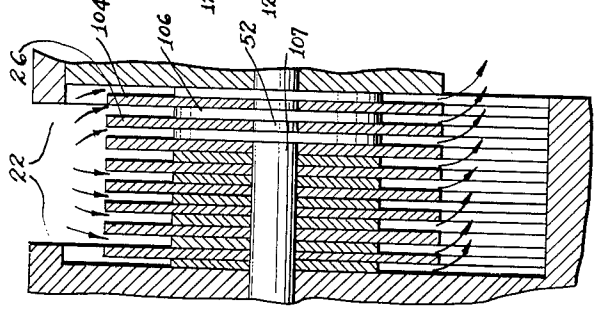

Fig. 2

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United States Patent Office 2,736,826
Patented Feb. 28, 1956

2,736,826

VENTILATED EXPLOSION-PROOF DYNAMO-ELECTRIC MACHINE

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Application April 13, 1953, Serial No. 348,516

9 Claims. (Cl. 310—88)

The present invention relates generally to the field of dynamo-electric machines, and more particularly to an improved dynamo-electric machine especially adapted for use in an inflammable or explosive fluid.

It is frequently desired that a dynamo-electric machine be utilized in an inflammable or explosive fluid, as for example air containing gasoline vapors or the like. When such is the case, special precautions must be taken to prevent the occurrence of an inadvertent explosion of such fluid resulting from the sparking of the dynamo-electric machine. A common expedient to prevent such explosions is the sealing of the working parts of the dynamo-electric machine within an air-tight housing. When a dynamo-electric machine is enclosed in this manner there is no free circulation of outside air over its various parts and the entire cooling thereof must be accomplished by cooling the outside of the housing. Hence, if the dynamo-electric machine is a motor, in order to carry a given load such motor must be considerably larger, and hence heavier, if it is fully enclosed than if it is exposed to outside air. In certain installations, as for example in aircraft, the weight of an electric motor must be kept to a minimum, yet its power rating must be high. Accordingly, the use of a fully enclosed motor is not feasible even though the motor is to be operated in an inflammable or explosive atmosphere.

It is a major object of the present invention to provide a dynamo-electric machine for use in an inflammable or explosive fluid, which machine weighs only slightly more than a conventional dynamo-electric machine of the same capacity.

This object is obtained by enclosing the dynamo-electric machine of the present invention within a housing formed with openings wherein are disposed novel flame arresters. The explosive fluid surrounding the device is free to enter the interior of this housing through the openings therein. Although it is contemplated that explosions may periodically take place within the housing, the novel flame arresters disposed in the housing openings are adapted to reduce the temperature of the products of combustion of such explosions to a value sufficiently low that the fluid surrounding the housing will not be ignited.

It is another object of the present invention to provide novel means for dissipating the heat generated within a dynamo-electric machine of this nature. The provision of such heat-dissipating means is essential in order that the internal temperature rise of the machine be maintained within safe limits.

A further object of the present invention is to provide a dynamo-electric machine having a housing wherein is disposed a single cooling fan, which fan is arranged in a novel manner to reduce the temperature both within and without the housing.

Yet another object of the present invention is to provide a novel dynamo-electric machine for use in an inflammable or explosive fluid, which machine is simple in design and rugged of construction, whereby it will be

foolproof in operation, require little maintenance, and provide a long service life.

An additional object of the present invention is to provide a novel flame arrester for use in a dynamo-electric machine.

Other objects and advantages of the present invention will become apparent from the following detailed description of a preferred embodiment thereof when taken in conjunction with the appended drawings, wherein:

Fig. 1 is a central vertical sectional view of an electric motor embodying the present invention whereby the motor is adapted for use in an inflammable or explosive fluid; and

Fig. 2 is a fragmentary enlarged view of the outlined portion of Fig. 1 designated 2, showing a novel flame arrester usable with the electric motor of Fig. 1.

Referring now to the drawings, and particularly to Fig. 1 thereof, the preferred form of electric motor embodying the present invention broadly comprises a stationary housing **10** wherein is mounted a stator core **12** and a rotor **14** carried by a shaft **16**, which shaft mounts a fan **18** on its front end. The fan **18** is disposed within a diffuser shroud **20** and is adapted upon rotation to draw air or other fluid surrounding the housing **10** into the confines of the diffuser shroud through a plurality of intake apertures **21** formed in the front of the shroud and discharge such air rearwardly over the exterior surface of the housing so as to reduce the external temperature thereof. The fan **18** also draws air or other fluid into the interior of the housing **10** through a circumferential inlet opening **22**, which air is adapted to pass out the front portion of the housing by means of a circumferential outlet opening **24** after having passed through the housing in heat-transfer relationship. In this manner such air will reduce the temperature within the housing. A first set of flame arresters **26** shown disposed adjacent the housing inlet opening **22** and a second set of flame arresters **28** shown disposed adjacent the housing outlet opening **24** are adapted upon the inadvertent occurrence of an explosion within the housing **10** to reduce the temperature of the products of combustion of such explosion to a value sufficiently low that ignition of the fluid surrounding the housing will not take place.

More particularly, the stationary housing **10** will preferably be of cylindrical configuration and will include a main body **30**, an end bell **32** located forwardly of the main body, a rear closure member **34** and a front wall **36**. The main body **30** encompasses a pair of field coils **38** and **39**, and the stator **12** itself, which stator core comprises a plurality of laminations **40** stacked together in the usual manner. It should be particularly noted that the stator core laminations will preferably be formed with one or more axially extending cooling ducts **41**. The end bell **32** encompasses a brush assembly **42** as well as a spider element **44**, which spider may be formed integrally with the end bell. The front wall **36** is shown rigidly affixed to the front end of the spider **44**, as by means of bolts **46**. A coaxial, generally flat backing ring **38** is shown mounted forwardly of the front wall **36** by means of axially extending rivets **50**. The axially extending circumferential space separating the front wall **36** and the backing ring **48** is seen to define the housing outlet opening **24**. The rear closure member **34** includes a mounting ring **35** adapted to fit within the rear opening of the main body **30**. This mounting ring is shown axially spaced from the base element **37** of the rear closure member, and it will be seen that the axially extending circumferential space therebetween defines the housing's inlet opening **22**.

The rear closure member **34** is shown formed with a coaxial cylindrical cavity **54** wherein is disposed the rear bearing **56**. This bearing **56** will preferably be of the

ball bearing type and may be secured in place by an inner retainer 58 and an outer retainer 60. The inner retainer 58 in turn is shown restrained against axial movement by means of a collar 62 which shoulders against an enlargment of the shaft 16. Preferably, a sealing means, such as an O-ring 64, will be positioned between the outer retainer 60 and the outer race of the bearing 56 so as to seal off the interior of the housing 10 at this point. The front bearing 66 will also preferably be of the ball bearing type and is shown coaxially supported by the spider element 44. To this end the spider element may include a plurality of webs 68 (only one of which is shown) adapted to receive a bearing retainer 70 by means of bolts 72. The axially extending spaces 74 between adjoining webs 68 permit the discharge of air from the interior of the housing 10, as indicated by the directional arrows. A removable cover 53 may be provided for the end bell 32 over the brush assembly 42.

The front and rear bearings rotatably mount the ends of the shaft 16, the intermediate portion of which shaft rigidly carries the rotor 14. The rotor may comprise a plurality of magnetic laminations 76 stacked together in the usual manner and plurality of windings 78. Forwardly of the rotor 14 on the shaft 16 is mounted a conventional commutator 80. A Junction box 82 is shown affixed to the bottom of the housing 10, which junction box includes a plug 84 adapted to be connected to an outside source of electric current.

The fan 18 is shown rigidly affixed to the front of the shaft 16, to which end the front portion of the shaft may be of reduced diameter whereby it may receive a collar 86, which collar will be locked against relative rotation by a key 87. The preferred form of fan will include a cylindrical hub 88 which is bored to receive the collar 86 and which will be rigidly affixed thereto, as by bolts 90. An annular plate 92 forms an integral radial extension of the hub 88. This plate rigidly supports a plurality of generally flat radially extending blades 94 which include rear portions 93 extending inwardly to a point adjacent the outer periphery of the backing ring 48 and serving to draw air from the outlet opening 24.

The cylindrical diffuser shroud 20 is shown coaxially mounted by the front end of the housing 10 in encompassing relationship to the fan 18. To this end, the shroud may be supported by a plurality of radially extending webs (not shown). Preferably, the diffuser shroud will include a coaxial ring element 96 of greater diameter than the housing 10, and a transversely extending frontal closure element 98 constituting an integral extension of the ring element 96. The intermediate portion of the frontal closure element 98 is shown formed with the intake apertures 21 by means of which the fan 18 may draw air into the confines of the diffuser shroud. The rear of the diffuser shroud is open as indicated at 102. Accordingly, as stated hereinbefore, upon rotation of the fan 18 the air drawn into the diffuser shroud 20 through the openings 21 together with that drawn through the housing and discharged through opening 24 is all caused to pass through the diffuser discharge opening 102.

Referring now to Fig. 2, the preferred form of flame arrester will comprise a plurality of axially spaced coaxially aligned flat cooling rings or fins 104, which rings or fins are maintained in spaced relationship by flat washers 106 interposed therebetween. The assembly of rings and washers may conveniently be held together by the rivets 50 used for securing the backing ring 48 to the front wall 36, in the case of the outlet flame arrester 28, and by the rivets 107 used for securing the mounting ring to the rear closure member 34 in the case of the inlet flame arrester 26. The construction of both the inlet flame arrester 26 and the outlet flame arrester 28 is similar; the cooling rings of the outlet flame arrester being designated 104*a* and the washers thereof being designated 106*a*. With reference to the outlet flame arrester 28, it will be seen that the outer peripheries of the cooling rings 104*a* are seen to correspond generally to the outer periphery of the backing ring 48 while the inner periphery of these rings may correspond generally to the periphery of the bore 108 of the front wall 36. Likewise, with reference to the inlet flame arrester 26, the outer peripheries of the cooling fins 104 are shown as being substantially equal to the outer diameter of the mounting ring 35, while the inner peripheries of these fins may correspond generally to the bore 109 of the mounting ring 35.

As indicated by the directional arrows shown in Fig. 1, upon rotation the fan 18 draws air through the housing inlet opening 22 so as to cool the interior of the housing. Thus, it will be seen that the air entering the inlet opening 22 will pass through the annular gap 114 between the stator and the rotor, and through the stator cooling ducts 41, the axially extending spaces 74 defined between the spider webs 68, the bore 108 of the front wall, and will then discharge through the housing outlet opening 24 after having progressed in heat-transfer relation from one end of the housing to the other. After passing through the outlet opening 24, the air drawn through the housing, together with that drawn through the intake apertures 21 into the confines of the diffuser shroud 20, is discharged through the rear opening 102 of the diffuser shroud and flows over the exterior surface of the housing 10 in cooling relationship thereto. With this arrangement, the temperature rise within the motor may be maintained within safe limits under the most rigid operating conditions. If, during operation of the motor, sparking, as from the brushes thereof, should occur whereby an explosion of the fluid contained within the housing takes place, the flames or other products of combustion of such explosion will pass outwardly from the exterior of the housing through one or both of the openings 22 and 24. During such passage these products of combustion will be cooled by exposure to the surfaces of the flame arresters 26 and 28. By virtue of such exposure, the temperature of these products of combustion will be lowered sufficiently that an explosion of the explosive atmosphere surrounding the housing will not occur.

Conveniently, the rear end of the shaft 16 may be formed with axially extending splines 116 adapated to mesh with the teeth 118 of a power take-off gear 120. This gear is shown mounted by a hollow shaft 121 between a pair of ball bearings 122 and 124 supported by the upper portion of the rear closure member 34. The hollow shaft 121 may be formed with internal axially extending splines 126 adapted to receive a shaft to be driven by the motor. The assembly may be mounted by means of support lugs 128 formed at the upper portion of the main body 30. To this end, these lugs are shown formed with threaded sockets 130 for receiving the lower end of mounting studs (not shown).

While there has been described and shown what is at present considered to be a preferred embodiment of the invention, it will be apparent to those skilled in the art that various changes may be made without departing from the essence of the invention, and it is intended to cover herein all such modifications and changes as are within the spirit of the invention and the scope of the appended claims. In this regard it is evident that although the invention has been applied in this description to an electric motor, it is not limited to such machine and may be equally well applied to other types of dynamo-electric machines, such as generators.

I claim:

1. A dynamo-electric machine for use in an explosive fluid, comprising: a cylindrical housing, said housing being formed at one of its ends with an axially extending circumferential inlet opening and at its other end with an axially extending circumferential outlet opening; a stator core in said housing; a rotor in said housing; fan means mounted adjacent said outlet opening for drawing said fluid through the interior of said housing by means of

said openings; a diffuser shroud encompassing said fan means and arranged to direct the fluid moved by said fan means over the major portion of the exterior of said housing; and a flame arrester including a plurality of axially spaced cooling rings mounted by said housing adjacent each of said openings for reducing the temperature of the products of combustion of explosions produced within said interior.

2. A dynamo-electric machine for use in an explosive fluid, comprising: a cylindrical housing, said housing being formed at one of its ends with a circumferential outlet opening and at its opposite end with a circumferential inlet opening; a stator core rigidly mounted in said housing; a rotor rotatably mounted within said housing; fan means disposed adjacent said outlet; a cylindrical diffuser shroud coaxially mounted by said housing in encompassing relationship to said fan means, said shroud being formed with intake apertures for said fluid at its central portion whereby said fan may draw said fluid into said shroud, and said shroud having a greater diameter than said housing whereby the fluid drawn into said shroud through the interior of said housing by means of said openings and through said intake apertures will be forced through the rear of said shroud over the exterior of said housing; and a flame arrester including a plurality of axially spaced flat cooling rings mounted by said housing adjacent each of said openings for reducing the temperature of the products of combustion of explosions produced within said interior.

3. A dynamo-electric machine for use in an explosive fluid, comprising: a cylindrical housing, said housing being formed with an outlet opening at its front portion and an inlet opening at its rear portion; a stator core mounted within said housing; a rotor mounted within said housing; a cylindrical diffuser shroud coaxially mounted by the front portion of said housing, said shroud including a ring element of greater diameter than said housing and a front closure element, the rear of said shroud being open; an intake aperture formed in said front closure element; a fan concentrically mounted within said ring element and adapted to be rotated by said rotor so as to draw said fluid into said shroud through said intake aperture and through the interior of the housing in a path which includes said openings, said fluid being forced through the rear of said shroud over the exterior of said housing; and a flame arrester, including a plurality of axially spaced flat cooling rings mounted adjacent each of said openings for reducing the temperature of the products of combustion of explosions produced within said interior.

4. A dynamo-electric machine for use in an explosive fluid, comprising: a cylindrical housing, said housing being formed with a circumferential outlet opening at its front portion and a circumferential inlet opening at its rear portion; a stator core coaxially mounted in said housing; a shaft coaxially rotatably mounted by said housing; a rotor carried by said shaft; a cylindrical diffuser shroud coaxially mounted by the front portion of said housing, said shroud including a ring element of greater diameter than said housing and a front closure element, the rear of said shroud being open; an intake aperture formed in said front closure element; a fan affixed to the front end of said shaft in concentric relation to said ring element and adapted to be rotated by said rotor so as to draw said fluid into said shroud through said intake aperture and through the interior of the housing in a path which includes said openings, said fluid being forced through the rear of said shroud over the exterior of said housing; and a flame arrester, including a plurality of axially spaced annular cooling fins mounted within each of said openings for reducing the temperature of the products of combustion of explosions produced within said interior.

5. A dynamo-electric machine for use in an explosive fluid, comprising: a cylindrical housing; an inlet opening formed at the rear portion of said housing; a stator core in said housing, said stator core being formed with axially

extending cooling ducts; a rotor in said housing; a transverse front plate for said housing having a coaxial bore; a coaxial backing ring disposed forwardly of said front plate, so as to define an axially extending circumferential outlet opening therebetween; a flame arrester, including a plurality of axially spaced coaxial cooling annular cooling fins interposed between said front plate and said backing ring; a cylindrical diffuser shroud coaxially mounted by the front of said housing, said shroud including a ring element of greater diameter than said housing and encompassing said inlet opening, and a transversely extending front closure element spaced forwardly of said front plate; intake apertures formed in said front plate; a fan coaxially rotatably mounted in said shroud, said fan including a plurality of blades having their rear portions cut out to encompass said outlet opening, whereby upon rotation of said fan said fluid will be drawn into said shroud through said intake apertures and through the interior of said housing in a path which includes said openings and said cooling ducts, said fluid being forced through the rear of said shroud over the exterior of said housing; and a second flame arrester mounted adjacent said inlet opening, said flame arresters serving to reduce the temperature of the products of combustion of explosions occurring in the interior of said housing.

6. A dynamo-electric machine for use in an explosive fluid, comprising: a cylindrical housing including a rear closure member having a coaxially bored mounting ring, a coaxial end bell disposed within its front portion, and a coaxial annular front wall secured to the front of said end bell; a coaxial bore formed in said front wall; a rear bearing coaxially mounted by said rear closure member; a transverse spider element coaxially mounted within said end bell, said spider including a plurality of radially extending webs separated by axially extending spaces; a front bearing coaxially mounted by said webs; brush means mounted within said end bell; a shaft rotatably supported by said bearing, the front portion of said shaft extending through said front wall; a stator core coaxially mounted within said housing, said stator core being formed with axially extending cooling ducts; a coaxial rotor carried by said shaft; a commutator carried by said shaft in radial alignment with said brush means; a coaxial backing ring disposed forwardly of said front wall so as to define an axially extending circumferential outlet opening therebetween, said ring being of lesser diameter than said housing; a cylindrical diffuser shroud coaxially mounted by the front of said housing, said shroud including a coaxial ring element of greater diameter than said housing and encompassing said outlet opening, and a transversely extending front closure element spaced forwardly of said front plate and formed with intake apertures in its intermediate portion; a fan rigidly mounted by the front of said shaft, said fan including a hub, an annular plate constituting a radial extension of said hub and having its rear face disposed adjacent the front of said front plate, and a plurality of radially extending blades, the front portion of said blades extending forwardly from said annular plate and the rear portion of said blades extending rearwardly therefrom, and the radially inner edges of said rear blade portions terminating adjacent said outlet opening, whereby upon rotation of said rotor said fan will draw fluid into the confines of said shroud through said intake apertures and through the interior of said housing in a path which includes said inlet opening, said cooling ducts and the annular rotor gap, said axially extending spaces, and said outlet opening, said fluid being forced through the rear of said shroud over the exterior of said housing; a flame arrester, including a plurality of axially spaced annular cooling fins coaxially mounted within said outlet opening between said front wall and said backing plate, said fins being maintained in spaced relationship by a plurality of washers, and said fins having an outer diameter substantially equal to that of said backing ring and an inner

diameter substantially equal to the bore formed in said front wall; and a second flame arrester, including a plurality of axially spaced annular cooling fins coaxially mounted within said inlet opening, said fins being maintained in spaced relationship by a plurality of washers, and said fins having an outer diameter substantially equal to that of said mounting ring and an inner diameter substantially equal to the bore of said mounting ring, said flame arresters serving to reduce the temperature of the products of combustion of explosions produced within said housing.

7. A dynamo-electric machine comprising: a cylindrical housing; an inlet opening formed at the rear portion of said housing; a stator core in said housing, said stator core being formed with axially extending cooling ducts; a rotor in said housing; a transverse front plate for said housing having a coaxial bore; a coaxial backing ring disposed forwardly of said front plate, so as to define an axially extending circumferential outlet opening therebetween; a cylindrical diffuser shroud coaxially mounted by the front of said housing, said shroud including a ring element of greater diameter than said housing and encompassing said outlet opening, and a transversely extending front closure element spaced forwardly of said front plate; inlet apertures formed in said front plate; and a fan coaxially rotatably mounted in said shroud, said fan including a plurality of blades having their rear portions cut out to encompass said outlet opening, whereby upon rotation of said fan fluid will be drawn into said shroud through said intake apertures and through the interior of said housing in a path which includes said openings and said cooling ducts, said fluid being forced through the rear of said shroud over the exterior of said housing.

8. A dynamo-electric machine comprising: a cylindrical housing including a coaxially bored mounting ring formed within the rear end thereof, and a base element axially spaced from the rear of said mounting ring; a coaxial end bell within the front portion of said housing; a coaxial annular front wall secured to the front of said end bell and having a coaxial bore formed therein; a rear bearing coaxially mounted by said mounting ring; a transverse spider element coaxially mounted within said end bell, said spider including a plurality of radially extending webs separated by axially extending spaces; a front bearing coaxially mounted by said webs; brush means mounted within said end bell; a shaft rotatably supported by said bearings, the front portion of said shaft extending through said front wall; a stator core coaxially mounted within said housing, said stator core being formed with axially extending cooling ducts; a coaxial rotor carried by said shaft; a commutator carried by said shaft in radial alignment with said brush means; a coaxial backing ring disposed forwardly of said front wall so as to define an axially extending circumferential outlet opening therebetween, said ring being of lesser diameter than said housing; a cylindrical diffuser shroud coaxially mounted by the front of said housing, said shroud including a coaxial ring element of greater diameter than said housing and encompassing said outlet opening, and a transversely extending front closure element spaced forwardly of said front plate and formed with intake apertures in its intermediate portion; and a fan rigidly mounted by the front of said shaft, said fan including a hub, an annular plate constituting a radial extension of said hub and having its rear face disposed adjacent the front of said front plate, and a plurality of radially extending blades, the front portion of said blades extending forwardly from said annular plate and the rear portion of said blades extending rearwardly therefrom, and the radially inner edges of said rear blade portions terminating adjacent said outlet opening, whereby upon rotation of said rotor said fan will draw air into the confines of said shroud through said intake apertures and through the interior of said housing in a path which includes said inlet opening, said cooling ducts and the annular rotor gap, said axially extending spaces, and said outlet opening, said air being forced through the rear of said shroud over the exterior of said housing.

9. A dynamo-electric machine for use in an explosive fluid, comprising: a housing, said housing being formed at one of its ends with an inlet opening and at its opposite end with an outlet opening; a stator core in said housing; a rotor in said housing; fan means mounted adjacent said outlet for drawing said fluid through the interior of said housing by means of said openings; a diffuser shroud encompassing said fan means and arranged to reverse the direction of flow of said fluid so as to direct said flow over the major portion of the exterior surface of said housing in heat-transfer relationship, said diffuser being formed with apertures that are in direct communication with the atmosphere; and flame arresters mounted adjacent said openings for reducing the temperature of the products of combustion of explosions produced within said housing.

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