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VARIABLE AND REVERSIBLE PITCH FAN
FOR INTERNAL COMBUSTION ENGINE
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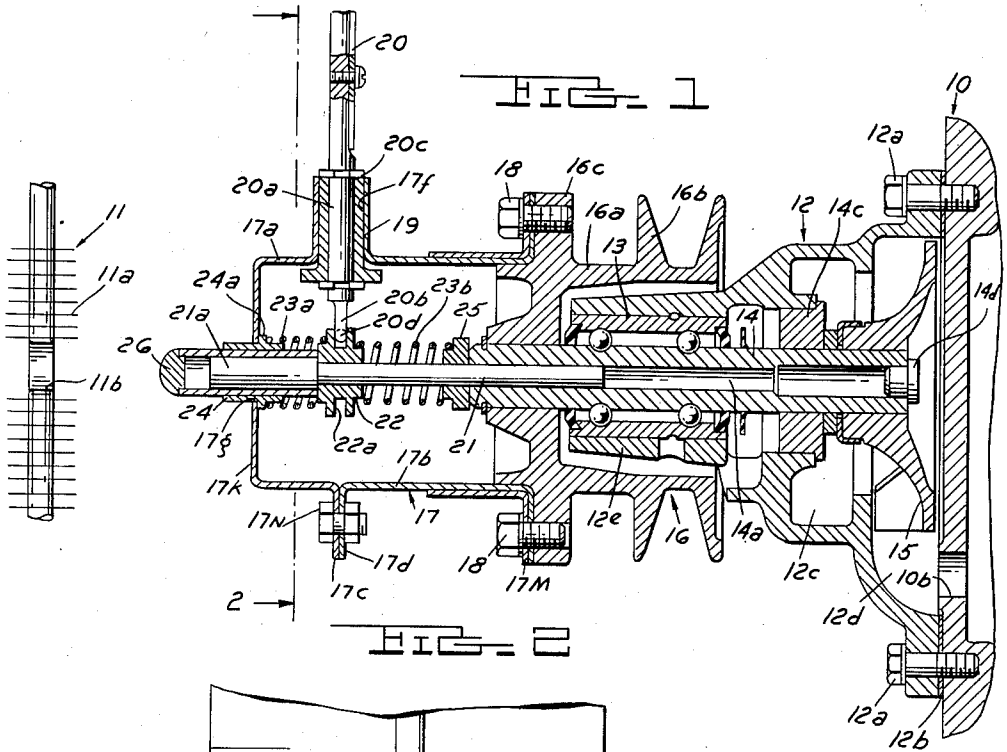
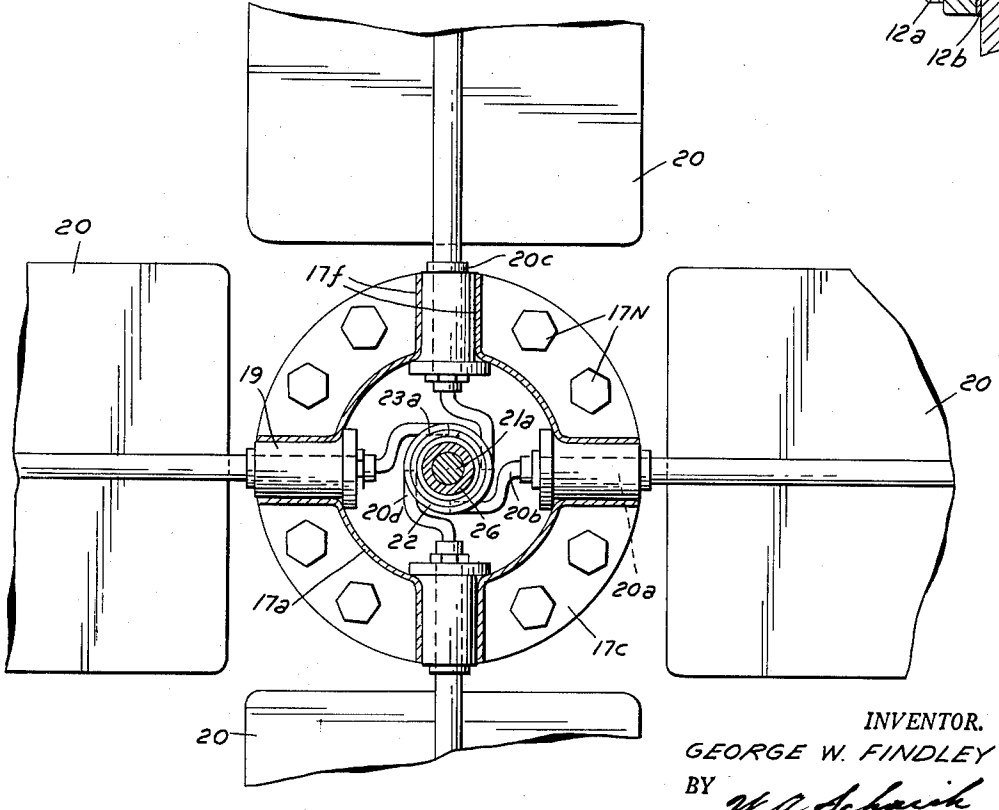


FIG. 1

FIG. 2



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VARIABLE AND REVERSIBLE PITCH FAN FOR INTERNAL-COMBUSTION ENGINE

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3 Claims. (Cl. 123—41.12)

This invention relates to an improved fan cooling mechanism for internal combustion engines, and particularly to a variable pitch fan and improved mechanism for controlling the air flow characteristics of such fan as a function of the temperature of the coolant of a liquid cooled internal combustion engine.

It has long been recognized that the air fan conventionally provided on an internal combustion engine is very wasteful of a substantial amount of the power developed by such engine in that the fan is commonly designed to produce an air blast of the intensity required to effect proper cooling of the engine under the most extreme conditions of use and ambient temperature to which the engine may be subjected. In most instances, the engine does not operate under such extreme conditions and the excessive air blast produced by the fan constitutes wasted power.

An additional problem is encountered in the cooling of internal combustion engines utilized in agricultural applications in that clogging of the radiator due to chaff, vegetation or the like is often encountered. This problem is particularly acute on farm tractors and engines employed on various types of harvesting equipment such as combines, forage harvesters, hay balers, and the like. It is necessary for the farmer to be continuously alert to observe the condition of the radiator and to periodically effect the cleaning of the chaff from the radiator. Obviously, such cleaning could be more conveniently and rapidly effected by a mere reversal of the air stream produced by the fan, thus blowing the trash out of the radiator.

Accordingly, it is an object of this invention to provide an improved variable and reversible pitch fan for an internal combustion engine and particularly an improved mechanism for controlling the pitch of the blades of the variable pitch fan as a function of the temperature of an internal combustion engine.

A particular object of this invention is to provide an improved variable pitch fan and control mechanism therefor which may be conveniently mounted in the same position on an internal combustion engine as the conventional constant pitch fan, and further characterized by the fact that the pitch of such fan is controlled as a function of the temperature of the liquid coolant for the internal combustion engine.

Still another object of this invention is to provide an improved air fan and radiator construction which permits the cleaning of trash and similar foreign matter from the radiator air passages by the convenient reversal of the pitch of the fan blades.

The specific nature of this invention, as well as other objects and advantages thereof, will become apparent to those skilled in the art from the following detailed description, taken in conjunction with the attached sheet of drawings on which, by way of preferred example only, is illustrated one embodiment of this invention.

On the drawings:

Figure 1 is a sectional view taken on the plane passing through the rotational axis of a variable pitch fan construction embodying this invention, shown in assembled relationship to the radiator and engine block of an internal combustion engine; and

Figure 2 is a sectional view taken on the plane 2—2 of Figure 1.

As shown on the drawings:

The numeral **10** represents an engine block of a conventional internal combustion engine of the type employed in tractors and similar agricultural equipment. A conventional radiator **11** is provided in spaced relationship to the front engine wall **10***a* and liquid coolant for cooling the engine is circulated through the finned tubes **11***a* of radiator **11** in conventional fashion. On the front engine wall **10***a* a pump housing **12** of conventional construction is mounted by virtue of the bolts **12***a* and gasket **12***b*. Pump housing **12** defines an internal annular inlet chamber **12***c* into which coolant fluid is drawn from the bottom of radiator **11** by the customary hose connection (not shown). Axially adjacent to inlet chamber **12***c* a pump chamber **12***d* is defined which communicates with a suitable opening **10***b* in the engine block wall **10***a* to provide fluid communication with the coolant passages in the engine. Additionally, pump housing **12** has a forwardly projecting hollow conical extension **12***e* which mounts a conventional sealed anti-friction type bearing **13**. A hollow shaft **14** is journaled in bearing **13**, projecting forwardly out of bearing **13** for a purpose to be described and projecting rearwardly into pump chamber **12***d*. A conventional impeller **15** is mounted on the rearward end of hollow shaft **14** and cooperates with the walls of pump chamber **12***d* to produce a pumping action on the coolant fluid of the internal combustion engine, thus drawing the fluid through the radiator **11** and discharging it into the engine block from whence it is conducted to the top of radiator **11** in conventional fashion. A seal unit **14***c* is mounted on the shaft **14** intermediate the impeller **15** and bearing **13** to prevent coolant leakage out of pump inlet chamber **12***c*.

On the forwardly projecting end of hollow shaft **14**, a driving pulley hub **16** is mounted and suitably keyed to shaft **14**. Hub **16** has a rearwardly extending sleeve-like flange **16***a* which terminates in an integral pulley portion **16***b*. Pulley portion **16***b* is driven by the engine fan belt (not shown) in conventional fashion.

Additionally, the pulley hub **16** is provided with a radial flange **16***c* and the flange is utilized to mount a blade support or hub **17** for a variable pitch fan. Hub **17** is of generally cup-shaped construction overall having at its open end an axial flange **17***m* which abuts a similar flange **16***c* on the pulley hub and is secured thereto by a plurality of bolts **18**. Hub **17** is conveniently formed of two co-axial stampings **17***a* and **17***b* which have abutting radial flange portions **17***c* and **17***d* respectively secured together by bolts **17***n*. At spaced intervals around the peripheries of flanges **17***c* and **17***d*, semi-cylindrical mating depressions are formed, thus defining angularly spaced cylindrical bores **17***f*. Bearing sleeves **19** are pressed into each bore **17***f*. A plurality of fan blades **20** are provided, each of such blades having a cylindrical stem portion **20***a* journaled in a bearing sleeve **19** and secured against axial displacements by snap rings **20***c*. The extreme inner end of stem portions **20***a* are of reduced diameter and formed into a crank-shaped configuration **20***b*, as best shown in Figure 2. Hence, the rotation of crank portions **20***b* will effect a variation in the pitch of the fan blades **20** and thus change the air pumping characteristics of the fan.

To control the pitch of the fan blades **20**, an hydraulically actuated piston **21** is slidably mounted within the cylindrical bore **14***a* of the hollow shaft **14**. Piston **21** has a forwardly projecting rod portion **21***a* integrally

formed thereon which projects forwardly into an actuator sleeve **26** which is supported in the end wall **17***k* of the fan hub **17**. A shifter collar **22** is secured to a medial portion of piston rod **21***a* and such shifter collar defines an annular external groove **22***a* which receives each of the crank end portions **20***d* of the fan blades **20**. Thus, movement of piston **21** will produce a change in the pitch of the blades **20** and effect a change in the air pumping characteristics of the fan.

The piston rod **21***a*, and hence the variable pitch blades **20**, are preferably spring biased to a neutral position which closely approximates the zero pitch position of the fan blades **20**. Such biasing arrangement may, for example, comprise a pair of compression springs **23***a* and **23***b* which are respectively engageable with opposite axial ends of shifter collar **22**. The other end of spring **23***a* is bottomed on a radial flange **24***a* provided on a sleeve **24** which is snugly inserted in a central aperture **17***g* in the end of hub **17**, while the other end of spring **23***b* is bottomed upon a collar **25** which abuts the end of hollow shaft **14**.

To actuate the piston **21**, the other end of the bore **14***a* of hollow shaft **14** is closed by a plug **14***d*. A suitable charge of a low boiling point fluid is then introduced into the bore **14***a*. It will be noted that the one end portion of bore **14***a* defines an hydraulic cylinder cooperating with piston **21**, while the other end of bore **14***a* is disposed in intimate heat transfer relationship with the coolant which is circulated through the engine. Hence, the average temperature of bore **14***a* will vary as a function of the engine temperature. The low boiling point fluid which is inserted in the enclosed bore **14***a* is of the type that will vaporize at a temperature in the bore **14***a* corresponding to an engine temperature somewhat below the normal operating temperature and will produce a vapor pressure within the enclosed bore **14***a* which will increase as a function of the engine temperature. Such fluid shall be hereinafter referred to as a temperature responsive, variable pressure fluid.

It is therefore apparent that the piston **21** will be subjected to a vapor pressure which increases as a function of the engine temperature, thus producing forward displacement of piston **21** and piston rod **21***a* in proportion to the engine temperature. Such forward displacement of piston rod **21***a* effects an increase in the effective pitch of fan blades **20** and thus produces an increased flow of air through the radiator **11** and rearwardly over the engine. It should be noted that the power consumed by the fan is always maintained in proportion to the cooling requirements of the engine. When the engine is cold or operating below normal engine temperatures, the fan blades **20** will remain at their substantially zero position and little power will be consumed in driving the fan.

The variable pitch fan construction heretofore described may be conveniently manually operated to reverse the pitch of the fan blades so as to drive air forwardly through the radiator **11** to effect cleaning of such radiator of accumulated trash. To accomplish such reversal, a cup-shaped actuating element **26** is provided which is slidably mounted within the spring support sleeve **24***a* and in turn slidably journals the forward end of piston rod **21***a*. Pushing the actuator **26** inwardly, or rearwardly with respect to radiator **11**, produces a corresponding movement of shifter collar **22** and hence effects a reversal of the pitch of the fan blades **20**. While a variety of well-known mechanical devices could obviously be employed to effect the shifting of actuator **26**, this operation can be most conveniently accomplished by forming the radiator **11** with a suitable aperture **11***b* in alignment with actuator **26** so as to permit the manual insertion of a suitable tool (not shown) through aperture **11***b* to engage actuator **26** and displace it rearwardly. In this manner, the operator may avoid all possibility of injury from the rotating fan blades **20**.

From the foregoing description, it is apparent that there is here provided an unusually simple and economically manufacturable variable pitch fan unit which may be conveniently applied to existing types of internal combustion engines and which will effect the automatic regulation of the fan blade pitch as a function of engine temperature and which will further permit the convenient reversal of the pitch of the fan blades to direct a reverse flow blast of air through the radiator for cleaning purposes.

It will, of course, be understood that various details of construction may be varied through a wide range without departing from the principles of this invention and it is, therefore, not the purpose to limit the patent granted hereon otherwise than necessitated by the scope of the appended claims.

I claim:

1. A variable pitch fan for an internal combustion engine comprising a rotatable fan hub, a plurality of fan blades radially mounted on said hub and journaled for movement about their radial axes, an hydraulically actuated piston operatively connected to said fan blades to effect pitch adjustment thereof, resilient means opposing displacement of said piston in either direction from a neutral position corresponding to a substantially zero pitch position of said fan blades, means defining an enclosed cylinder chamber cooperable with said piston, a portion of said chamber being disposed in heat transfer relationship to said engine, and a charge of temperature responsive, variable pressure fluid in said cylinder chamber, whereby said piston is actuated by said fluid in the one direction to increase the engine cooling properties of said fan blades as engine temperature increases, and manually operable means for displacing said piston in the opposite direction to reverse the pitch of said fan blades.

2. A variable pitch fan for a liquid cooled internal combustion engine having a radiator, comprising a fan hub rotatably journaled behind the radiator, a plurality of fan blades radially mounted on said hub and journaled for movement about their radial axes, an hydraulically actuated piston operatively connected to said fan blades to effect pitch adjustment thereof, resilient means opposing displacement of said piston in either direction from a neutral position corresponding to a substantially zero pitch position of said fan blades, means defining an enclosed cylinder chamber cooperable with said piston, a portion of said chamber being disposed in heat transfer relationship to said engine, and a charge of temperature responsive, variable pressure fluid in said cylinder chamber, whereby said piston is actuated by said fluid in the direction to increase the air flow through the radiator produced by said fan blades as engine temperature increases, and manually operable means for displacing said piston in the opposite direction to reverse the pitch of said fan blades, and thereby reverse the air flow through said radiator.

3. The combination defined in claim 2 wherein said last mentioned means comprises a rod-like extension operatively connected to said piston and extending toward said radiator, said radiator having an aperture therethrough aligned with said extension to permit manual operation of said extension.

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