Oct. 13, 1936. W. G. SCHNEIDER 2,057,637

COOLING SYSTEM FOR DYNAMO-ELECTRIC MACHINES

Filed Nov. 20, 1933 4 Sheets-Sheet 1

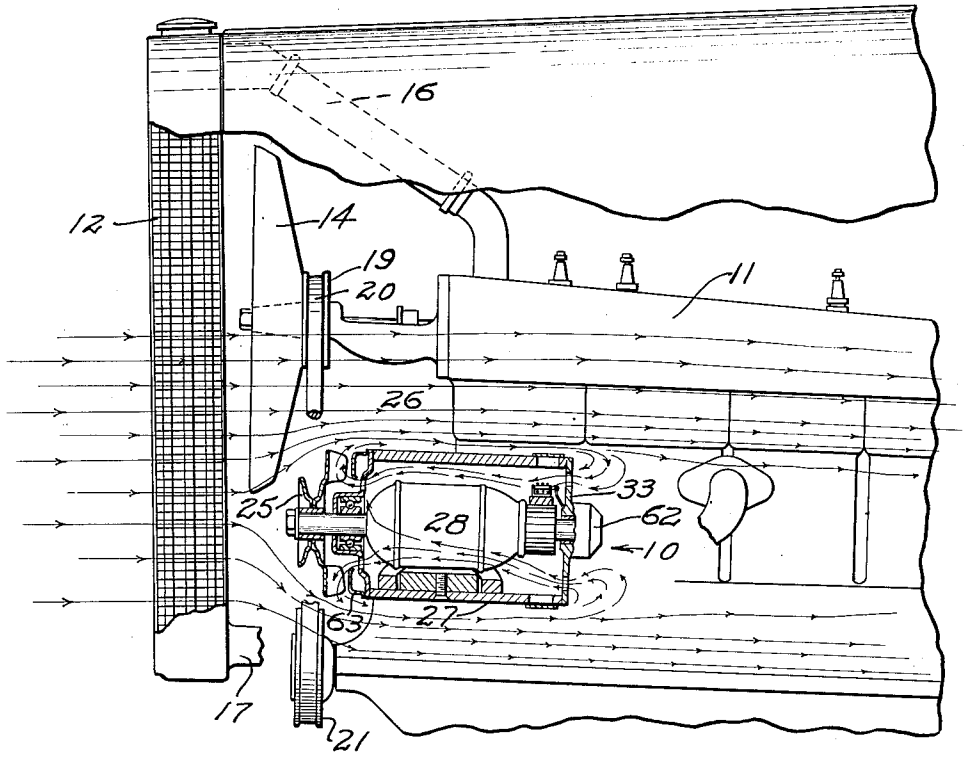


FIG. 1.

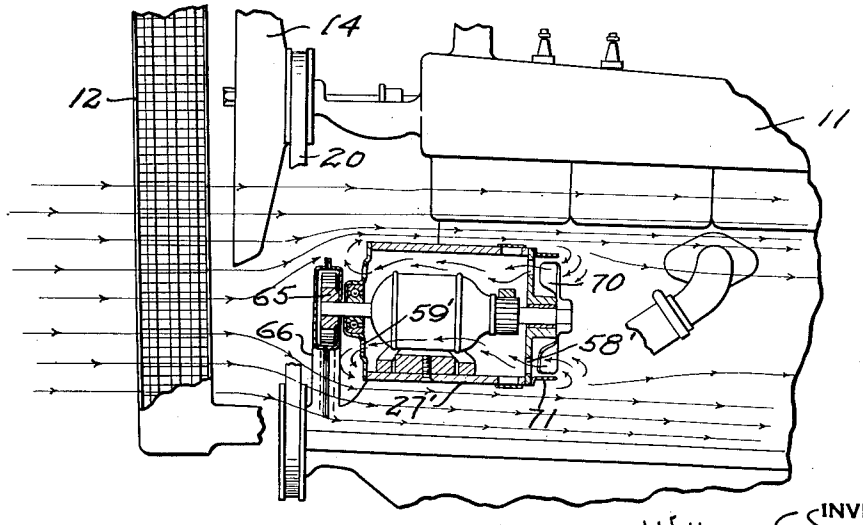


FIG. 2.

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COOLING SYSTEM FOR DYNAMO-ELECTRIC MACHINES

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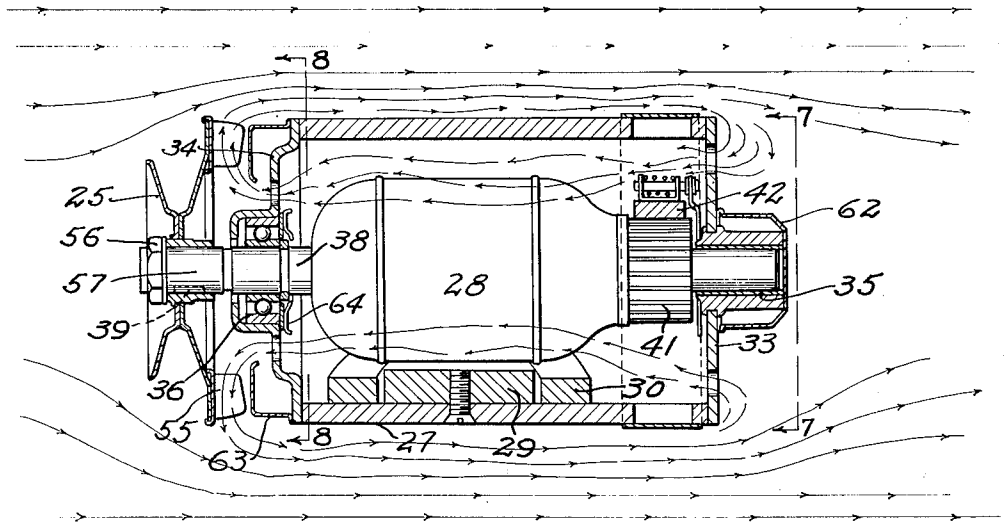


FIG. 3.

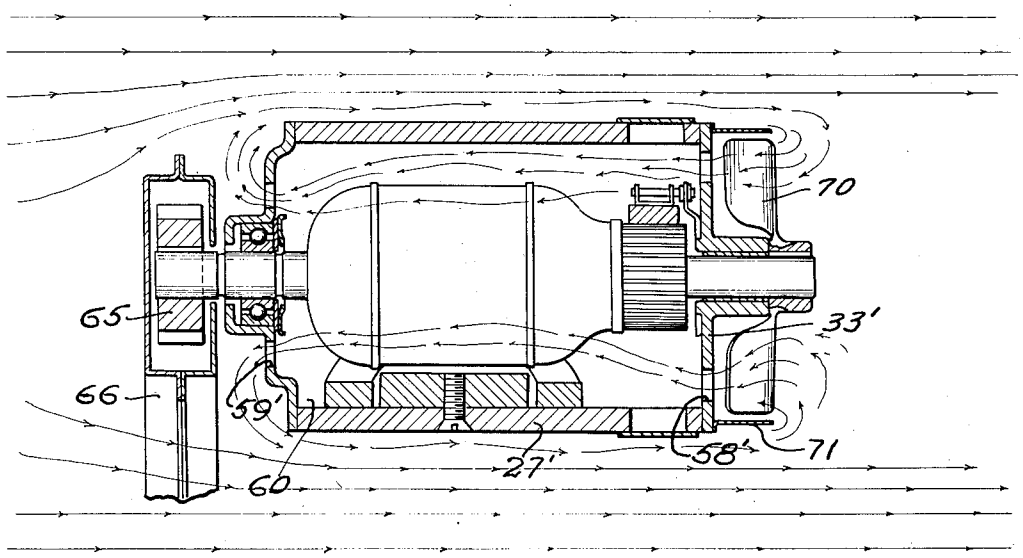


FIG. 4.

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COOLING SYSTEM FOR DYNAMO-ELECTRIC MACHINES

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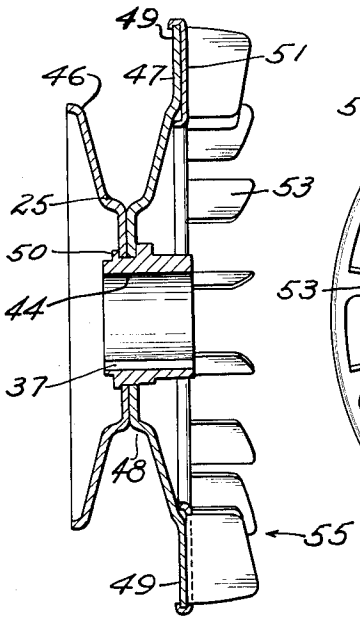


FIG. 5.

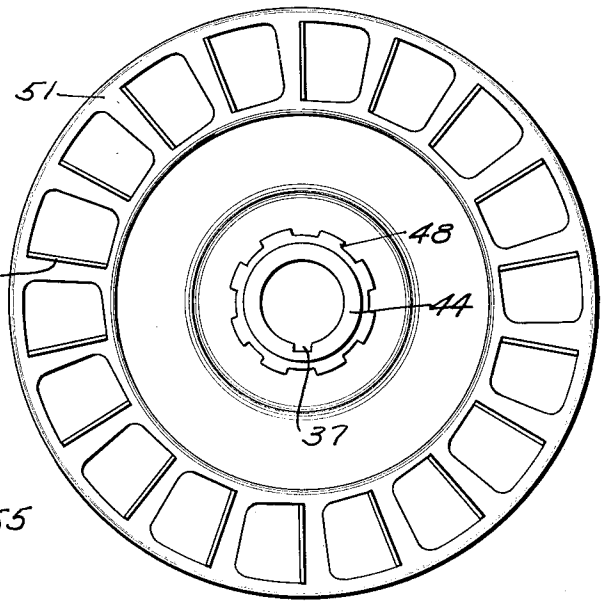


FIG. 6.

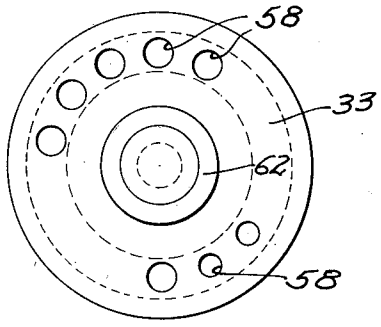


FIG. 7.

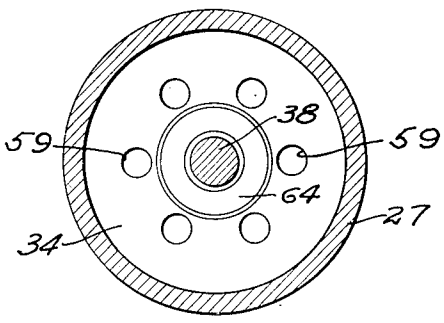


FIG. 8.

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Oct. 13, 1936. W. G. SCHNEIDER 2,057,637

COOLING SYSTEM FOR DYNAMO-ELECTRIC MACHINES

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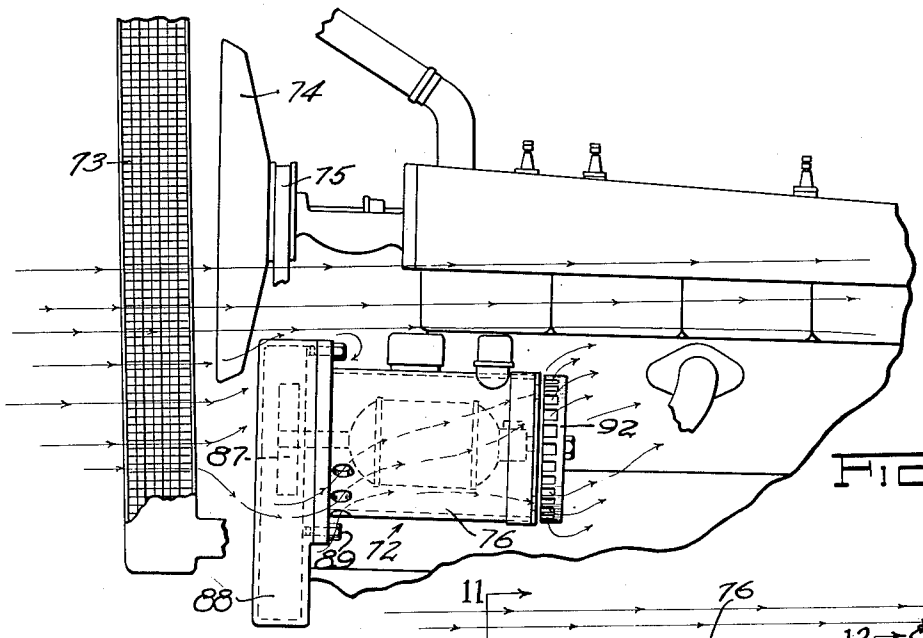


FIG. 9.

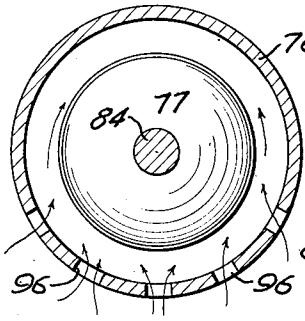


FIG. 11.

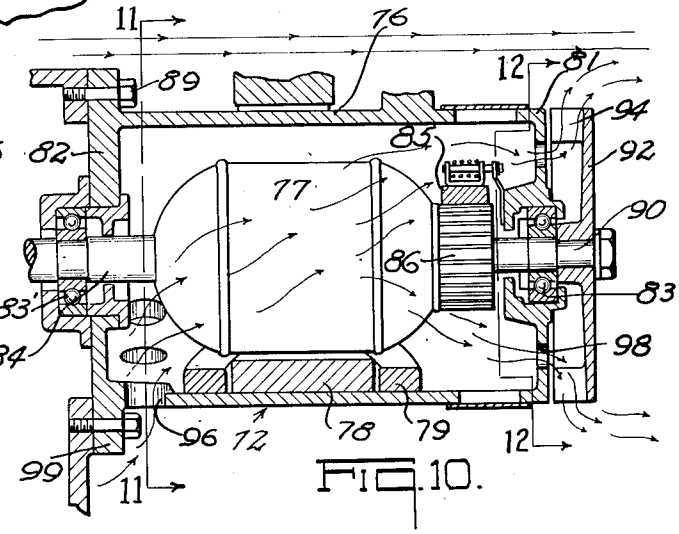


FIG. 10.

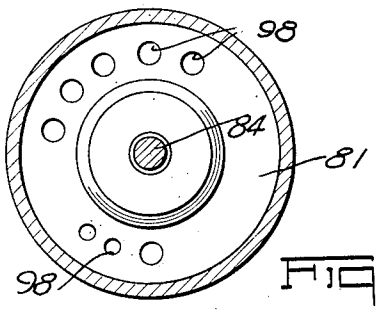


FIG. 12.

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UNITED STATES PATENT OFFICE

2,057,637

COOLING SYSTEM FOR DYNAMO-ELECTRIC MACHINES

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Application November 20, 1933, Serial No. 698,883

6 Claims. (Cl. 171—252)

This invention relates to a method and means for cooling dynamo-electric machines, and more particularly to a system and apparatus for cooling generators used in connection with internal combustion engines of automotive vehicles.

The invention contemplates the utilization of the means used for cooling other elements which is also used for circulating the medium adjacent the dynamo-electric machine.

The invention embraces the provision of means associated with the generator for modifying the flow of cooling medium past the generator and directing the circulation of said medium through the generator the arrangement preventing the ingress of dust and foreign matter into the generator housing without the use of filtering or cleaning devices.

An object of the invention is to provide the dynamo-electric machine with means for dissipating the heat generated therein by effectively circulating cooling air adjacent to and around the heat producing elements.

It is a further object of the invention to provide in a dynamo-electric machine having means for directing the air currents in such a manner as to produce a rapid dissipation of heat without the use of any additional heat radiating surfaces.

Another object of the invention is the provision of a means associated with the generator whereby this means performs the dual function of driving the generator armature and circulating the fluid through said generator.

A still further object of the invention is the provision of a cooling system of this character wherein currents adjacent the end portions of the casing are circulated through the casing in opposition to the normal flow adjacent the casing.

Further objects and advantages are within the scope of this invention such as relate to the arrangement, operation and function of the related elements of the structure, to various details of construction and to combinations of parts, elements per se, and to economies of manufacture and numerous other features as will be apparent from a consideration of the specification and drawings of a form of the invention, which may be preferred, in which:

Figure 1 is a fragmentary side elevation view of an internal combustion engine incorporating a form of the invention;

Figure 2 is a view similar to Figure 1 showing another arrangement of the invention;

Figure 3 is an enlarged sectional view of the dynamo-electric machine and the driving and cooling arrangement shown in Figure 1;

Figure 4 is an enlarged sectional view of the dynamo-electric machine and driving and cooling arrangement shown in Figure 2;

Figure 5 is a enlarged detailed sectional view of the fluid circulating means shown in Figure 3;

Figure 6 is an enlarged front view of the circulating means shown in Figure 5;

Figure 7 is a detail end view taken substantially on the line 7—7 of Figure 3;

Figure 8 is a detail sectional view taken substantially on the line 8—8 of Figure 3;

Figure 9 is a fragmentary side elevational view of an internal combustion engine incorporating another modified form of the invention;

Figure 10 is an enlarged sectional view of the dynamo-electric machine and driving and cooling arrangement shown in Figure 9;

Figure 11 is a detailed sectional view taken substantially on the line 11—11 of Figure 10;

Figure 12 is a detailed sectional view taken substantially on a line 12—12 of Figure 10.

I have illustrated a form of my invention as utilized in connection with internal combustion engines used with automotive vehicles, but it is to be understood that I contemplate its use with other types and installations, and where the same may be found to have utility.

Referring more particularly to Figure 1 of the drawings, a form of the invention has been illustrated in connection with a dynamo-electric machine 10 for use in association with the internal combustion engine 11, the engine being provided with a cooling system which is inclusive of a radiator 12 and fan 14. The radiator 12 is suitably connected to the engine 11 by means of the water intake and outlet connections 16 and 17 respectively. The fan 14 is preferably located between the engine 11 and the radiator 12, and may be driven through the medium of pulley 19, belt 20 and pulley 21 suitably connected and driven by the engine.

The dynamo-electric machine 10 used in this system as a source of power to supply electric energy to some of the instrumentalities associated with the engine such as the ignition system and storage battery is mounted adjacent to the fan 14 which is shown as located at forward portion of the engine 11. Generator 10 is driven by the engine by the use of pulley 25 secured to the generator and by means of belts 20 driven by pulley 21 connected to the engine. By the arrangement illustrated, the cooling medium upon which fan 14 acts to increase its normal velocity is directed to the generator 10 and the currents of air produced are indicated as at

26, these air currents serving to cool the generator and dissipate any heat produced, thus maintaining the generator at a proper temperature increasing its output and the dissipation of thermal units per square inch. In the form of the invention illustrated in Figure 1 the generator 10 and fan 14 are driven from the engine by means of common means consisting of pulley 21 and belt 20.

The dynamo-electric machine and driving means incorporating the cooling arrangement forming an important part of my invention are particularly shown in Figures 1 and 3, in which generator 10 of the enclosed type includes an outer longitudinal casing or field frame 27 associated with a rotating member or armature 28. The field frame 27 is made of magnetic material preferably of a tubular configuration and which serves to support a plurality of field poles 29 and cooperating energizing coils 30. The ends of the generator frame 27 are closed by means of transverse front and rear end plates 33 and 34 supporting suitable bearings 35 and 36 in which is journalled the shaft 38 which serves to rotate armature conductors and commutator 41 fixedly secured therewith. Rotation of the armature is accomplished by the use of the means of my invention used to drive the generator and direct air current through the field frame, these means are illustrated in the form of a pulley 25 and associated fan or air agitating elements which as a unit are secured to shaft 38 by means including a keyway 37 cooperating with a key 39 carried by shaft 38, this unit is held in place against longitudinal movement by means of a member or nut 56 threaded upon extension 57 of shaft 38. Pulley 25 is driven by the engine by means of a belt 20.

The means of my invention to drive the generator and direct the air currents through the field frame are preferably formed of sheet metal and consist of a hub portion 44 and sheet metal members 46 and 47 fixedly secured to hub 44 by splines 48 and swaged portion 50. Sheet metal members 46 and 47 are formed to such a configuration as to provide a groove 48 for belt 20. Sheet metal member 47 is provided with a peripheral flange or extension 49 to which is suitably secured a substantially ring-like member 51. The face of member 51 is provided with a plurality of spaced outstanding projections or blades 53 angularly displaced with respect to the main body portion of said member and arranged to form blades or elements of fan 55, producing a suction on the generator elements through the frame 27 by their rotation when actuated by the armature shaft.

In order that the air currents drawn by fan 55 are properly directed through the generator housing and in order to secure an efficient cooling or heat dissipation of the generator elements, plates 33 and 34 are provided with suitable openings. The end plate 33 as shown in Figure 7 is provided with a plurality of openings 58 for admitting a flow of the cooling medium into the generator 10. It will be noted that the openings 58 are properly spaced from the central portion of plate 33 so as to direct the incoming cool air against the commutator 41 and brushes 42 in order to effectively cool these elements. It should be noted that by this arrangement, the air flow adjacent the generator is drawn abruptly around the end plate 33 into the openings 58, and due to the sharp turn imparted to the air flow, heavier matter will not be carried into the generator. The end plate 34 is also provided with a plurality of openings 59 which are provided to permit the proper withdrawal or discharge of air from the interior of the casing 27. It will be noted that the openings 59 are spaced about the bearing 36 adjacent to armature shaft for the purpose of forcing the air into contact with the armature. Thus, upon rotation of the pulley 25 and cooling means, air circulating outside the generator is drawn through the casing 27 by means of the suction fan 55 cooling the component parts of the generator 10.

As more particularly illustrated in Figure 1, it can be seen that the air passing through the radiator 12, the velocity of which is increased by the fan 14, is circulated adjacent to the generator casing 27, as indicated by the arrows. Some of the currents passing adjacent to the generator frame or casing 27 by the use of fan 55 are drawn into the generator casing through openings 58 in the rear plate 33 and discharged through openings 59 in plate 34. It will be noted that due to the location of the openings in plates 33 and 34, the air drawn is efficiently carried through the generator casing and comes first in contact with the commutator and brushes, and other elements of the generator irrespective of some currents produced by rotation of the armature. In the arrangement as particularly illustrated in Figures 7 and 8, the openings 58 on plate 33 are preferably located near the generator field frame or casing 27, while openings 59 in the plate 34 adjacent to the fan 55 are symmetrically displaced and located near the generator shaft 38. The particular location of openings 58 with reference to the generator casing 27 and air currents produced by engine cooling fan 14 forces the air when drawn by fan elements 55 to take a very sharp turn, thereby changing its direction and due to the greater specific gravity and component of inertia of dust or other foreign matter, the same can not follow the sharp turn taken by the air currents, the air entering the generator housing being free from dust or foreign matter without the use of filtering or cleaning devices such as wire screens or knitted fabric for retaining dust particles which interfere with proper circulation of air and obstruct its ingress into the generator housing, a factor which decreases efficiency and increases manufacturing cost.

In this form of the invention I provide an arrangement, wherein few, if any, of the dust particles carried by the air enter the generator casing 27, which feature is very desirable inasmuch as the efficiency of the generator depends materially upon the amount of foreign matter and dirt which enters the casing. However, should any dirt be carried into the casing, the position of the openings 58 and 59 and in addition the air currents produced by the rotation of the armature forces the circulation of air flow so that an area adjacent to the junction of the generator and end plates with the frame produces a pocket substantially free from air currents in which any dirt would drop due to the specific gravity, and be thereby accumulated without affecting the proper function of the generator. For the purpose of eliminating any unsymmetrical projections on the component parts of the generator and in order to increase the efficiency of the suction of fan 55 in drawing or forcing air through generator casing 27 at the desired velocity the generator end plate 33 supports a cup shaped member 62 covering and enclosing the projecting support for

bearing 35 thus forming a smooth surface and also serves to prevent any suction on the lubricant of said bearing. End plate 34 is provided with an annular flange 63 adjacent to its outer contour, and bearing 36 is enclosed at one end by an annular member or deflecting washer 64.

Figures 2 and 4 illustrate a modification of the invention shown in Figures 1 and 3. In this arrangement, a generator of similar construction to the one shown in Figure 3 is used, the generator being also similarly placed with respect to the engine fan and being fixedly supported with respect thereto so that the air currents produced by the engine fan properly surround the generator housing. The generator in this form of the invention is supported by suitable means carried by the engine and is driven by means of a gear 65 coacting with a timing chain (not shown) contained within timing gear housing 66. The generator shaft is provided with an extension adjacent to the end plate 33', upon which is suitably supported fan 70 mounted to force and direct air currents through the openings 58' of the generator casing 27', the air being forced out of the generator housing by the fan 70 through the discharging openings 59'. In order to properly direct the air through the generator housing and confine the fan action to the interior of the generator housing proper, I provide a guard 71 adjacent to the periphery of the generator frame in close proximity to the extreme portion of the blades or fan 70. In this arrangement, the air, that surrounds the generator housing and whose velocity has been increased by the engine fan, is rapidly changed in its direction and forced through the generator housing 27' around the end of guard 71 by means of fan 70. The rapid change in direction of the air currents will serve to separate the dust particles from the air, due to the specific gravity of the particles and velocity component. If any of the dust particles may enter the generator, the same are separated and retained in the periphery of the generator, being confined in the area such as the one indicated by numeral 60, in Figure 4. The arrangement of the openings in the end plates of the generator is substantially similar to the one described and particularly illustrated in Figures 7 and 8 of the drawings.

Another form of the invention is shown in Figures 9 to 12, in which a dynamo-electric machine 72 is used in connection with an internal combustion engine, the engine being provided with a cooling system which includes a radiator 73 and a fan 74, the radiator being connected to the engine by means of suitable water intake and outlet conduits. Fan 74 is rotated through the medium of a belt 75 properly connected with a pulley (not shown) driven by the engine. Fan 74 serves to draw air through radiator 73 increasing the air velocity and directing air currents to certain portions of the engine and also towards the generator 73 in order to cool these units and particularly dissipate any heat produced by the generator which, in this case, serves to supply electrical energy for the battery and other instrumentalities used with the engine.

The dynamo-electric machine, particularly shown in Figures 9 and 10, is inclusive of an outer casing or field frame 76 within which is located a rotating member or armature 77. The field frame 76 is made of magnetic material and preferably of a symmetrical tubular configuration which serves to support the field poles 78 and energizing coils 79 and also carries some instrumentalities to effectively regulate its output or voltage. The ends of the housing or frame 76 are enclosed by means of end plates 81 and 82 upon which ball bearings 83 and 83' are retained, serving as journals for shaft 84 of armature 77. Suitably supported on plate 81 is a brush holder carrying brush 85 coacting with the commutator 86 of armature 77. The generator armature 77 in this embodiment is driven from the engine by means of a gear 87 fixedly secured to a portion of shaft 84, projecting exteriorally of end plate 82, said gear 87 coacting with a timing chain contained within timing gear housing 88. The generator in this case is supported as a unit by suitable means such as a plurality of screws 89 passing through the end plate 82 and coacting with threaded portion adjacent to an opening provided in gear housing 88 to permit removal of the generator and gear as a unit.

In this modified form of invention, the means to aid in circulating and directing air currents to the component parts of the generator are preferably secured to extension 90 of armature shaft 84 projecting through end plate 81 adjacent to bearing 83. On shaft extension 90 is suitably supported a fan element 92 having a plurality of blades 94 serving upon rotation to draw air through suitable openings 96 formed on generator frame 76 and openings 98 provided in end plate 81. In order to efficiently draw air and direct the same to the component parts of the generator such as the armature and brush, and prevent the ingress of any dust particles which may be carried by the air currents or cooling medium circulated by fan 74, the openings 96 in the frame of generatoor frame 76 are located in close proximity to end plate 82 and are preferably located below the central portion of the tubular frame, as particularly indicated in Figure 11. The openings 98 are provided in the end plate 81 to permit the withdrawing of the air without restrictions by the operation of fan 92 after the air has been drawn into the generator frame 76, the openings being preferably located adjacent to generator brushes and commutator in order to efficiently cool the same. It should be noted, as shown in Figure 12, that the major part of the openings 98 are located above the central portion of the armature in order that a large amount of the air is withdrawn at this portion.

The particular location of openings 96 in the generator housing 76 with respect to the end plate 82 and the air currents produced by the fan 74 is such that it is necessary for the air currents when drawn by the fan 92 to abruptly change direction before entering the generator housing 76. This abrupt change in the present case is accomplished by the presence of peripheral flange 99 forming part of end plate 82. This arrangement and principally by the sharp turn or abrupt change in direction of the air currents adjacent to the generator while entering the housing 76, serves to eliminate the ingress within the generator of any dust or foreign matter as the same can not follow, due to their great specific gravity and component of velocity, the sharp turn taken by the air currents. It can be seen that by this arrangement, the air drawn through the generator housing is free from any dust or foreign matter and that this is accomplished without the use of any filtering or cleaning devices which materially increase the cost of the generator and which in all cases increase

the energy used by any air withdrawing or circulating means and decrease its efficiency. It should be noted that in the cooling system of my invention as herein disclosed, the air is drawn or forced into the frame of the dynamo-electric machine by abruptly changing its direction before entering into the frame in order to efficiently clean the same and that in some form of the invention, the direction and circulation of the cooling medium through the generator housing is in opposition to the flow of the direction of the cooling medium adjacent to some of the external parts of the generator. This arrangement serves to efficiently dissipate the heat generator by any elements of the generator and thereby increase materially its efficiency.

It is apparent that, within the scope of the invention, modifications and different arrangements may be made other than is herein disclosed, and the present disclosure is illustrative merely, the invention comprehending all variations thereof.

What I claim is:

1. A generator cooling system including a source of power; a fan driven by said source of power to circulate fluid adjacent thereto; a generator located in the fluid circulated by said fan; the armature of said generator driven by said source of power; a second fan located exteriorly of said generator housing and fixed to the generator armature; a plurality of openings in said generator housing co-acting with said second fan for abruptly changing a portion of the air flow adjacent to the generator housing and directing it through the interior of the generator housing.

2. The method of cooling a dynamo-electric machine of the enclosed housing type of an automobile which consists in creating a flow of cooling fluid along the exterior of the dynamo-electric machine housing; of forcing a part of said fluid flow into the dynamo-electric machine housing; of abruptly reversing the flow of fluid and circulating said fluid within the housing in a direction opposite to the flow of fluid exterior of the housing; and of withdrawing the cooling fluid from the housing.

3. A cooling system for dynamo-electric machines of the closed housing type including means to produce an air flow adjacent the exterior of the dynamo housing and parallel to the axis thereof; means external of said housing and adjacent to an end wall thereof to circulate air within the housing; unobstructed openings in the end walls of said housing adapted to receive and discharge air whereby a portion of the air flowing adjacent the exterior of said casing is abruptly reversed in direction to flow through said dynamo housing.

4. A generator cooling system, including a source of power; a fan driven by said source of power to circulate air adjacent thereto; an enclosed generator including a longitudinal frame and transverse front and rear end plates connected to said frame, said end plates adapted to carry a generator armature and an armature shaft driven by said source of power, said generator located in the air flow produced by said fan; a second fan located on the armature shaft and adapted to be driven thereby, said end plates each having an opening therein adapted to co-act with said last mentioned fan, and arranged to abruptly change a portion of the air flow adjacent to the generator housing and direct it through the interior of the generator.

5. A generator cooling system, including a source of power; a fan driven by said source of power to circulate air adjacent thereto; an enclosed generator having a housing with front and rear end plates, said generator having an armature and shaft, said enclosed generator located in the air flow produced by said fan; said armature driven by said source of power; a second fan located on said armature shaft and adapted to be driven thereby; said end plates each having a plurality of openings, the openings in one end plate being near the periphery thereof and the openings in the other end plate being located near the center thereof, said openings co-acting with said last mentioned fan for abruptly changing a portion of the air flow adjacent to the generator housing and directing it through the interior of the generator housing.

6. A cooling system for dynamo-electric machines, said machines including a housing having a longitudinal frame; transverse front and rear end plates connected to said frame; means to produce an air flow adjacent the exterior of said dynamo housing and parallel to the axis of said dynamo frame; a fan having a plurality of blades located external of said housing and adjacent to one of said end plates adapted to circulate air within the housing; openings in said end plates of the housing, the openings in the end plate adjacent to said fan having portions offset in a radial direction with respect to said fan blades, said openings in said end plates being adapted to receive and discharge air whereby a portion of the air flow adjacent the exterior of the housing is abruptly reversed in direction to flow through said dynamo housing.

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