Feb. 12, 1963 H. S. MOHN 3,077,228

HEAVY-DUTY INTERNAL COMBUSTION FAN ASSEMBLY

Filed April 22, 1960

FIG. 2

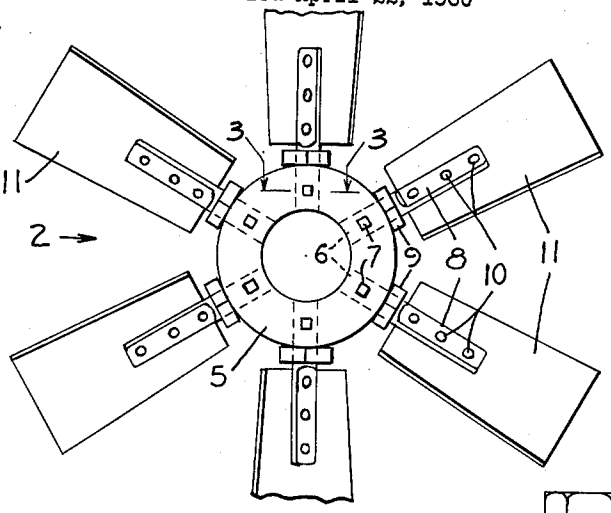


FIG. 1

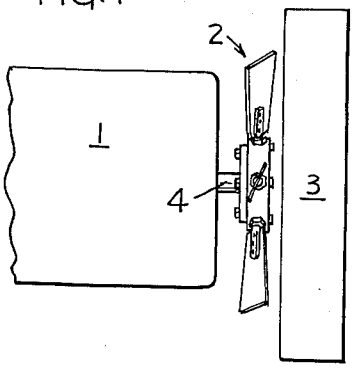


FIG. 3

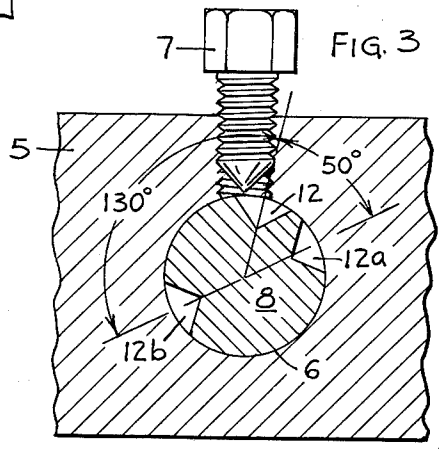


FIG. 4

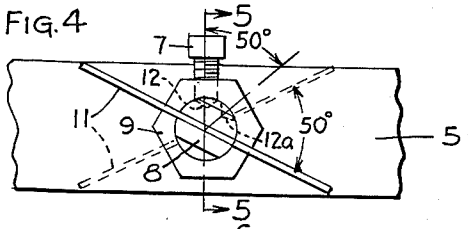


FIG. 5

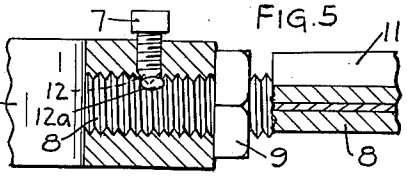


FIG. 6

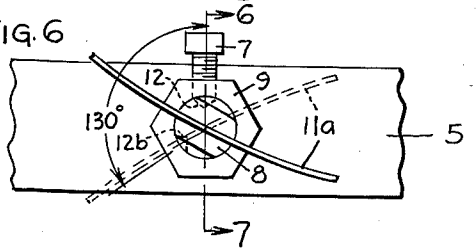
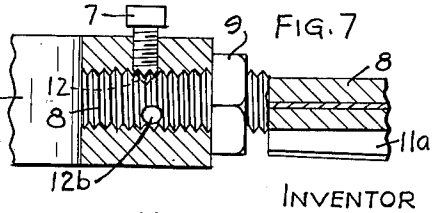


FIG. 7



INVENTOR
HOWARD S. MOHN
BY Frederick C. Meyers
ATTORNEY

United States Patent Office 3,077,228
Patented Feb. 12, 1963

3,077,228

HEAVY-DUTY INTERNAL COMBUSTION FAN ASSEMBLY

Howard S. Mohn, 10441 Beard Ave. S., Minneapolis 20, Minn.

Filed Apr. 22, 1960, Ser. No. 24,012
10 Claims. (Cl. 170—160.6)

This invention relates to an improvement in heavy-duty internal combustion engines and particularly to an improved air circulating fan assembly for use in the cooling system of such engines and is a continuation-in-part of my co-pending United States patent application, Serial Number 716,598, filed February 21, 1958, now abandoned.

In utilizing heavy-duty, water-cooled, internal combustion engines employing a radiator and an air circulating fan to aid in removing heat from the coolant, it is often desirable and many times essential that the air flow direction about the radiator be reversed.

For example, in earth moving equipment being operated under cold conditions, it may be essential or desirable to circulate warm air from around the engine through the radiator and conversely when operating under extreme heat, it may be desirable to reverse this flow and pull in fresh air. Moreover, when air is being pulled through the radiator from the outside, the radiator may become blocked with dust and chaff thereby causing excessive engine heating in which case the fan should be reversed to blow out the radiator and prevent further clogging. Indeed the need for such flow reversal with the equipment of the type described may be required frequently or infrequently either as a result of seasonal changes or as a result of the conditions under which the equipment is being operated.

Normally it is necessary, when a reverse air flow is desired, to cease operating the equipment, manually remove the fan assembly, and install a substitute assembly of reversed pitch. Necessarily, such an operation results in considerable equipment down-time and loss of productive man hours.

Because of the foregoing difficulties, several attempts have been made to provide a fan assembly adaptable to be used on heavy equipment which would permit reversing the fan blade pitch without necessitating removal of the entire fan assembly from the machine. To my knowledge, however, none of these attempts have been successful.

Most attempts to provide such an assembly have failed because the structure employed to permit reversal of the fan blade introduced such structural weakness into the fan assembly that it was no longer suitable for use under the rugged conditions imposed by heavy-duty engines and equipment employing the same, and in those prior art fan assemblies which offered sufficient structural strength, the mode of blade pitch reversal imposed as many difficulties as were involved in changing the entire fan assembly. Moreover, these prior art assemblies have universally, to my knowledge, been expensive to manufacture and maintain.

It is, therefore, an object of the present invention to provide a reversible pitch fan assembly of sufficient structural strength to be used with high-speed, heavy-duty engines and equipment employing the same.

Another object of this invention is to provide such a fan assembly with practical means for effecting reversal of the blade pitch.

A further object of this invention to provide such a fan assembly with built-in blade positioning means.

Another object of this invention is to provide a fan

assembly of the type described which is economical to manufacture and maintain.

Still another object of this invention is to provide heavy equipment having water-cooled engines with engine air circulating fan assemblies having reversible blades and means whereby the same may be reversed and positively repositioned and retained.

Other objects will be apparent from the following description of that embodiment of my invention illustrated in the accompanying drawings.

In the drawings wherein I have illustrated one embodiment of my invention, I have utilized like reference numerals to indicate like elements.

Referring to the drawings:

FIGURE 1 is a top plan view of a high-speed, heavy-duty, water-cooled internal combustion engine having a radiator and an air circulating fan assembly embodying my invention.

FIGURE 2 is a front elevation of the fan assembly shown in FIGURE 1.

FIGURE 3 is an enlarged partial section through the hub and blade shank taken along line 3—3 of FIGURE 2.

FIGURE 4 is an enlarged fragmentary top plan view of the fan assembly shown in FIGURE 2 and shows the hidden portion of the blade positioning bolt and the conical recesses lying within the blade shank in dotted line.

FIGURE 5 is a partial section of hub 5 and a partial elevation of shank 8 taken along line 5—5 of FIGURE 4.

FIGURE 6 is an enlarged fragmentary top plan view of the fan assembly shown in FIGURE 2 illustrating a fan blade which has been arced about its long axis and showing the hidden portion of the blade positioning bolt and the conical recesses within the blade shank in dotted line.

FIGURE 7 is a partial section of hub 5 and a partial section and elevation of shank 8 taken along line 7—7 of FIGURE 6.

Referring now to FIGURE 1, high-speed, water-cooled, internal combustion engine 1 carries drive shaft 4 which, in turn, carries fan assembly 2. Radiator 3 is associated with engine 1 and is positioned directly in front of and in close proximity to fan assembly 2. When engine 1 is running, drive shaft 4 is constantly rotated from left to right as is fan assembly 2 which is carried by drive shaft 4. The blade portions of fan assembly 2 are pitched at approximately 25° in relation to the radiator 3 and as the is rotated, fan assembly 2 pulls air from around engine 1 and pushes it through radiator 3.

Fan assembly 2 is comprised of hub 5 which has a plurality of longitudinal and radial internally threaded bores 6, shown in dotted line in FIGURE 2, and opening at its periphery. Carried within radial bores 6 are a plurality of blade shanks 8 threaded at one end and bifurcated at the other end. Each of blade shanks 8 carries a jam nut 9 in abutting relation to the peripheral surface of hub 5. A plurality of blades 11 are carried by the bifurcated portion of shanks 8 being secured thereto by blade shank pins 10. Each of blades 11 is pitched at an angle of about 25°, as shown in FIGURE 1, and is positionally held at that angle by a plurality of threaded blade positioning bolts 7 which are threadably carried within a face of hub 5 and which are threadably advanceable therethrough into mating engagement with a conical recess lying within the portion of blade shanks 8 which is carried within radial bores 6 of hub 5.

Lying within the threaded portion of blade shank 8 are three conical recesses, 12, 12*a* and 12*b*, any of which is mateably engageable with the conical terminal end portion of blade positioning bolt 7 which is also carried in hub 5 and is threadably advanceable therethrough at

right angles to blade shank 8. As blade positioning bolt 7 is advanced into hub 5, the conically shaped terminal end portion will advance into conical recess 12 thereby rotating shank 8 counterclockwise, as shown, until conical recess 12 is aligned with and mateably engaged by the conical terminal end portion of blade positioning bolt 7. When it is desired to rotate the blade which is carried by blade shank 8, blade positioning bolt 7 is withdrawn from engagement with shank 8 and shank 8 and the blade carried thereby are rotated into the desired predetermined position. Then blade positioning bolt 7 is advanced through hub 5 and into engagement with either conical recess 12, 12*a* or 12*b*, depending upon which of them corresponds to the blade position selected.

Where a straight form of blade 11 is carried by the bifurcated portion of blade shank 8, jam nut 9 being carried by the threaded portion thereof in abutted relation to the peripheral surface of hub 5, the threaded portion of blade shank 8 carried within radial bore 6 of hub 5 has a first conical recess 12, shown in dotted line in FIGURE 4, mateably engaged by the terminal end of blade positioning bolt 7. Thus engaged, blade shank 8 carries blade 11 at a pitch of approximately 25° whereby the same will push air forwardly when moved by the left to right rotation of hub 5. A second conical recess 12*a* shown in dotted line also lies within that portion of shank 8 carried within radial bore 6 and when it is desired to reverse the air flow set up by blade 11 as it moves with the left to right rotation of hub 5, blade positioning bolt 7 is withdrawn from recess 12 to permit manual rotation of blade 11 counter clockwise by about 50°, as shown in dotted line. Then bolt 7 is advanced into engagement with conical recess 12*a* to align blade 11 so that it will push air rearwardly when hub 5 is again rotated from left to right.

When shank 8 is adapted to carry a straight form of blade 11, the first conical recess 12 which is mateably engaged by the conical terminal end of blade positioning bolt 7 is arcuately spaced from conical recess 12*a* by 50° and is longitudinally offset therefrom to compensate for the longitudinal movement of shank 8 when the same is threadably rotated within hub 5 to reverse the pitch of straight blade 11.

An arced blade 11*a* may also be carried by the bifurcated portion of blade shank 8. When an arced blade is employed, the portion of blade shank 8 carried within radial bore 6 of hub 5 has a first conical recess 12 and a second conical recess 12*b* which is arcuately spaced from the first conical recess 12 by 130°. Blade shank 8 also carries the arced blade 11*a* at a pitch of about 25° whereby the same will push air forwardly as it is moved around by the left to right rotation of hub 5. When it is desired to reverse the air flow set up by the movement of blade 11*a*, blade positioning bolt 7 is withdrawn from recess 12 and blade 11*a* is manually rotated clockwise by about 130° as shown in dotted line in FIGURE 6. The bolt 7 is then advanced into engagement with conical recess 12*b*, also shown in dotted line in FIGURE 6, to align blade 11*a* so that it will push air rearwardly as hub 5 is rotated from left to right.

Where shank 8 carries the arced blade 11*a*, the first conical recess 12 which is mateably engaged by the conical terminal end portion of bolt 7 is arcuately spaced from conical recess 12*b* by 130° and is also longitudinally offset therefrom to compensate for the longitudinal movement of shank 8 when it is threadably rotated within hub 5 to reverse the pitch of arced blade 11*a*.

From the foregoing, it may be seen that in the practice of my invention, I may employ any convenient means for mounting the fan assembly of my invention to the engine and I may utilize any suitable hub member or the equivalent thereof. Moreover, the blade members of my fan assembly invention may be either conventional flat blades or they may be formed, as for example, in the manner of the arced blades illustrated in FIGURE 6 of the drawings. It is, however, important that these elements be of sturdy and durable construction and adapted to withstand sustained high-speed operation under rugged conditions.

It is also important that the elongated members or blade shanks utilized to secure the blades to the hub member be of sturdy construction and that they be secured to the hub member in a manner which admits of easy manual rotation but will not permit movement in respect of the hub member during operation.

The conical recesses which lie within the blade shank, or its equivalent, must be accurately positioned in respect of the blade element and in respect of each other. If the conical recesses are not carefully positioned, one or more of the blade members could be positioned out of pitch and/or out of balance in relation to the others and produce a malfunction of the fan assembly. Furthermore, the shape of the conical recesses must be such that the terminal end portion of the blade positioning bolt or its equivalent will engage therewith in a manner which will inherently self align the blade members and retain that alignment during operation.

What I claim is:

1. A heavy-duty fan assembly comprising a hub member, a plurality of radially extending bores lying within said hub and opening at its periphery, a plurality of blade members each having an inwardly terminating shank end rotatably carried within one of said bores, at least two arcuately and longitudinally offset conical recesses within said terminating shank end, and self aligning and retaining means within said hub member mateably engageable with said conical recesses for pitch reversal and adjustment of said blade members.

2. A heavy-duty fan assembly comprising a hub member, a plurality of radially positioned threaded bores lying within said hub and lying within its periphery, a plurality of blade members each terminating in a threaded shank at one end and rotatably carried within said bores by said threaded shank, at least two arcuately and longitudinally offset conical recesses within each said threaded shank, and self aligning and retaining means within said hub member mateably engageable with said conical recesses for pitch reversal and adjustment of said blade members.

3. A heavy-duty fan assembly comprising a hub member, a plurality of radially extending threaded bores lying within said hub and opening at its periphery, a plurality of blade members each having one end terminating in a threaded shank and threadably and rotatably carried within said bores, at least two arcuately spaced and longitudinally offset conical recesses within each said threaded shank, and selfaligning and retaining means within said hub member mateably engageable with said conical recesses for pitch reversal and adjustment of said blade members, whereby fluid flow may be reversed.

4. A heavy-duty fan assembly comprising a hub member, a plurality of radially extending bores lying within said hub and opening at its periphery, a plurality of blade members having one end terminating and rotatably carried within said bores, at least two arcuately spaced and longitudinally offset conical recesses within said terminating blade ends, a plurality of channels passing through a face of said hub and carrying self aligning and retaining means advanceable into mating engagement with said conical recesses for pitch reversal and adjustment of said blade members, whereby fluid flow may be reversed.

5. A heavy-duty fan assembly comprising a hub member, a plurality of radially extending bores lying within said hub and opening at its periphery, a plurality of blade members each having an inwardly terminating shank end rotatably carried within one of said bores, at least two arcuately and longitudinally offset conical recesses within each said terminating shank end, a plurality of threaded channels passing through a face of said hub and communicating with said bores, and threaded

blade self positioning and retaining means carried within said threaded channels and advanceable therethrough into mating engagement with said conical recesses for pitch reversal and adjustment of said blade members, whereby fluid flow may be reversed.

6. For a heavy-duty, water-cooled internal combustion engine having a radiator and an air circulating fan, the improvement comprising a hub member adapted to be driveably carried by said engine and positioned in close proximity to said radiator, a plurality of blade members terminating in a shank at one end, at least two arcuately and longitudinally offset conical recesses within each said shank, a plurality of radially extending bores lying within said hub member and opening at its periphery and rotatably carrying said blade shanks, a plurality of channels passing through a face of said hub member and communicating with said bores, and blade self positioning and retaining means carried within said channels and advanceable therethrough into mating engagement with said conical recesses for pitch reversal and adjustment of said blade members, whereby air flow may be reversed.

7. For a heavy-duty, water-cooled internal combustion engine having a radiator and a fan adapted to circulate air about said radiator, the improvement in said fan comprising a hub member adapted to be driveably carried by said engine, a plurality of radially extending bores lying within said hub member and opening at its periphery, a plurality of blade members each having an inwardly terminating shank rotatably carried within one of said bores, at least two arcuately and longitudinally offset conical recesses within each said terminating shank and self aligning and retaining means within said hub member mateably engageable with said conical recesses for pitch reversal and adjustment of said blade members, whereby air flow of said fan may be reversed.

8. For a heavy-duty, water-cooled internal combustion engine having a radiator and a fan adapted to circulate air about said radiator, an improvement in said fan comprising a hub member adapted to be driveably carried by said engine and positioned in close proximity to said radiator, a plurality of blade members terminating in a threaded shank at one end, at least two arcuately spaced and longitudinally offset conical recesses within each said shank, a plurality of the radially extending threaded bores lying within said hub member and opening at its periphery and rotatably threadably carrying said threaded shanks, and a plurality of channels passing through a face of said hub and carrying self aligning and retaining means advanceable therethrough into mating engagement with said conical recesses for pitch reversal and adjustment of said blade members whereby air flow direction may be reversed.

9. For a heavy-duty, water-cooled internal combustion engine having a radiator and an air circulating fan, the improvement in said fan comprising a hub member adapted to be driveably carried by said engine and positioned in close proximity to said radiator, a plurality of blade members terminating in a threaded shank at one end, at least two arcuately spaced and longitudinally offset conical recesses within each said shank, a plurality of radially extending threaded bores lying within said hub member and opening at its periphery and threadably rotatably carrying said blade shanks, a plurality of threaded channels passing through a face of said hub and communicating with said bores, and threaded blade self positioning and retaining means carried within said channels and threadably advanceable therethrough into mating engagement with said conical recesses for pitch reversal and adjustment of said blade members, whereby the air flow direction may be reversed.

10. For a heavy-duty, water-cooled internal combustion engine having a radiator and a reversible fan adapted to circulate air about said radiator, the improvement in said fan comprising a hub member adapted to be driveably carried by said engine and positioned in close proximity to said radiator, a plurality of blade members arced about their long axis and terminating at one end in a threaded shank carrying a jam nut, a pair of conical recesses within said each threaded shank and arcuately spaced about 130° apart and longitudinally offset, a plurality of radially extending internally threaded bores lying within said hub member and opening at its periphery and rotatably threadably carrying said blade shanks, a plurality of internally threaded channels passing through a face of said hub member and communicating with said bores at right angles thereto, and threaded blade self positioning and retaining means threadably carried within said channels and threadably advanceable therethrough and terminating in a conical end portion adapted to mateably engage said conical recesses upon advancement thereinto for pitch reversal and adjustment of said blade members, whereby the air flow may be reversed.

References Cited in the file of this patent

UNITED STATES PATENTS

705,866	Punzelt	July 29, 1902
925,030	Russel	June 15, 1909
1,347,377	Jensen	July 20, 1920
1,790,163	McCauley	Jan. 27, 1931
2,307,490	Curley	Jan. 5, 1943

FOREIGN PATENTS

197,421	Great Britain	May 16, 1932