May 24, 1966 R. COUCHMAN, JR., ETAL 3,252,449

SCREEN UNIT FOR AIR COOLED INTERNAL COMBUSTION ENGINES

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Fig. 1.

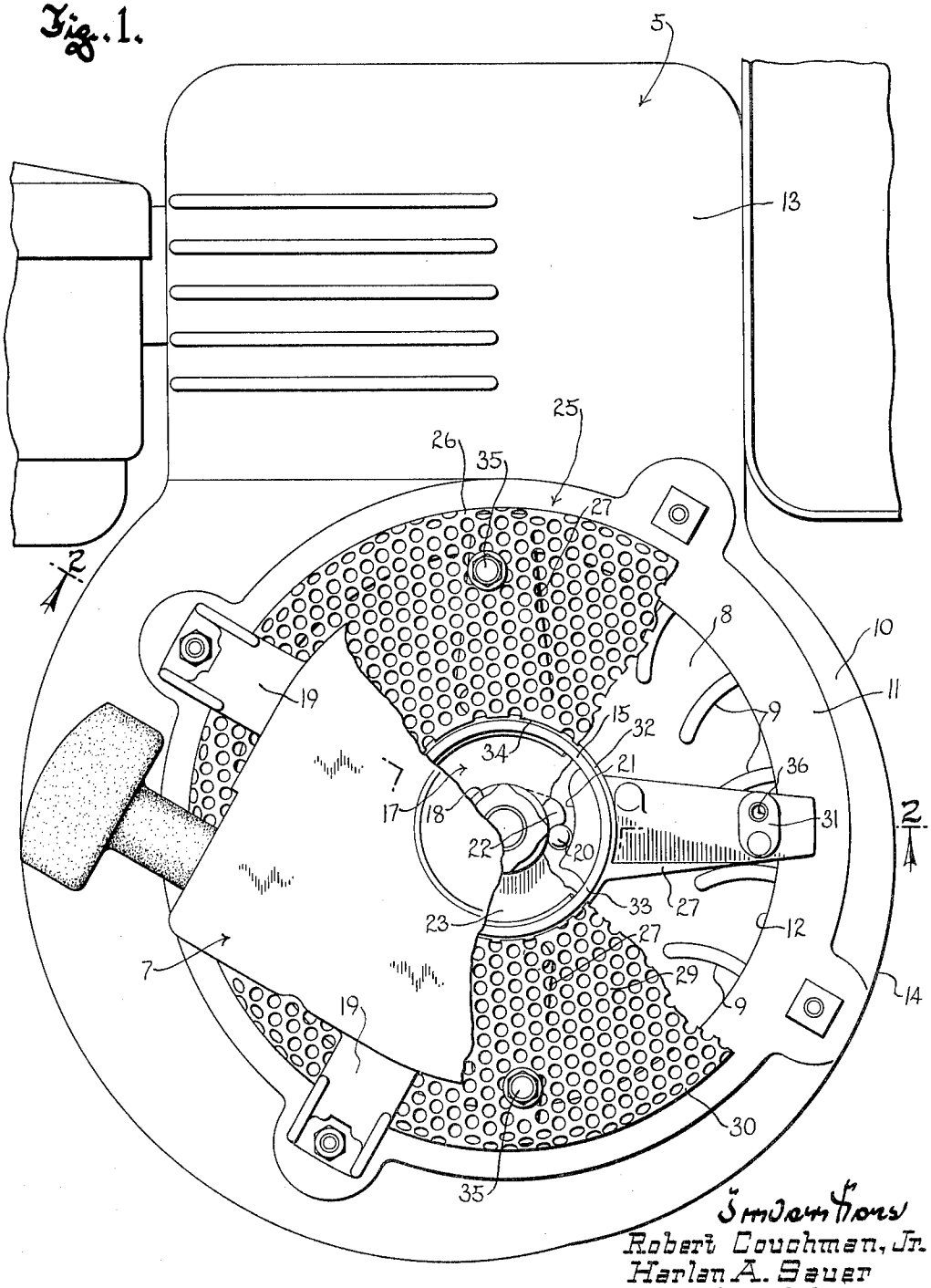

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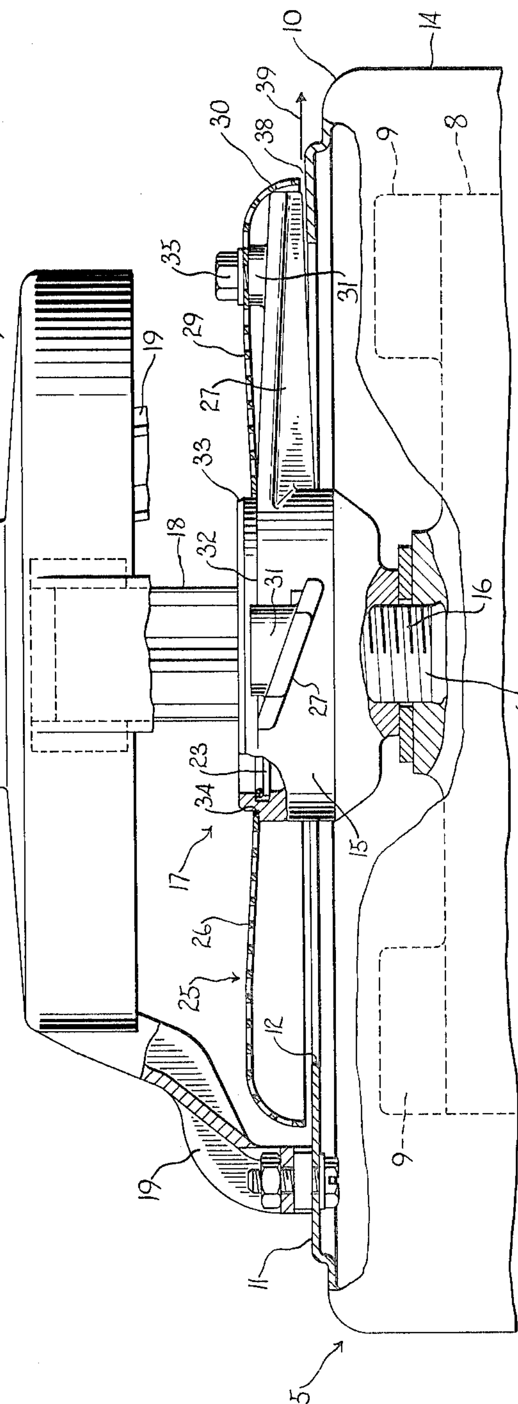
Fig. 2.



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SCREEN UNIT FOR AIR COOLED INTERNAL COMBUSTION ENGINES

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This invention relates to internal combustion engines, and has more particular reference to improvements in single cylinder engines of the air cooled type.

A typical air cooled engine of this character has a crankshaft, one end portion of which projects from the engine to have a flywheel mounted thereon. This end portion of the crankshaft ordinarily projects outwardly beyond the flywheel and also has a member secured thereto that provides for the application of engine starting torque to the crankshaft. This member can comprise a drum around which a starter rope is wound, or now more commonly, the driven element of a unidirectional or overrunning clutch that has a driving element connected to starter mechanism of one form or another.

The flywheel is enclosed within a shroud or blower housing on the engine. It rotates in the space between the engine and an outer wall of the shroud in which is formed a large central air entrance opening, concentric to the axis of the crankshaft. Air to cool the engine is drawn into the air entrance opening by blades on the flywheel as the latter rotates, and the shroud directs such air over those parts of the engine which become hot during operation of the engine. The hot parts of the engine, of course, are its cylinder and head, and fins are customarily formed thereon to more readily transfer heat to the stream of cooling air flowing thereover.

As is well known, the finned surfaces of such air cooled internal combustion engines tend to become fouled with foreign matter or debris entrained in the air stream drawn into the engine by the flywheel impeller, thus interfering with proper cooling of the engine. This is especially true in small single cylinder air cooled engines such as are used to power lawn mowers and rotary tillers. For example, grass clippings strewn about by the rotating blades of a lawn mower, or light weight mulch materials driven upwardly from the ground being acted upon by the tines of a rotary tiller, can be drawn into the air stream entering the shroud or blower housing and become lodged in the spaces between the cooling fins on the engine cylinder and head. When this occurs the air flow through the spaces between the fins is impeded, and overheating of the engine results.

Heretofore, the most effective approach to the solution of this problem involved fitting of a screen over the air entrance opening in the shroud, to intercept grass clippings and other foreign matter entrained in the air stream. Such screens were either stationarily mounted on the shroud itself, or on a part of the engine crankshaft to rotate therewith. In either case, the screen had to have an annular configuration so as to allow the engine crankshaft or a starter part thereon to project through the open center of the screen. Obviously, when the screen was fixed to the shroud, it was necessary to provide a clearance space between the edge of its central opening and the part on the crankshaft that passed through said opening. Similarly, if the screen was constrained to rotate with the crankshaft, a clearance space had to be provided between the peripheral portion of the screen and the outer wall of the shroud beneath the screen. Hence, grass clippings and other foreign matter could still gain entrance to the interior of the shroud through the necessary clearance spaces between the screen and either the shroud or the rotating part of the engine crankshaft encircled by the screen, to eventually foul the cooling fins on the engine cylinder and head.

With this problem in mind, it is the purpose of this invention to provide an air cooled internal combustion engine of the character described with an improved screen unit that assures against the entry of grass clippings and other foreign matter into the shroud in which the engine flywheel is housed.

Accordingly, it is one of the objects of the invention to provide the engine with a crankshaft driven annular screen which tightly engages around that part of the engine crankshaft which projects through its central opening, and wherein impeller means fixed with respect to the screen to rotate therewith, forcefully expels part of the air passing through the screen substantially radially outwardly over the outer wall of the shroud and through a clearance space between it and the peripheral portion of the screen, to prevent grass clippings and other debris from gaining access to the interior of the shroud.

More specifically, it is a purpose of this invention to provide a crankshaft driven screen unit of the character described, wherein the impeller means on the screen comprises fan blades that operate in a space between the screen and the outer wall of the shroud and are pitched to assist the flywheel impeller on the engine crankshaft in drawing cooling air into the shroud.

Another purpose of this invention is to provide a crankshaft driven screen unit of the character described, in which the fan blades are fixed to and radiate from the exterior of a driven unidirectional clutch part on the engine crankshaft, and wherein the screen is secured to the fan blades so that it, the blades, and the driven clutch part in effect constitute a unitary assembly.

With the above and other objects in view which will appear as the description proceeds, this invention resides in the novel construction, combination and arrangement of parts substantially as hereinafter described and more particularly defined by the appended claims, it being understood that such changes in the precise embodiment of the hereindisclosed invention may be made as come within the scope of the claims.

The accompanying drawings illustrate one complete example of the physical embodiment of the invention constructed according to the best mode so far devised for the practical application of the principles thereof, and in which:

FIGURE 1 is an elevational view of a small air cooled internal combustion engine embodying the crankshaft driven rotary screen unit of this invention, portions being broken away to better illustrate details of construction; and

FIGURE 2 is a view partly in elevation and partly in section, taken along the line 2—2 in FIGURE 1.

Referring now particularly to the accompanying drawings, wherein like reference characters indicate like parts in the views, the numeral 5 generally designates a small air cooled internal combustion engine of the type extensively used as the power source on lawn mowers, rotary tillers, and the like. The engine shown by way of example is of the horizontal type, so designated because it is adapted for mounting with its crankshaft disposed on a horizontal axis. One end portion 6 of the crankshaft projects laterally from the adjacent side of the engine to enable starting torque to be applied thereto, as by means of a starter mechanism 7.

A flywheel 8 is secured to the end portion 6 of the crankshaft to rotate therewith, and it has curved air impeller blades 9 on its outer face, near its periphery. As is customary, the flywheel is enclosed within a shroud or blower housing 10 secured to the engine in any suitable

manner. The shroud has an outer wall **11** which overlies the flywheel and has a substantially large air entrance opening **12** therein centered over the flywheel. The outer wall of the shroud is extended upwardly as at **13** to cover the engine cylinder and head, not shown. Side walls **14** on the shroud, which are directed rearwardly around the periphery of the flywheel and over the sides and top of the engine, direct cooling air drawn into the opening **12** in the shroud by the flywheel impeller blades, upwardly and then rearwardly across finned surfaces, not shown, on the engine cylinder and head.

The air entrance opening **12**, which is concentric with the axis of the engine crankshaft, easily accommodates a part **15** that is secured to the projecting end portion **6** of the crankshaft to rotate therewith. The part **15** may be mounted on the crankshaft as by screw threads **16**, and provides for the application of engine starting torque to the crankshaft. In the present case, the part **15** is a cup-like hub member that comprises the driven element of a unidirectional or overrunning clutch generally designated **17**. The hub of the driven element faces the flywheel and is screw-threaded onto the outer end of the crankshaft, and its open side faces axially outwardly to receive the driving element **18** of the clutch.

Rotation is imparted to the driver **18** by means of the starter mechanism **7**, which can be of any suitable type and which is here shown as manually actuatable and mounted upon the outer wall **11** of the shroud by a number of legs **19**, which hold the starter mechanism spaced a distance outwardly of but centered over the air entrance opening **12** in the shroud.

The unidirectional clutch may be of the type shown and described in the copending application of Ib H. Svendsen, Serial No. 341,828, filed January 22, 1964. Engagement of the clutch entails some rotation of the driving element **18** relative to the cup-like driven element **15**, in the clockwise direction as viewed in FIGURE 1, before one of a number of balls **20** in the cup-like driven element becomes drivingly wedged between a cam surface **21** on the side wall of the latter and a lobe **22** on the driving element. A cover disc **23** closes the open outer side of the cup-like driven element, and is centrally apertured to snugly but rotatably receive the driving element **18**.

The screen unit **25** of this invention is fixed with respect to the engine crankshaft to rotate therewith, and covers the air entrance opening **12** in the outer wall of the shroud, to prevent grass clippings and other debris entrained in the air stream flowing toward the air entrance opening from entering the shroud. It comprises an annular screen member **26** having a diameter larger than that of the air entrance opening **12**, and a plurality of fan blades **27** which radiate from the side wall of the cup-like driven element **15** of the clutch and are fixed thereto. In the present case, the cup-like driven element **15** of the clutch is a die-casting having four angular equispaced fan blades **27** cast integrally therewith.

The fan blades extend radially from the side wall of the driven element **15**, and are of such length that their outer end portions overlie the outer wall **11** of the shroud adjacent to the edge of the air entrance opening **12** therein, as seen best in FIGURE 2. The fan blades are pitched to blow air inwardly toward the flywheel and the adjacent side of the engine during rotation of the crankshaft **6** in the clockwise direction, as viewed in FIGURE 1, and in this respect the fan blades cooperate with the flywheel impeller in inducing a flow of cooling air into the shroud.

The annular screen member **26** covers the fan blades **27**, and has a nearly flat body portion **29** and a rim portion **30** which is curved toward the outer wall **11** of the shroud and embraces the outer ends of the fan blades. Hence, the screen member has a shallow inverted cup-like shape and receives the fan blades **27** in its interior.

Near their outer ends, the fan blades have pads **31** formed thereon which project toward the screen and define screen supports having surfaces that lie in a common plane normal to the crankshaft axis and spaced outwardly a short distance from the plane of a shoulder **32** on the side wall of the cup-like driven element **15** of the clutch **17**. The shoulder **32** is located at the base of a reduced neck **33** on the side wall of the driven element, and serves as a seat upon which the inner edge portion of the annular screen member rests. The reduced neck **33** projects axially through the central hole **34** in the screen member, and the shoulder **32** thus serves to close the central hole in the screen member to prevent grass slippings and other air borne debris from passing therethrough to the interior of the shroud.

Cap screws **35** passing through the screen member and threading into tapped holes **36** in the pads **31** on the fan blades fasten the screen to the blades and hence to the driven element **15** of the clutch. These screws also serve to draw the screen member axially toward the shroud to seat the outer body portion of the screen on the pads **31** and to hold its inner edge portion tightly against the shoulder **32** on the driven element **15** of the clutch. For this latter purpose, the body portion of the screen member can be tapered inwardly, toward the edge of its central hole, as shown best in FIGURE 2, so that the inherent resilience of the sheet metal from which the screen member is formed can be utilized to maintain intimate engagement between the inner edge portions of the screen member and the shoulder **31** when the cap screws **35** are tightened.

The rim or curved peripheral portion **30** of the screen member, of course, must clear the outer wall **11** of the shroud so that the latter does not interfere with rotation of the screen unit. Ordinarily, the clearance space **38** between the outer wall **11** of the shroud and the rim of the screen member would constitute an annular passage through which grass clippings and other debris could be sucked into the shroud during operation of the engine. According to this invention, however, the fan blades **27** on the screen unit positively prevent grass clippings or other debris from entering the shroud through the clearance space **38**. This results from the fact that the outer end portions of the fan blades create a zone of positive pressure where they sweep over the outer wall **11** of the shroud outwardly of the edge of the air entrance opening **12** therein. This positive pressure causes air being acted upon by the fan blades to blow outwardly through the annular clearance space **38**, in all radial directions as indicated by the arrow **39**, to thus divert grass clippings and other debris away from the passage provided by the space **38**.

While the screen unit **25** of this invention has been shown installed on a horizontal shaft engine, it is equally well suited for use on vertical shaft engines such as are commonly used to power rotary lawn mowers. Such vertical shaft engines usually have starter mechanisms **7** mounted on the shroud at the top of the engine, over the air entrance opening in the shroud, and the screen unit can be incorporated in such engines more or less in the fashion seen in FIGURE 2.

From the foregoing description, together with the accompanying drawings, it will be readily apparent to those skilled in the art that the rotating screen unit of this invention for the first time assures against the entry of grass clippings and other air borne debris into the shroud of a small air cooled internal combustion engine of the type used on lawn mowers, rotary tillers and the like.

What is claimed as our invention is:

1. An air cooled internal combustion engine of the type wherein the driven element of a unidirectional overrunning clutch is secured to one end of the engine crankshaft to provide for the transmission of starting torque thereto and projects through a substantially large air entrance opening in one wall of a shroud having other walls arranged to direct air entering the shroud over

those parts of the engine which become hot when the engine is in operation, characterized by:

(A) fan blades on said driven element of the clutch, pitched to force air into the air entrance opening in the shroud during operation of the engine and having outer end portions which sweep closely over the exterior of said one wall of the shroud outwardly of the edge of the air entrance opening therein;

(B) and an annular screen fixed with respect to the blades at the side thereof remote from the engine, said screen closely encircling the driven element of the clutch and extending around the ends of the blades.

2. In combination with an air cooled internal combustion engine having a crankshaft:

(A) an air impeller comprising

(1) hub means fixed on the crankshaft, and

(2) blades fixed on and radiating from the exterior of the hub means, said blades being pitched to blow air toward the engine during operation thereof;

(B) a shroud on the engine having

(1) a wall substantially normal to the crankshaft axis and interposed between the engine and the path along which the impeller blades travel,

(2) said wall of the shroud having a substantially large opening therein concentric with the crankshaft but smaller in diameter than the orbit defined by the end portions of the impeller blades, said opening defining an entrance through which cooling air is forced into the shroud by the impeller;

(C) a substantially annular screen covering the impeller blades at the side thereof remote from the shroud, said screen

(1) closely fitting the hub and

(2) extending around the ends of the blades;

(D) and means securing the screen to the impeller so that the screen rotates with the engine crankshaft.

3. In combination with an air cooled internal combustion engine having a crankshaft:

(A) a flywheel impeller fixed on the crankshaft to rotate therewith;

(B) a shroud on the engine defining a blower housing in which the flywheel impeller operates,

(1) said shroud having a wall overlying the flywheel impeller and substantially normal to its axis of rotation, and

(2) said wall having a substantially large hole therein concentric to the crankshaft axis, providing an entrance through which air is drawn into the shroud by the flywheel impeller;

(C) a unidirectional clutch through which starting torque can be applied to the engine crankshaft, said clutch comprising

(1) a driven member fixed on the engine crankshaft outwardly of the flywheel impeller, and

(2) a driving element cooperable with the driven element and projecting outwardly thereof in substantially coaxial relation to the engine crankshaft;

(D) starter mechanism operatively connected with the driving element of the clutch;

(E) means mounting the starter mechanism on the shroud in outwardly spaced relation to said wall thereof so that the starter mechanism does not interfere with flow of air into said entrance opening in the shroud;

(F) impeller blades on the driven element of the clutch, extending substantially radially outwardly therefrom over said entrance opening in the shroud and having outer end portions arranged to sweep closely over exterior surfaces of said wall of the shroud adjacent to the edge of the entrance opening therein, said blades being pitched to cooperate with the flywheel impeller in inducing a flow of cooling air into the shroud through the entrance opening therein; and

(G) a shallow dish-shaped annular screen fixed to said blades to rotate therewith, said screen closely encircling the driven element of the clutch and covering the impeller blades, and having a curved rim portion which extends around the ends of said blades.

4. In combination with an internal combustion engine having a crankshaft, one end of which projects from the engine:

(A) a flywheel fixed to said end of the crankshaft;

(B) a member fixed to said end of the crank shaft axially outwardly of the flywheel, to provide for the application of starting torque to the crankshaft;

(C) impeller blades fixed to said member and extending substantially radially outwardly therefrom, and pitched to blow cooling air toward the engine during operation thereof;

(D) a shroud on the engine to guide cooling air blowing toward the engine over those parts thereof which become hot during its operation, said shroud having a wall which is interposed between the flywheel and the impeller blades, and close to the latter, said wall having a hole therein concentric with the crankshaft axis but smaller in diameter than the orbit of the impeller blades so that outer end portions of the latter sweep closely across portions of said wall outwardly of the edge of the hole therein;

(E) and an annular screen fixed to and covering the blades at the side thereof remote from said wall of the shroud, said screen closely encircling said member and the ends of the blades.

5. An article of manufacture, comprising:

(A) a cup-shaped clutch member adapted to provide the driven element of a unidirectional clutch;

(B) a hub on the clutch member providing for securement of the same to the crankshaft of an internal combustion engine;

(C) fan blades radiating from the exterior of the clutch member and fixed thereto;

(D) and an annular screen secured to the fan blades at the side thereof remote from said hub, said screen snugly encircling the clutch member and having a curved rim portion that extends around the ends of the fan blades.

6. The article of claim **5**, further characterized by:

(A) cooperating ledge means on the clutch member and on outer portions of the blades to hold the screen spaced from said side of the blades;

(B) and means securing the screen to the ledge means on the blades.

7. An air cooled internal combustion engine of the type wherein starter mechanism on the engine provides for the transmission of starting torque to the crankshaft of the engine through the driving element of an overrunning unidirectional clutch which has its driven element fixed to the crankshaft of the engine, characterized by:

(A) fan blades secured to the driven element of the clutch to rotate therewith and pitched to blow cooling air toward the engine when the engine is running;

(B) a shroud on the engine to direct said cooling air over those parts of the engine which become hot during operation thereof,

said shroud having a wall which is interposed between the engine and the fan blades, and which has an air inlet opening therein smaller in diameter than the orbit of the outer ends of the fan blades, through which air is blown by the blades, the outer end portions of the blades being disposed to sweep closely over said wall of the shroud outwardly of the air inlet opening therein; and

(C) a screen fixed with respect to the fan blades and covering the same at the side thereof remote from said wall of the shroud.

8. An air cooled internal combustion engine having a flywheel on its crankshaft, the flywheel having air impelling vanes thereon to induce a flow of engine cooling air, and an air directing shroud encompassing the flywheel and having a wall generally perpendicular to the crankshaft, said wall having an air inlet opening generally concentric with the crankshaft, characterized by:

(A) a hub member fixed with respect to the engine crankshaft axially outward of the flywheel;

(B) a plurality of fan blades radiating from said hub member to travel in a plane generally parallel to and adjacent to the plane of the wall of the shroud in which the air inlet opening is located,

said fan blades being pitched to blow cooling air through the air inlet opening in the shroud and to the air impelling vanes on the flywheel;

(C) a perforated screen covering the axially outer face of the blades and having an outer marginal portion extending beyond the extremities of the blades,

so that solid particles entrained in the flow of air induced by the fan blades will be kept from entering the engine; and

(D) means securing said screen to the fan blades.

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