ABSTRACT

The drawings illustrate an engine cooling fan which decreases in overall diameter in response to increased engine speed as a result of a centrifugal weight-actuated camming arrangement.

8 Claims, 7 Drawing Figures
ENGINE COOLING FAN

The invention relates generally to engine cooling fans and, more particularly, to variable diameter fans.

While engine cooling is generally accomplished by either a viscous fluid clutch-driven or a flexible blade fan, it is desirable to combine the good qualities of each in a variable diameter fan arrangement, i.e., substantially reducing high speed fan tip noise while increasing the cooling characteristics at low engine speed when ambient temperature is generally high.

Accordingly, an object of the invention is to provide an improved engine cooling fan having variable length blades which automatically decrease in diameter in response to increased engine speed.

Another object of the invention is to provide an improved variable diameter fan including a centrifugal force-actuated camming arrangement for automatically varying the overall diameter thereof.

A further object of the invention is to provide a variable diameter fan including four spaced discs, two being interconnected and having radial grooves formed therein, and the other two being interconnected and having spiral grooves formed therein, with a pair of spring-loaded centrifugal weights mounted on a pair of pins extending through adjacent radial and spiral grooves of the respective adjacent discs.

The present invention is directed to a camming arrangement for causing the blades of a variable diameter fan to change position in stages, such that the diameter of the fan decreases as the engine speed increases.

The invention includes a cam mechanism having a cam member with a cam profile and a cam follower. The cam member is rotatably supported and the cam follower is mounted on the cam member. The cam follower is biased to move in a direction away from the cam member, and the cam profile is configured such that as the engine speed increases, the cam follower is moved toward the cam member, causing the blades of the fan to decrease in diameter.

OPERATION

The cam mechanism is operable to move the cam follower in response to changes in engine speed, such that the diameter of the fan decreases as the engine speed increases. This provides improved cooling efficiency and reduced noise at high engine speeds.

Additionally, the invention includes a cam member with a cam profile configured to engage with the cam follower over a range of engine speeds, allowing for smooth and gradual changes in blade diameter. The cam member is rotatably supported, and the cam follower is biased to move away from the cam member, allowing for a wide range of engine speeds.

The present invention provides a novel camming arrangement for causing the blades of a variable diameter fan to change position in stages, such that the diameter of the fan decreases as the engine speed increases. This allows for improved cooling efficiency and reduced noise at high engine speeds.
an engine cooling fan to retract to a smaller overall diameter in response to increased centrifugal force and to increase in overall diameter upon a reduction in engine speed.

While but one embodiment of the invention has been shown and described, it should be apparent that other arrangements would be possible within the scope of the invention, such as the interchange and/or realignment of the discs, and different interconnecting means for the respective radially slotted and spirally slotted discs. Furthermore, the disc 20 could consist of a hub having fixed radial blade portions formed thereon adaptable for the slidable mounting thereon of the respective curved blades 38.

We claim:
1. An engine cooling fan comprising a shaft, a first pair of discs at least one of which is secured to said shaft, a second pair of discs rotatably mounted on said shaft, a plurality of fan blades slidably mounted on one of said discs, centrifugal weight means slidably mounted on another of said discs, and camming means formed on said discs and operatively connected to said camming means and to said fan blades to move the opposite radial direction to that of said fan blades under the action of centrifugal force.
2. An engine cooling fan comprising a shaft, a first pair of discs secured to said shaft, a second pair of discs rotatably mounted on said shaft, a plurality of fan blades slidably mounted on one of said discs, centrifugal weight means slidably mounted on another of said discs, camming means formed on said discs, and means operatively connected to said camming means and to said fan blades to move the opposite radial direction to that of said fan blades under the action of centrifugal force.
3. An engine cooling fan comprising a shaft, a first pair of discs secured to said shaft, a second pair of discs rotatably mounted on said shaft, a plurality of fan blades slidably mounted on one of said discs, centrifugal weight means slidably mounted on another of said discs, camming means formed on one of said discs, and camming means operatively connected to said camming means and to said fan blades to move the opposite radial direction to that of said fan blades under the action of centrifugal force.
4. An engine cooling fan comprising a shaft, a first pair of discs secured to said shaft, a second pair of discs inter-connected and rotatably mounted on said shaft, a plurality of fan blades slidably mounted on one of said discs, a pair of weight members slidably mounted on another of said discs, a plurality of radial slots formed on each of said pairs of discs, a plurality of spiral slots formed on each of the other of said pairs of discs, a plurality of radially disposed pins secured to said pins mounted in adjacent radial and spiral slots of one of each of said pairs of discs and secured to said respective weight members, and a plurality of pins mounted in adjacent radial and spiral slots of the other of each of said pairs of discs and secured to said respective fan blades, a pair of pins and said plurality of pins serving to move said plurality of fan blades in the opposite radial direction to that of said weight members under the action of centrifugal force.
5. The engine cooling fan described in claim 4, and a spring interconnecting said pair of weight members to return said weight members radially inwardly upon a decrease in centrifugal force.
6. An engine cooling fan comprising an engine-driven shaft, a first pair of discs secured to said shaft, a second pair of discs rotatably mounted on said shaft, a plurality of fan blades slidably mounted on one of said pairs of discs, a pair of weight members slidably mounted on the other of said first pair of discs, a pair of radial camming slots formed on said other of said first pair of discs, a pair of spiral camming slots formed on one of said second pair of discs, a plurality of unequally spaced radial camming slots formed on said other of said second pair of discs, a pair of spiral camming slots formed on the other of said second pair of discs, a pair and said plurality of spiral camming slots being formed in opposite directions, a pair of oppositely disposed pins mounted in adjacent radial and spiral camming slots and secured to said respective weight members, a plurality of pins mounted in adjacent pluralities of radial and spiral camming slots and secured to said fan blades, a pair of pins and said plurality of pins serving to move said plurality of fan blades in the opposite radial direction to that of said weight members under the action of centrifugal force, and a return spring interconnecting said pair of weight members.
7. An engine cooling fan comprising an engine speed-proportional shaft, a first disc secured adjacent the free end of said shaft, a pair of oppositely disposed radial grooves formed in said first disc, a second disc rotatably mounted on said shaft adjacent said first disc, a pair of oppositely disposed radial grooves formed in said second disc, a third disc rotatably mounted on said shaft adjacent said second disc, a plurality of unequally spaced spiral grooves formed in said third disc, said plurality of spiral grooves being arced in the opposite direction to that of said pair of spiral grooves, a connector member between said second and third discs, a fourth disc secured to said shaft adjacent said third disc, a plurality of unequally spaced radial grooves formed in said fourth disc, a pair of pins slidably mounted in said respective adjacent pair of radial and spiral grooves, a pair of centrifugal weight mounted on said respective pair of pins adjacent said first disc, a spring interconnecting said pair of centrifugal weights, a plurality of pins slidably mounted in said respective adjacent plurality of radial and spiral grooves, a plurality of linkage members secured to said respective plurality of pins adjacent said fourth disc, and a plurality of fan blades secured to the outer ends of said respective plurality of linkage members.
8. An engine cooling fan comprising an engine-driven shaft, a first disc secured adjacent the free end of said shaft, a pair of oppositely disposed radial camming slots formed in said first disc, a sleeve member rotatably mounted on said shaft having one end thereof adjacent said first disc, a second disc secured to said sleeve member, a pair of oppositely disposed spiral camming slots formed in said second disc, a third disc secured to
said sleeve member adjacent said second disc, a plurality of unequally spaced spiral camming slots formed in said third disc, said plurality of spiral camming slots being arced in the opposite direction to that of said pair of spiral camming slots formed in said second disc, a fourth disc secured to said shaft adjacent the other end of said sleeve member, a plurality of unequally spaced radial camming slots formed in said fourth disc, a pair of pins slidably mounted in said respective adjacent pair of radial and spiral camming slots, a pair of centrifugal weight members mounted on said respective pair of pins adjacent said first disc, a return spring interconnecting said pair of centrifugal weight members, a first plurality of pins slidably mounted in said respective adjacent plurality of radial and spiral camming slots, a second plurality of pins secured to said fourth disc, a plurality of linkage members secured to said respective first plurality of pins adjacent said fourth disc and slidably mounted on said second plurality of pins, and a plurality of fan blades secured to the outer ends of said respective plurality of linkage members, the resultant camming action of said cooperating radial and spiral camming slots causing said plurality of fan blades to move radially inwardly to decrease the overall diameter thereof in response to the radial outward movement of said centrifugal weight members under the action of centrifugal force.