March 18, 1958 R. D. MADISON ET AL 2,827,224

INLET VANE ACTUATING DEVICE

Filed June 30, 1955 2 Sheets-Sheet 1

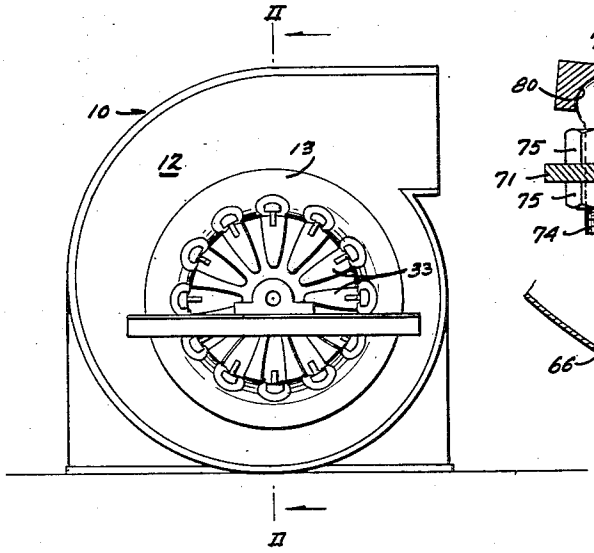


FIG. 1.

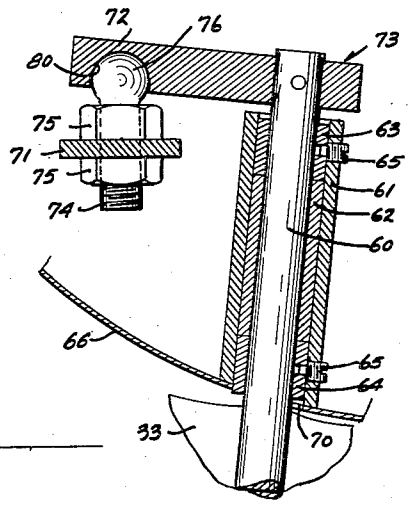


FIG. 5.

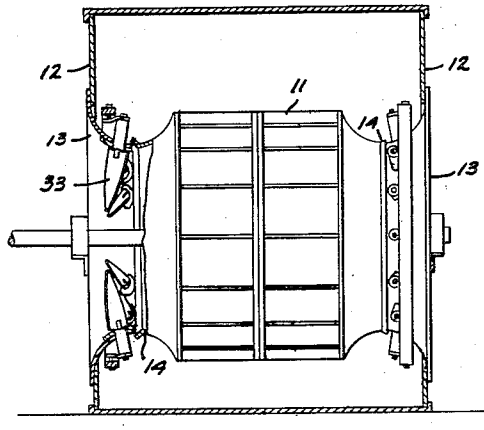


FIG. 2.

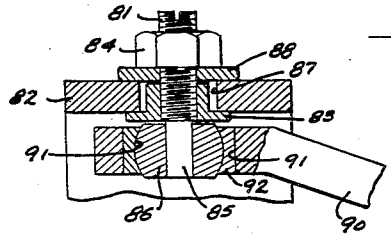


FIG. 6.

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March 18, 1958 R. D. MADISON ET AL 2,827,224

INLET VANE ACTUATING DEVICE

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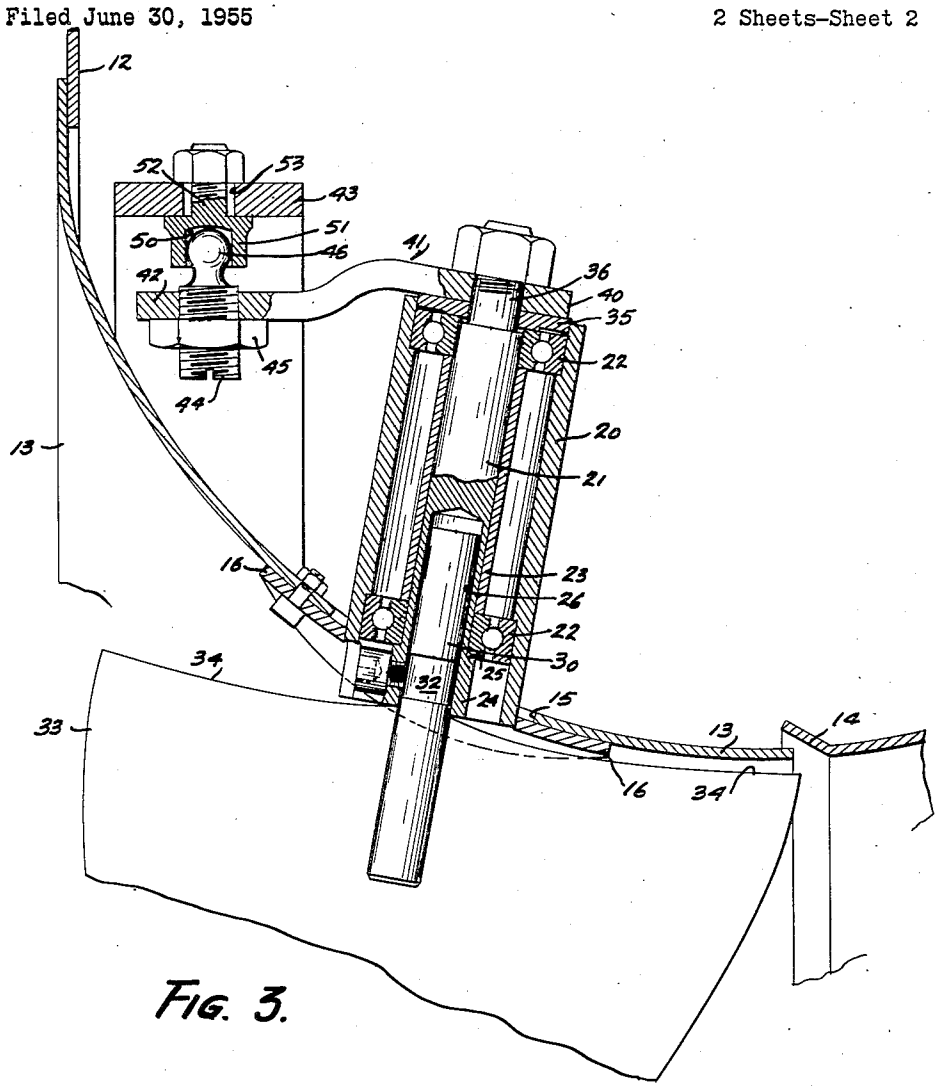


FIG. 3.

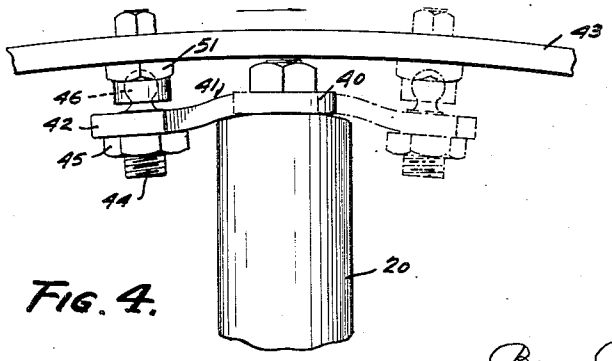


FIG. 4.

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INLET VANE ACTUATING DEVICE

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5 Claims. (Cl. 230—114)

Our invention relates in general to centrifugal fans, and in particular to the inlet vanes of such fans.

The principal object of our invention is to provide a plurality of cantilever inlet vanes supported at their outer ends, each having its axis radially disposed and its upper end inclined inwardly in the inlet eye.

Another object is to provide a vane adjusting means which is simple in design and which reduces the number of parts usually required for vane control.

Another object is to provide a mounting for fan inlet blades which may be individually removed from the fan housing in convenient manner.

A further object is to provide a plurality of inlet vanes so shaped and positioned in the inlet eye that leakage of air is minimized as the vanes are moved to their closed positions.

Furthermore, it has been an object to provide regulating means carried by each vane and connected together by means of a floating ring, whereby unison operation of the vanes is achieved.

The above objects and advantages have been accomplished by the device shown in the accompanying drawings, of which:

Fig. 1 is an exterior view of a centrifugal fan embodying our invention;

Fig. 2 is a fragmentary sectional elevation thereof taken on line II—II of Fig. 1;

Fig. 3 is an enlarged fragmentary sectional view of one of the vanes and its actuating mechanism and is taken on line II—II of Fig. 1;

Fig. 4 is a fragmentary elevation of the vane actuating means as viewed from the inside of the casing toward the outside thereof;

Fig. 5 is a longitudinal sectional view of a modification of our invention; and

Fig. 6 is a fragmentary sectional view of another modification form of our invention.

While we show our invention in Fig. 2 as applied to a double inlet fan, it is obvious that it may be applied to any type of centrifugal fan.

In the drawings, **10** represents the fan casing, and **11** the fan wheel. The casing is provided with two side walls **12** in each of which is mounted an inlet eye **13**. The fan wheel **11** is formed at each side with a shroud ring **14**. Each of the inlet eyes is formed, where a vane is to be located, with an opening **15** which is covered by means of a patch plate **16**. Each patch plate is attached to the eye by suitable removable fastening means. Each of the patch plates carries a vane shaft housing **20** which is secured to the plate preferably by welding. Each housing projects through the adjacent opening **15** and extends into the interior of the casing above the inlet eye. Each of these housings has its axis radially disposed and its upper end inclined inwardly from a plane normal to the axis of said wheel as shown in Fig. 3 for reasons to be hereinafter described.

Mounted within each of the vane shaft housings is a vane shaft **21** supported by two anti-friction bearings

22 held in spaced relation by means of a separator sleeve **23**. Each vane shaft is provided at its lower end with an enlarged portion **24** forming a shoulder **25** which bears against the lower bearing **22**. The lower end of each of the vane shafts is formed with an axial recess **26** within which the upper end of a stub shaft **30** is disposed. Each stub shaft is held in place by means of a set screw **31** which preferably engages a reduced portion **32** formed on the stub shaft. Each of the stub shafts carries an inlet vane **33** which is preferably secured thereto by means of welding or the like. The upper edges **34** of each of the vanes are curved so that they conform substantially to the shape of the inlet eye when approaching closed position, whereby leakage of air is minimized. A bearing washer **35** is preferably secured to the upper reduced end **36** of the vane shaft, and this washer, which bears against the upper bearing **22**, serves to prevent axial movement of the vane shaft.

Carried at the upper end of each of the vane shafts **21** and secured in place upon the reduced portion **36** thereof is the end **40** of an actuating lever **41**. This lever extends outwardly toward the inlet bell and, when in mid position, has its outer end **42** preferably so disposed as to be substantially coplanar with the axis of the wheel. Mounted about the series of actuating levers **41** and disposed over the outer ends thereof is a rigid one-piece adjusting ring **43**. Carried by each of the ends **42** of the actuating levers is a coupling unit having a ball stud **44** which is screwthreaded into the end of the lever and is adjustably locked in place by means of a lock nut **45**. Each ball stud when in mid position has its axis substantially perpendicular to the wheel axis and is provided at its upper end with a ball **46** which engages a cylindrical recess **50** of the coupling unit which is formed with a sleeve member **51**. Each sleeve member is provided with a sleeve stud **52** which is passed through a slotted aperture **53** formed in the ring **43**. As hereinbefore pointed out the axis of each vane shaft housing and, therefore, the vane shaft mounted therein is radially disposed and inclined inwardly at its outer end, whereby when the ends **42** of the actuating levers are oscillated by movement of the adjusting ring **43**, the arcuate paths described by the balls **46** will be substantially concentric with the path of the adjusting ring about the axis of the fan shaft. During this oscillation there is substantially no sliding movement between the ball and the sleeve, but free rotative and angular movement between the parts is permitted as well as lateral movement of the ring. The slot **53** provides for initial adjustment of the socket members with relation to the ball studs.

In the form of invention shown in Fig. 5, the vane shaft **60** is of one-piece construction and extends through a vane shaft housing **61**. This housing is tubular in form and the inner diameter thereof is larger than the diameter of the shaft. A spacer **62** is fixedly mounted upon the shaft and is rotatably disposed within the vane housing. Bearings **63** and **64** are disposed at each end of the spacer and the shaft is mounted therein. The bearings are secured in place by means of set screws **65**. By means of the bearings **63** and **64** and the spacer **62**, the vane shaft **60** is prevented from axial movement within the shaft housing. The housing in this form of the invention is permanently secured at its lower end to the inlet bell **66** of the fan, a suitable opening **70** being formed therein for the accommodation of the shaft **60** and the lower bearing **64**.

In this modification, the rigid one-piece adjusting ring **71** is mounted inwardly of the outer ends **72** of the shaft levers **73**. This ring carries a series of ball studs **74** which are adjustably mounted by means of lock nuts **75**. Each of the studs is formed at its upper end with a ball **76** which engages a cylindrical recess **79** having a semi-

spherical recess 80 formed in the inner side of the end 72 of the lever.

The modification shown in Fig. 6 comprises a plurality of ball studs 81 which are carried by the rigid one-piece adjusting ring 82. Each of the studs is screwthreaded into a clamping washer 83 which bears against the bottom surface of the ring and which has its body portion disposed within a lateral slot 87 formed in the ring. A lock nut 84 engaging a washer 88 serves to lock the stud in adjusted position. The lower end of the stud is provided with a cylindrical portion 85 upon which a ball 86 is rotatably mounted. The adjusting lever 90 in this form of the invention is formed with a cylindrical recess 91 in which is mounted a two-part socket member 92. Each portion of the socket member has a spherical inner surface 93 for engagement with the spherical surface of the ball 86. In this form of invention, any axial movement between the ball 86 and the ring 82 will be permitted by sliding movement thereof upon the cylindrical portion 85.

From the foregoing it will be obvious that as the adjusting ring in either form of invention is rotated, the socket members will transmit motion through the engaged balls to the actuating levers, whereby each of the vanes will be adjusted in unison with the other vanes.

While we have shown and described the vanes as being of cantilever type, it is obvious that in large fans it may be necessary to support the free end of each of the vanes in suitable bearing means. These and other objects of the details herein shown and described may be made without departing from the spirit of our invention or the scope of the appended claims.

What is claimed is:

1. The combination in a centrifugal fan, of an inlet bell formed with a series of spaced openings, a patch plate secured to said bell over each of said openings, a vane shaft housing carried by each patch plate, each of said housings being inclined so that the outer end thereof is positioned toward a plane passing through the smaller diameter of the bell, a vane shaft carried by each housing and having an inlet vane carried by its free end, an actuating lever secured at the inner end to each of said shafts, a rigid one-piece adjusting ring adjacent the outer ends of said actuating levers, and means comprising a ball and a sleeve for connecting the outer end of each of said levers to said ring.

2. The combination with the inlet bell of a centrifugal fan, of a plurality of vane shaft housings detachably carried by said inlet bell, a cantilever vane shaft rotatably mounted in each of said housings, the axis of each shaft being inclined so that the outer end thereof is positioned toward the smaller diameter of the bell, a stub shaft removably carried by said vane shaft, an inlet vane carried by each of said stub shafts, an actuating lever carried by each vane shaft, a laterally movable rigid one-piece adjusting ring associated with said levers, and a free universal coupling carried by said ring and said levers for pivotally connecting the last mentioned parts, whereby said vanes will be actuated in unison.

3. The combination with the inlet bell of a centrifugal fan, of a plurality of inlet vane shafts rotatably carried by said bell, an inlet vane carried by each of said vane shafts, the axis of each shaft being inclined so that the outer end thereof is positioned toward a plane passing through the smaller diameter of the bell, an actuating lever carried by each vane shaft, a rigid one-piece adjusting ring associated with said levers, and a coupling unit comprising a single ball and a single sleeve formed with a cylindrical bore carried by said ring and by each of said levers for pivotally connecting said levers to said adjusting ring for unison actuation of said vanes, said ring being supported solely by said coupling units.

4. The combintaion with the inlet bell of a centrifugal fan, of a plurality of inlet vane shafts rotatably carried by said bell, an inlet vane carried by each of said vane shafts, the axis of each shaft being inclined so that the outer end thereof is positioned toward a plane passing through the smaller diameter of the bell, an actuating lever carried by each vane shaft and having its outer end substantially coplanar when in mid position with the axis of said fan, a rigid one-piece adjusting ring associated with said levers and a coupling unit comprising a single ball and a single sleeve formed with a cylindrical bore carried by said ring and by each of said levers for pivotally connecting said levers to said adjusting ring for unison actuation of said vanes, said ring being supported solely by said coupling units.

5. The combination with the inlet bell of a centrifugal fan, of a plurality of vane shaft housings detachably carried by said inlet bell, a cantilever vane shaft rotatably mounted in each of said housings, the axis of each shaft being inclined so that the outer end thereof is positioned toward the smaller diameter of the bell, an inlet vane carried by each of said vane shafts, an actuating lever carried by each vane shaft, a rotatable adjusting ring carried solely by said levers, said ring being laterally movable when being adjusted, and a plurality of two-part universal coupling units connecting said ring and said levers, each of said units comprising a single ball and a single sleeve formed with a cylindrical bore for actuating said vanes in unison.

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