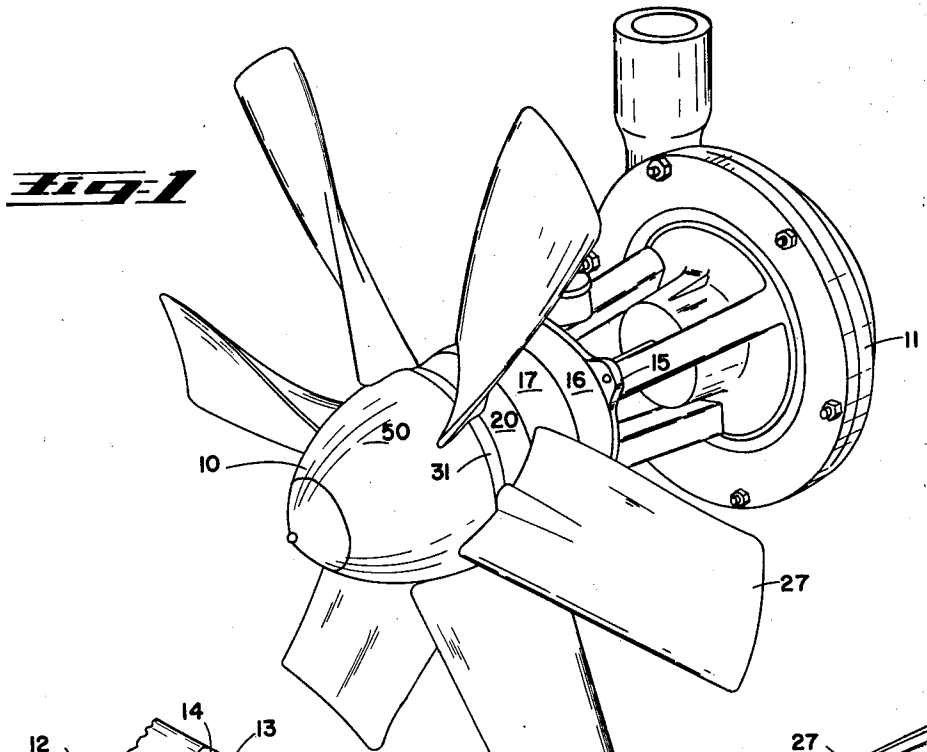
April 28, 1964 D. M. LIEBHART 3,130,677

VARIABLE PITCH FAN

Filed Jan. 29, 1962

Fig. 1



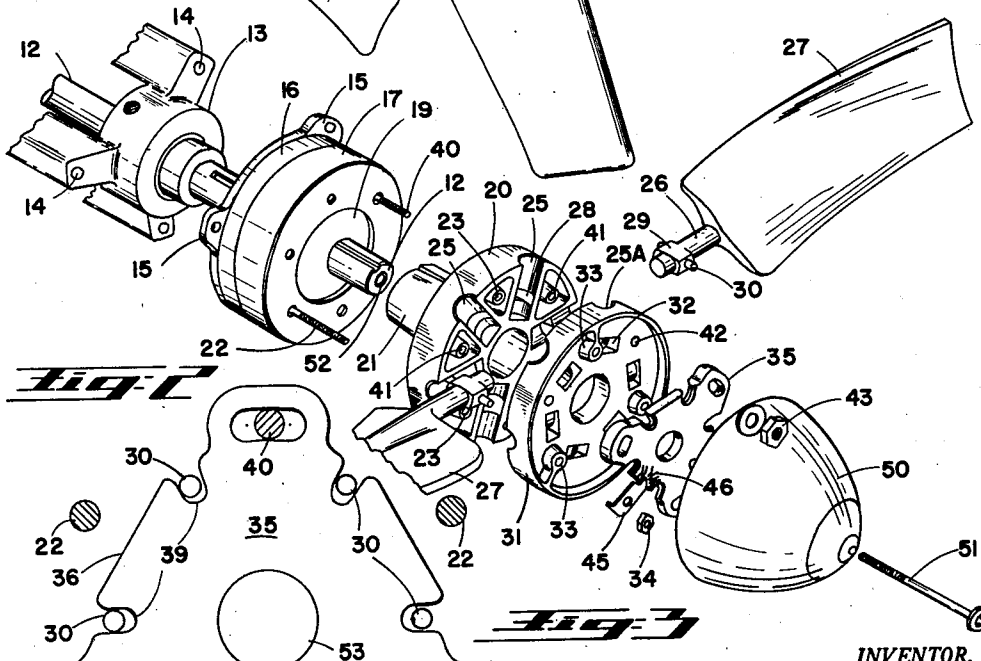


Fig. 2

Fig. 3

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United States Patent Office 3,130,677 Patented Apr. 28, 1964

3,130,677

VARIABLE PITCH FAN

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Filed Jan. 29, 1962, Ser. No. 169,503
2 Claims. (Cl. 103—87)

This invention relates to a variable pitch fan and has particular reference to a fan used for driving a pump in an aircraft spray system.

In spraying crops and forests and the like from an airplane, tubular spray booms equipped with nozzles are mounted on the wings. The pressure employed in the spray system depends upon the kind of spray material and the amount of material to be applied per acre. The great variation in these factors for different crops and different kinds of pests makes it desirable to be able to change the speed of the pump. Such pumps are usually driven, however, by a fan exposed to the slip stream adjacent to the body of the airplane whereby the fan rotates at a fairly constant speed. Conventional pitch changing mechanisms used on other fans and propellers are too complicated and expensive for the present purpose.

Objects of the invention are, therefore, to provide convenient means for changing the pitch of the blades of a small wind-driven fan in order to change the speed of the fan, to provide a fan having removable blades so that the number of blades may be varied, and to provide a rugged and durable fan of the type described which is relatively simple and inexpensive to manufacture.

The present fan construction has provision for six blades. Each blade is supported by a cylindrical shank which is clamped in semi-cylindrical recesses in two mating plates. A radial pin on each shank engages a rotatable pitch change plate. When the clamping pressure on the two clamp plates is released, the pitch change plate may be rotated slightly which, in turn, rotates all the blades to vary the pitch as desired and thereby change the speed of the fan. When the clamping plates are again secured, the blade pitch is fixed against accidental variation.

The construction is such that alternate blades may be removed to provide a three-blade fan or, if desired, four of the blades may be removed to provide a two-blade fan. In these ways the characteristics of the fan may be altered so that a single fan will meet the widely varying requirements of the pump.

The invention will be better understood and additional objects and advantages will become apparent from the following description of the preferred embodiment illustrated on the accompanying drawing. Various changes may be made, however, in the details of construction and arrangement of parts and all such modifications within the scope of the appended claims are included in the invention.

In the drawing:

FIGURE 1 is a perspective view of a fan and pump combination embodying the principles of the invention;

FIGURE 2 is an exploded view of the fan; and

FIGURE 3 is an enlarged view of the pitch change plate shown in FIGURE 2.

In FIGURE 1 the fan **10** is mounted on the shaft of pump **11**. The rear side of the pump housing is equipped with suitable brackets, not shown, for mounting the pump and fan on an airplane or helicopter, so that the fan will be rotated by its forward movement through the air.

Referring now to FIGURE 2, the pump has a shaft **12** and a stationary front end structure **13** equipped with a plurality of tapped holes **14** to receive screws through apertured ears **15** on a brake housing **16**. Brake housing **16** contains conventional internal expanding brake shoes engageable with the brake drum **17** which rotates with the shaft **12**. The brake mechanism is equipped with a lever, not shown, for actuating the shoes against the drum to stop the pump when desired.

A fan body plate **20** has a hub **21** which is keyed and secured to the shaft **12**. This hub projects rearwardly into a central opening **19** in the brake drum and is disposed between the arcuate brake shoes therein. Three long bolts **22** having heads within the brake drum pass through bosses **23** in body plate **20** for mounting the brake drum on the body plate. Body plate **20** is provided with six radially directed semi-cylindrical recesses **25** to receive cylindrical shank portions **26** on the blades **27**. Deeper recesses **28** accommodate the shouldered portions **29** of the shanks which carry pins **30** projecting radially from the shanks.

A saddle plate **31** is constructed similarly to body plate **20** to mate therewith except that the saddle plate does not have a hub. Thus, the saddle plate has six semi-cylindrical recesses **25***a* to register with the recesses **25** in the body plate and form cylindrical bores surrounding the cylindrical blade shanks **26**. Pins **30** project forward through openings **32** in the saddle plate. Saddle plate **31** is equipped with three apertured bosses **33** to receive the three bolts **22**. The forward ends of these bolts carry nuts and washers **34** which bear against the bosses **33** to clamp brake drum **17** against the rear face of body plate **20** and clamp saddle plate **31** against the front face of the body plate. The bores **25** and **25***a* are dimensioned to grip the blade shanks **26** and clamp them securely when the nuts **34** are tightened.

A triangular pitch plate **35** fits against the front face of the saddle plate. Pitch plate **35** has three flat sides **36** to clear the bosses **33** and bolts **22**, as shown in FIGURE 3, and three apex corners **37** provided with arcuate slots **38**. Between each flat side **36** and a corner portion **37** is a notch **39** to engage one of the pins **30**. The pitch plate is mounted on three bolts **40** which have heads on their rear ends inside the brake drum **17** and pass through three apertured bosses **41** in body plate **20** and thence through three circular holes **42** in saddle plate **31**. The forward ends of bolts **40** pass through arcuate slots **38** to support pitch plate **35** for limited rotation about the axis of shaft **12**.

When the pitch plate is rotated, its notches **39** shift pins **30** to rotate all the blades **27** simultaneously about the axes of their shanks **26** to vary the pitch of the blades through a range of 15° to 40°. The pitch plate **35** is clamped in adjusted position by nuts and washers **43**. As shown in FIGURE 2, one of the bolts **22** carries a pointer **45** which indicates the blade angle on a scale **46** on the pitch plate. A streamlined spinner cup **50** protects the adjusting mechanism and directs the air into the spiral curved blades for the greatest efficiency of the fan. The spinner cap is secured by a screw **51** which passes through a central hole **53** in the pitch plate and engages a tapped hole **52** in the end of shaft **12**.

In changing the pitch it is most convenient to rotate plate **35** by grasping any two opposite blades **27** and rotating them in opposite directions on the common axis of their shanks **26**. This will rotate plate **35** to the desired pitch angle as indicated on scale **46**.

When it is desired to adjust the pitch of blades **27**, screw **51** and spinner cap **50** are first removed. Then the three nuts **34** and the three nuts **43** are loosened. This permits pitch plate **35** to be rotated to the desired blade pitch as indicated on scale **46**. If it is desired to remove some of the blades, the nuts **34** and **43** are loosened sufficiently to permit saddle plate **31** to move forward from body plate **20** far enough to allow shouldered

portions 29 to be withdrawn out of the bores 25, 25*a*. Every other blade may be removed to provide a three-bladed fan or four of the blades may be removed to provide a two-bladed fan. When the nuts 34 and 43 are tightened, both the pitch plate 35 and the shanks 26 are clamped securely in adjusted position. The shouldered portions 29 on the blade shanks provide positive locks in the recesses 28 to prevent withdrawal of the blades by centrifugal force.

Thus, the blades are both secured and made adjustable by the three parts 20, 31 and 35 which may be made as inexpensive die castings. The blades and their shanks may be made entirely of a strong and durable plastic except for the pins 30 which are preferably made of steel and included as integral parts of the blade shanks during the molding operation. This provides an economical form of construction which is very durable and fully satisfies the variable speed requirements of the pump for crop spraying purposes.

Having now described my invention and in what manner the same may be used, what I claim as new and desire to protect by Letters Patent is:

1. A variable pitch fan for driving a rotary mechanism comprising a body plate having a hub for a shaft, a plurality of semi-cylindrical recesses in said plate radial to said hub, a plurality of bolts parallel with the axis of said hub passing through said body plate, a saddle plate mounted on said bolts and having semi-cylindrical recesses mating with said first recesses to form cylindrical bores, fan blades having cylindrical shanks in said bores, pins on said shanks radial to said shanks, said saddle plate having openings for said pins, a second plurality of bolts parallel with the axis of said hub and passing through said body and saddle plates, a rotatable pitch plate adjacent said saddle plate having arcuate slots for mounting the pitch plate for limited rotation on said last bolts, said pitch plate having notches in its edge portions engaging the pins of all of said blade shanks and arranged to change the pitch of all the blades in unison, nuts on said first plurality of bolts for clamping said body and saddle plates against said blade shanks, and nuts on said second plurality of bolts to clamp all of said plates together and prevent rotation of said pitch plate relative to said body and saddle plates.

2. A spray pump for aircraft comprising a pump having a housing and an impeller shaft, a brake mechanism mounted on said pump housing, a body plate having a hub secured on said shaft, a plurality of semi-cylindrical recesses in said plate radial to said hub, a brake drum surrounding said brake mechanism, a plurality of bolts parallel with said shaft passing through said brake drum and said body plate for mounting the brake drum on said body plate, a saddle plate mounted on said bolts and having semi-cylindrical recesses mating with said first recesses to form cylindrical bores, fan blades having cylindrical shanks in said bores, pins on said shanks radial to said shanks, said saddle plate having openings for said pins, a second plurality of bolts parallel with said shaft passing through said brake drum and said body and saddle plates, a pitch plate adjacent said saddle plate having arcuate slots for mounting the pitch plate for limited rotation on said last bolts, said pitch plate having notches in its edge portions engaging the pins of all of said blade shanks and arranged to change the pitch of all the blades in unison, nuts on said first plurality of bolts for securing said brake drum to said body plate and for clamping said body and saddle plates against said blade shanks, and nuts on said second plurality of bolts to clamp said brake drum and all of said plates together and prevent rotation of said pitch plate relative to said body and saddle plates.

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