March 30, 1954 E. A. MADER 2,673,681

COMBINED FLUID IMPELLER AND SELF-SEALING CLOSURE

Filed June 7, 1950 4 Sheets-Sheet 1

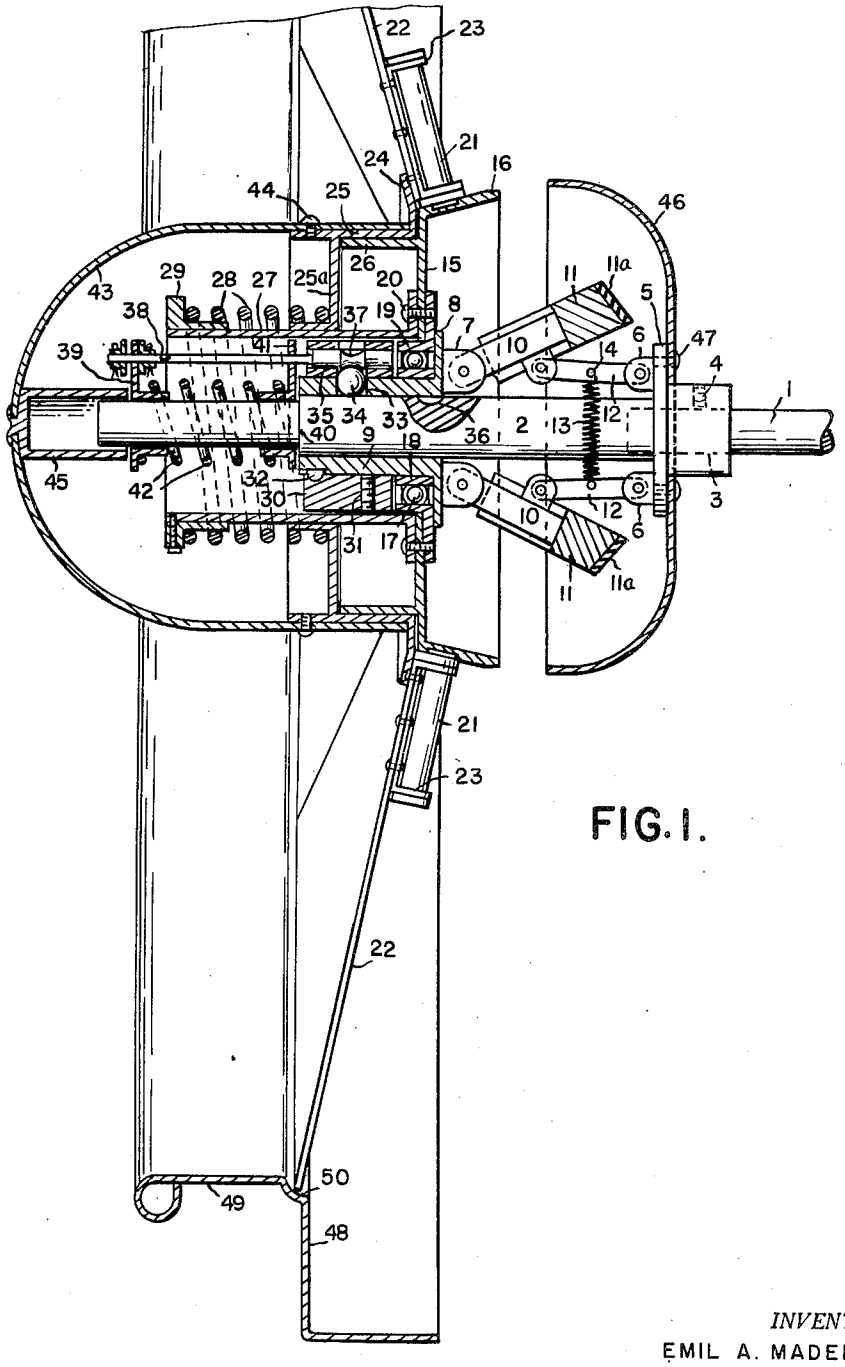


FIG. 1.

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COMBINED FLUID IMPELLER AND SELF-SEALING CLOSURE

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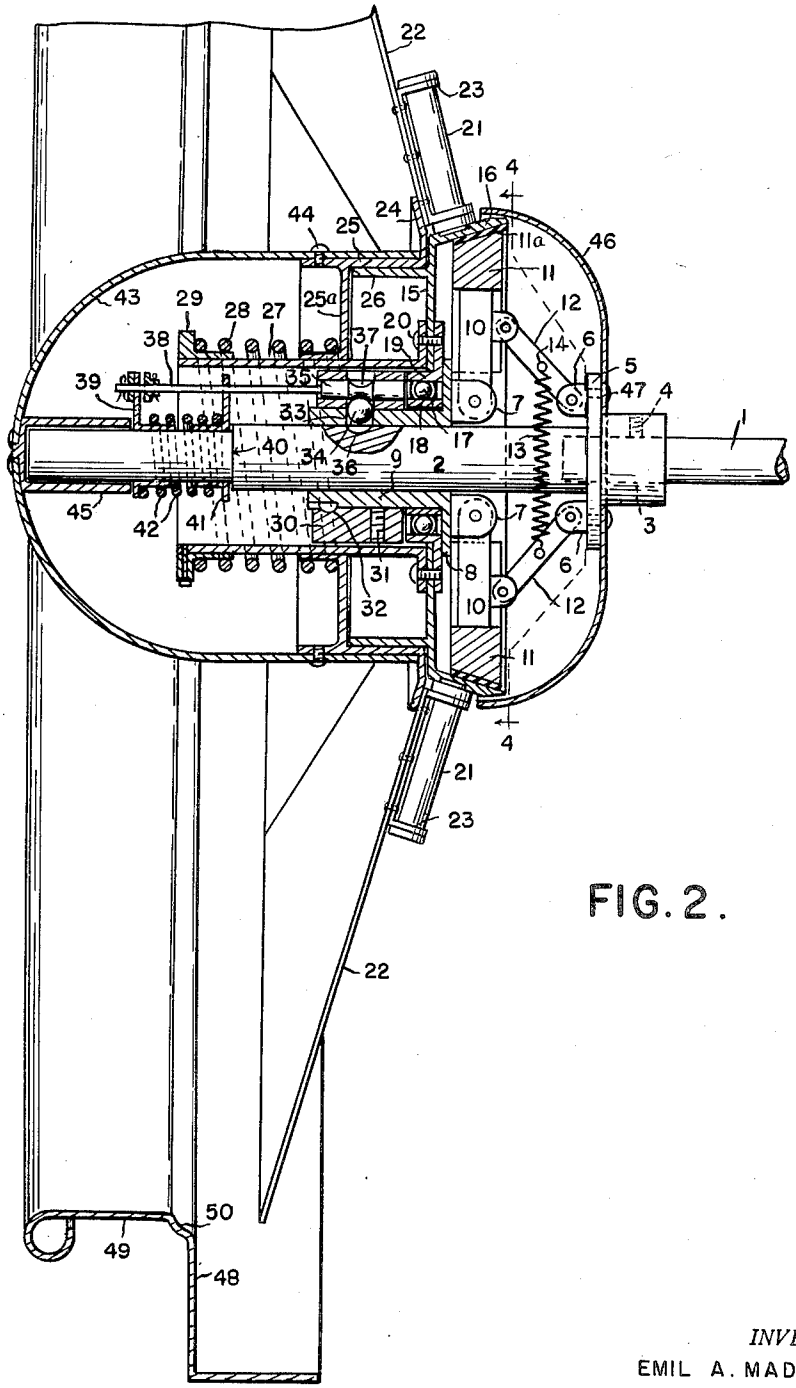


FIG. 2.

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COMBINED FLUID IMPELLER AND SELF-SEALING CLOSURE

Filed June 7, 1950 4 Sheets-Sheet 3

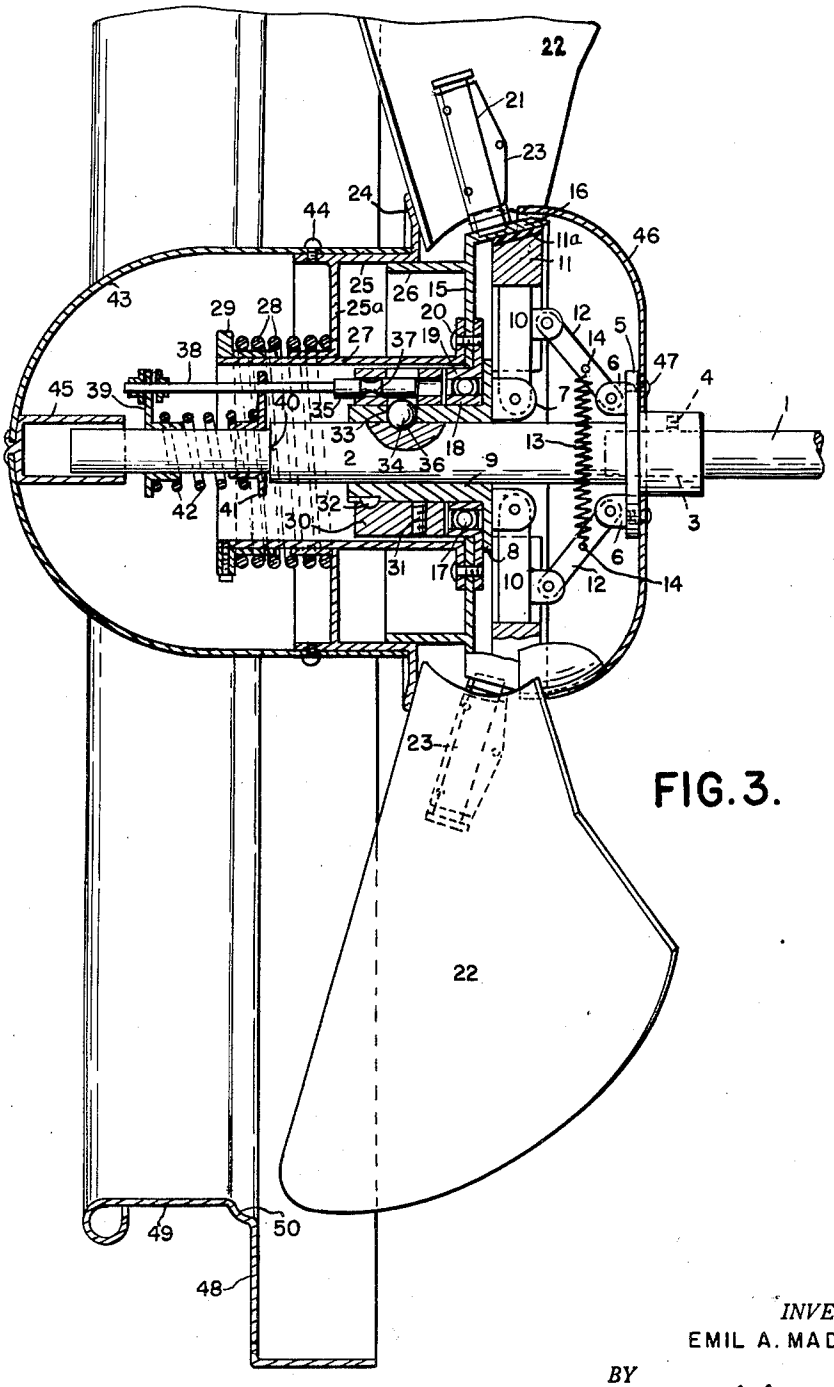


FIG. 3.

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COMBINED FLUID IMPELLER AND SELF-SEALING CLOSURE

Filed June 7, 1950 4 Sheets-Sheet 4

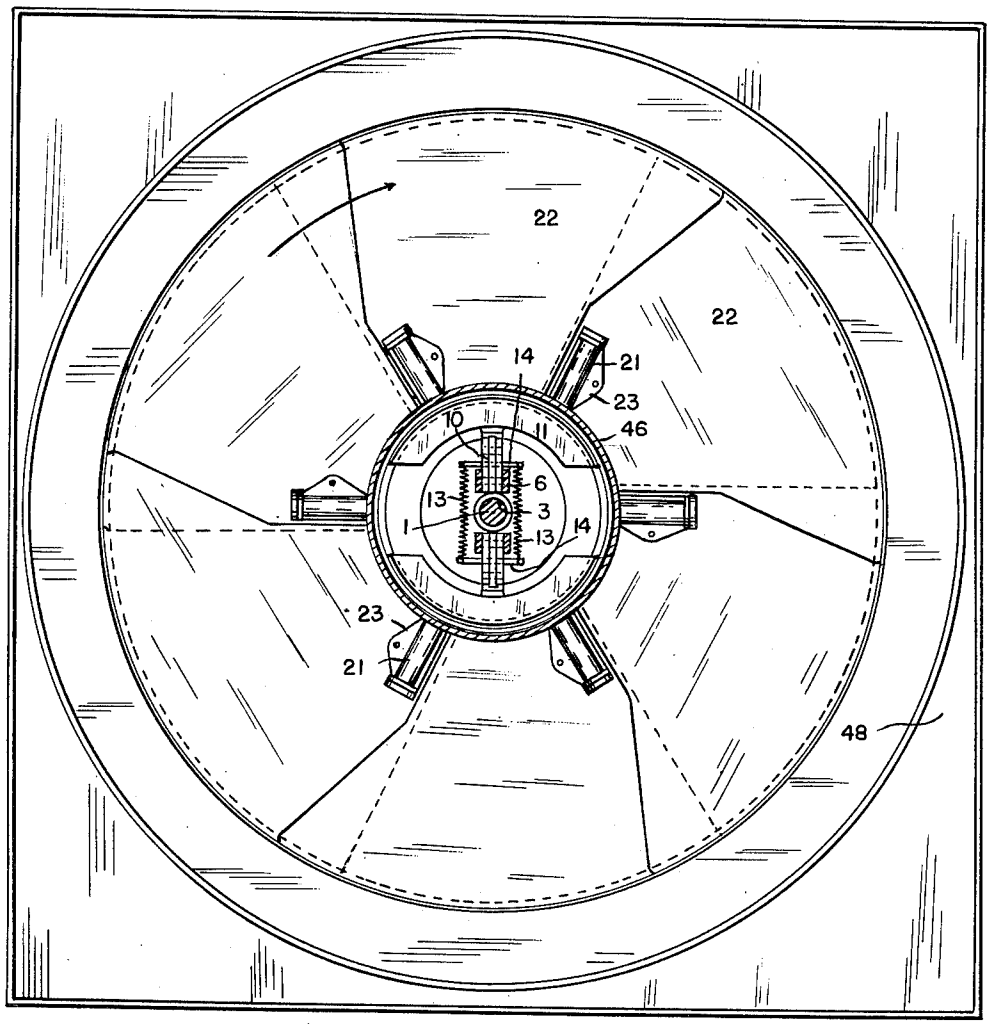


FIG. 4.

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Patented Mar. 30, 1954

2,673,681

UNITED STATES PATENT OFFICE

2,673,681

COMBINED FLUID IMPELLER AND SELF-SEALING CLOSURE

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Application June 7, 1950, Serial No. 166,716

19 Claims. (Cl. 230—114)

1

This invention relates to combined fluid impellers and closures, and relates particularly to improvements on the subject matter of my copending application, filed March 22, 1950, under Serial No. 151,250.

In common with said application, the present construction adapts an impeller of a swivel blade type to travel along its axis between impelling and closure-forming positions, according as a drive is applied or discontinued, the blades being permitted to swivel only while occupying their impelling position, whereby it is feasible to automatically engage the blade peripheries firmly with the margin of an opening controlled by the blades to adequately seal such opening, while avoiding interference by said margin with centrifugal swiveling of the blades.

An object of the invention is to provide for centrifugally shifting the impeller axially to its impelling position when a drive is applied, and to employ spring means for returning the impeller to its closure position following discontinuance of the drive.

Another object is to provide an impeller, functioning alternatively as a closure and slidable on its shaft between impelling and closure-forming positions, to further provide centrifugal means for sliding the impeller to impelling position upon application of a drive to the shaft, and to employ the same centrifugal means for clutching the impeller to the shaft, as the impelling position is established.

Another object is to associate with an impeller of the aforementioned type a set of weighted clutch shoes rotatable with the shaft and adapted to swing centrifugally outward from the shaft upon application of a drive to transmit such drive to the impeller, and to further utilize centrifugal swinging of the shoes to shift the impeller axially on its shaft from its closure-forming to its impelling position.

Another object is to provide an improved type of automatic latch, controlled by swivel motion of the impeller blades on their axes, and serving to positively maintain the impeller in its impelling position as regards axial travel, until the blades have collapsed after discontinuance of a drive.

Another object is to materially simplify the mechanism disclosed in my aforementioned copending application.

These and various other objects are attained by the construction hereinafter described and illustrated in the accompanying drawings, wherein:

Fig. 1 is a diametrical sectional view of my improved dual purpose impeller, showing its

2

blades positioned to close the air flow opening in a panel.

Fig. 2 is a similar sectional view showing the impeller axially shifted to its impelling position, with its clutch closed preliminary to rotative actuation of the impeller.

Fig. 3 is a similar sectional view, showing the blades swiveled to exercise an impelling function and resultant latching of the impeller against axial travel.

Fig. 4 is a rear elevational view of the impeller and correlated panel, with the blades occupying their collapsed position, said view being partially in section as indicated by the line 4—4 of Fig. 2.

In these views, the reference character 1 designates the shaft of a motor (not shown), on which shaft is fixed, in alignment therewith, an impeller shaft 2. As illustrated, an extremity of the motor shaft is inserted in a socket 3 of the impeller shaft and rigidly secured therein by a set screw 4. The shaft 2 has an annular flange 5 adjoining said socket and formed with a pair of lugs 6 at opposite sides of such shaft. Confronting and spaced from such lugs is a pair of lugs 7 on an annular flange 8 terminally carried by a collar 9 slidable on the shaft 2. The lugs 7 pivotally mount the inner ends of a pair of oppositely swinging arms 10, on the outer ends of which are centrally fixed a pair of complementary arcuate centrifugally weighted clutch shoes 11. These have frusto-conical terminal driving faces lined with frictional material 11a. A pair of links 12 form swinging connections from the arms 10 to the lugs 6, outwardly diverging when the arms are normal to the shaft as in Figs. 2 and 3, and closely approaching parallelism to the shaft when the arms are collapsed, as in Fig. 1. Thus each of said arms and the corresponding link form a toggle pair for applying a thrust or pull to the collar 9. A pair of coiled springs 13 interconnecting the links 12 and anchored thereto by pins 14, urge the arms to a collapsed position. It is to be noted that the collar 9 is driven by and in unison with the shaft 2, due to the connections formed by said arms and links. An impeller hub comprising a web 15 and a rim 16 is freely rotatable on the collar 9, and it is preferred to afford such hub an anti-friction bearing on the collar. Thus a set of balls 17 is interposed between inner and outer race rings 18 and 19 fixed respectively on the collar and web, the outer ring being secured to the web by screws 20. The rim 16 is frusto-conical and proportioned for clutch coaction with the shoes 11. Thus when the shoes interiorly

engage said rim, the hub is clutched to and will be driven by the shaft 2.

Welded to or otherwise fixed on the rim 16 is a plurality of equidistant pins 21 outwardly projecting at right angles to such rim, such pins thus jointly forming a skeleton cone of quite obtuse pitch. An impeller blade 22 is swiveled on each pin by a bracket 23 fixed on the inner end of such blade, the blades being so transversely curved that they may lap each other to jointly form a conical closure, in one of their limiting swivel positions. This curved form also adapts them for highly effective air impulsion in their other limiting swivel position.

At their sides remote from the pivot pins 21, the blades are engaged by an annular flange 24, outstanding from a thrust ring 25, slidable on an annulus 26 laterally fixed on the web 15. Said thrust ring has an inward extension 25*a*, surrounding a sleeve 27 rigidly projecting laterally from the web. Coiled on said sleeve is a spring 28 compressed between the extension 25*a* and a collar 29 fixed on the outer end of the sleeve.

Within the sleeve 27, a collar 30 is fixed on the collar 9 by a set screw 31, and is preferably further keyed to the collar 9, as at 32. A socket 33 radially drilled in the collars 9 and 30 loosely receives a ball 34. In the collar 30, a latch bolt 35 reciprocates, in parallelism with the shaft in a smaller drill hole intersecting the socket 33, the ball 34 being confined between the shaft and latch bolt. The shaft has a shallow spherical depression 36 to receive the ball 34, and the latch bolt has a shallow annular groove 37 for a like purpose. The latch bolt is formed on and operable by a pin 38 extending parallel to the shaft and anchored to a collar 39 slidable on the free end portion of the shaft. The shaft has an annular shoulder 40 inwardly spaced from the collar 39 and abutted by a collar 41 wherein the pin 38 is slidable, and a spring 42 is coiled on the shaft between the collars 39 and 41, tending to hold said collars predeterminedly spaced. A dome-shaped cap 43, telescoped at its open end over the thrust ring 25 and secured to such ring by screws 44, encloses the described collars, springs and latch provision, and the corresponding portion of the shaft, said cap rigidly and axially carrying a thrust tube 45 projecting inwardly and freely receiving the free end portion of the shaft. Under conditions to be presently explained, the thrust tube engages and shifts the collar 39, together with the pin 38 and latch bolt 35.

It is preferred to provide a dish-shaped dust cover 46 for the clutch mechanism of the described impeller, such cover being attached by screws 47 to the flange 5, and overlapping the rim 16 when the clutch is in driving position.

Associated with the described impeller is a panel 48 formed with a collar 49, forming a circular opening closed by the blades 22 when they are idle, and conducting impelled air when the blades are driven. At the juncture of the collar and panel and at the margin of said opening, there is formed an annular seat 50 for the blade peripheries, such seat presenting to the blades a surface acutely divergent to the axis of said collar. The described panel is positioned in any desired manner in a coaxially fixed relation to the shaft 2, and will most commonly be mounted in the wall of a building (not shown) requiring ventilation by the impeller.

Operation

When the impeller is idle, its blades are collapsed, as in Figs. 1, 2, and 4, due to thrust applied to their inner ends by the thrust ring 24, 25, 25*a*, responsive to the coiled spring 28. This maintains the blades in a cone-forming position, with their margins interlapped and in mutual sealing engagement, the flange 24 forming a seal for any space interval between the blades and hub. The clutch shoes 11 and their supporting arms 10 are maintained by the springs 13 at the moderate divergency to the shaft shown in Fig. 1, the inner ends of the arms having a toggle coaction with the links 12 to urge the impeller and its sliding supporting assembly to their Fig. 1 position, the blade peripheries having a firm sealing engagement with the panel 48. The groove 37 of the latch bolt 35 receives the ball 34, and the latter is spaced from the shaft depression 36 a distance determined by axial play of the sliding assembly.

When subjected to a drive, the shaft 2 with the arms 10, shoes 11, collars 9, 30, 39 and 41 initially rotates independently of the blades and hub, this condition continuing momentarily while said arms and shoes centrifugally swing outward, drawing the entire sliding assembly to a position (Fig. 2) setting up ample clearance between the blades and panel 48. In completing their outward swing, the shoes 11 frictionally seat on the rim 16, thus establishing a drive to the impeller. In assuming its Fig. 2 position, the sliding assembly acts through the thrust tube 45 to shift the collar 39, pin 38, and latch bolt 35 in substantial unison with such assembly, the spring 42 thus being compressed. The ball 34, while maintaining its registration with the groove 37 of the bolt, assumes additional registration with the shaft depression 36 as the various parts assume their Fig. 2 position. Such positioning of the ball is preliminary to locking the sliding assembly in its Fig. 2 position by means of the ball, as explained in the following paragraph.

Referring now to Fig. 3, this shows the blades in their air-impelling position, established a moment subsequent to the propeller drive. In picking up speed, the blades swivelly respond to centrifugal force, their impelling position (Fig. 3) being established since such position entails a slight outward shifting of their centers of gravity as compared to their cone-forming idle position. Clearance of the blade tips from the panel 48 is materially reduced by the described centrifugal swiveling of the blades, but such clearance remains adequate. The inner ends of the several blades exert a camming pressure on the flange 24 in responding to centrifugal force, whereby the thrust ring 24, 25, 25*a* is shifted away from the hub 15, 16 and correspondingly shifts the cap 43 and thrust tube 45. This relieves compression of the spring 42, which forces the collar 39 to its Fig. 3 position, said collar carrying with it the pin 38 and latch bolt 35. The groove 37 of the bolt is now out of registration with the ball 34, and said bolt hence locks the ball in the shaft depression 36, the illustrated (Fig. 3) limiting position of the sliding assembly being thus positively maintained.

Upon discontinuance of a drive to the impeller, deceleration of the blades rapidly reduces their subjection to centrifugal force and hence reduces their camming effect on the flange 24, permitting the spring 28 to swivelly shift them to their cone-forming position, as per Fig. 2. The clutch shoes 11 are likewise relieved of centrifugal force and tend to promptly respond to the springs 13 but are restrained from such response by the latch effect of the ball 34. In other words, said

shoes cannot swing in without simultaneously shifting the sliding assembly to the position shown by Fig. 1. When, however, the parts have assumed their position shown in Fig. 2, the ball 34 is free to escape from the depression 36, and such escape allows travel of the sliding assembly to its Fig. 1 position in response to springs 13. The described delay in establishment of the idle position of the sliding assembly is of the essence of the invention, since without such delay, the blades could be thrown against the panel while still retaining considerable velocity, and such velocity could centrifugally hold the blades more or less expanded. The blades could thus be bent and damaged, and in any event an undesirable loud clashing noise would occur, accompanied by heavy wear on the blades and panel.

Extensive tests of the described construction have shown its ability to operate under the most adverse conditions, starting and stopping freely, and maintaining an almost perfect seal in functioning as a closure. One of the severest tests of such a device consists in positively maintaining the closure position of the blades, while applying a drive to the shaft 2. Such a condition would arise in actual practice only in case a heavy ice formation bonded the blade tips tightly to the panel. The mechanism is such as to permit the shaft to be motor-driven under such conditions, the parts maintaining their Fig. 1 position, and no damaging excessive load being thrown on the motor. The weighted shoes would be strongly stressed centrifugally outward but could not respond to such stress except through release of the blade tips. Hence shaft rotation would exert a constant pull on the blades, such as to soon release them, unless very heavily bonded to the panel.

Another important advantage of the described mechanism is a positive locking of the blades in their closure position, resulting from alignment of the links 12 with the pivots of the arms 10. Thus high winds or other forces acting on the concaved faces of the closed blades cannot overcome the restraint imposed by the springs 13.

From the foregoing it will appear that the arms 10, weights 11, links 12, and springs 13 form a centrifugal controller which automatically establishes the impeller at its limits of sliding travel. Additionally such controller automatically establishes or cuts off a rotary drive to the hub, transmits a rotary drive to the collar 9, and sets up a powerful locking action to maintain the closure position of the blades.

Other advantages lie in the thorough safeguarding of the mechanism from dust, dirt and moisture, and in adaptability of the construction to operate equally well on a horizontal or vertical axis, or at any divergency to such axes.

What I claim is:

1. In a combined impeller and closure of the type which is correlated with a member defining an opening for fluid flow and which is adapted to alternatively impel fluid through or close such opening, and employing blades and elements swiveling the blades individually on a hub to afford the blades either a fluid impelling or a collapsed position, and having said hub slidable on a shaft disposed substantially at the axis of said opening to establish clearance of the blade tips from the margin of said opening for impelling purposes or seat such tips at such margin for closure purposes, and having means yieldably biasing the blades swivelly on said elements toward their collapsed position, said type adapting the blades to swivelly assume impelling positions responsive to impeller rotation, the combination with said shaft, hub, and blades, of a centrifugal controller for sliding travel of the hub, carried by and rotative with the shaft, and effective on the hub to alternatively establish the clearance or seated relation of the blade tips to the margin of said opening, according as the shaft is driven or idle.

2. A combined impeller and closure as set forth in claim 1, said controller including a means for locking the hub in its blade-seating position.

3. In a combined impeller and closure as set forth in claim 1, a latch element for resisting sliding of the hub from its blade clearance position, and means for releasing the latch element responsive to swiveling of the blades to said collapsed position.

4. In a combined impeller and closure as set forth in claim 1, a collar carrying the hub and slidable on the shaft, said centrifugal controller comprising a plurality of weighted arms, means pivotally mounting such arms on the collar to swing to or from the shaft, swinging links interconnecting the arms and shaft and coacting with the arms to slide the hub toward or from its blade-seating position, according as said arms swing to or from the shaft, and spring means resisting outward swinging of the arms.

5. In a combined impeller and closure as set forth in claim 1, a collar carrying the hub and slidable on the shaft, said centrifugal controller comprising a plurality of weighted arms, means pivotally mounting such arms on the collar to swing to or from the shaft, swinging links interconnecting the arms and shaft and coacting with the arms to slide the hub toward or from its blade-seating position, according as said arms swing to or from the shaft, and spring means resisting outward swinging of the arms, said arms and links having toggle elements coacting to lock the collar in its blade-seating position.

6. In a combined impeller and closure as set forth in claim 1, a collar carrying the hub and slidable on the shaft, said centrifugal controller comprising a pivotally interconnected toggle pair, pivotally interconnecting the collar and shaft to swing to or from the shaft, spring means resisting swinging of the toggle pair from the shaft, and a weight connected to the toggle pair for centrifugally swinging such pair outwardly from the shaft responsive to a predetermined velocity of shaft rotation.

7. In a combined impeller and closure as set forth in claim 1, a collar carrying the hub and slidable on the shaft, and a latch element carried by said collar and coacting with the shaft to resist sliding of the collar from its position establishing impelling clearance of the blade tips, and means for releasing said latch element responsive to establishment of said collapsed position of the blades.

8. In a combined impeller and closure as set forth in claim 1, a clutch correlated with said centrifugal controller, for driving the hub from the shaft, the controller including means for closing or opening such clutch according as the clearance or seated positions of the blade tips are established by the controller.

9. In a combined impeller and closure of the type which is correlated with a member defining an opening for fluid flow and is adapted to alternatively impel fluid through or close such open-

ing, and employing blades and elements swiveling the blades individually on a hub to afford the blades either a fluid impelling or a collapsed position, and having said hub slidable on a shaft disposed substantially at the axis of said opening to establish clearance of the blade tips from the margin of said opening for impelling purposes or seat such tips at such margin for closure purposes, and having means yieldably biasing the blades swivelling on said elements toward their collapsed position, said type adapting the blades to swivelly assume impelling positions responsive to impeller rotation, the combination with said shaft and hub, of a centrifugal controller carried by and rotative with the shaft, means for sliding the hub along the shaft responsive to the controller to effect said positioning of the blade tips, and means for establishing or interrupting a drive from the shaft to the hub responsive to the controller.

10. In a combined impeller and closure of the type which is correlated with a member defining an opening for fluid flow and is adapted to alternatively impel fluid through or close such opening, and employing blades and elements swiveling the blades individually on a hub to afford the blades either a fluid impelling or a collapsed position, and having said hub slidable on a shaft disposed substantially at the axis of said opening to establish clearance of the blade tips from the margin of said opening for impelling purposes or seat such tips at such margin for closure purposes, and having means yieldably biasing the blades swivelly on said elements toward their collapsed position, said type adapting the blades to swivelly assume impelling positions responsive to impeller rotation, the combination with said shaft, hub, and blades, of a collar slidable on the shaft and carrying said hub, and a centrifugal controller carried by and rotative with the shaft and transmitting rotation from the shaft to said collar, and effective on the blades through said collar and hub to establish the clearance or seated relation of the blade tips to the margin of said opening according as the shaft is driven or idle.

11. In a combined impeller and closure of the type which is correlated with a member defining an opening for fluid flow and which is adapted to alternatively impel fluid through or close such opening, and employing blades and elements swiveling the blades individually on a hub to afford the blades either a fluid impelling or a collapsed position, and having said hub slidable on a shaft disposed substantially at the axis of said opening to establish clearance of the blade tips from the margin of said opening for impelling purposes or seat such tips at such margin for closure purposes, and having means yieldably biasing the blades swivelly on said elements toward their collapsed position, said type adapting the blades to swivelly assume impelling positions responsive to impeller rotation, the combination with said shaft, hub, and blades, of a collar slidable on the shaft and carrying said hub, a clutch element fixed on the hub, a coacting clutch element mounted on said collar and centrifugally movable outwardly to engage and inwardly to release the clutch element on the hub, and a link connecting said coacting clutch element to the shaft, and effective on the collar to slide the hub to or from its position affording the blade tips clearance for blade rotation, according as said coacting element is shifted outwardly or inwardly.

12. In a combined impeller and closure as set forth in claim 11, an arm pivoted on said collar to swing inwardly and outwardly, said arm carrying said coacting clutch element and being operatively engaged by said link.

13. In a combined impeller and closure of the type which is correlated with a member defining an opening for fluid flow and is adapted to alternatively impel fluid through or close such opening, and which comprises a hub, a plurality of blades, means swiveling the blades on the hub and thus affording their travel between an impelling and a closure position, the blades being centrifugally actuable from said closure to said impelling position responsive to their rotation about the hub axis, and spring means effective on the blades to yieldably maintain their closure position, the combination with the margin of said opening and with said blades and hub, of a collar on which the hub is rotatable, a shaft disposed substantially at the axis of said opening on which shaft the collar is slidable, and a controller mounted on and driven by the shaft, and including weights centrifugally outwardly movable from the shaft, spring means resisting outward movement of the weights, connections from the weights to the collar effective to slide the collar, hub and blades to alternatively clear the blades from the margin of said opening responsive to outward travel of the weights or seat them against such margin responsive to inward travel of the weights.

14. In a combined impeller and closure as set forth in claim 13, means for establishing a drive to said hub from the shaft, responsive to outward movement of said weights.

15. A combined impeller and closure as set forth in claim 13, said means swiveling the blades on the hub including pins outwardly extending from the hub, the respective blades being mounted on the respective pins.

16. In a combined impeller and closure of the type which is correlated with a member defining an opening for fluid flow and is adapted to alternatively impel fluid through or close such opening, and which comprises a plurality of blades, a hub carrying the blades, and a shaft disposed substantially at the axis of said opening whereon the hub and blades are slidable as a unit to seat the blades at the margin of the opening for closure purposes or clear them from such margin for impelling purposes, the combination with said blades, hub and shaft, of a controller on the shaft comprising arms, means pivoting the arms to swing inwardly toward or outwardly from the shaft, links interconnecting the arms and shaft and transmitting a drive from the shaft to the arms, weights on the arms tending to centrifugally swing the arms outward responsive to shaft rotation, and spring means for yieldably urging the arms inwardly, said arms and links having a toggle coaction for sliding the hub to clear the blades from or seat them at the margin of said opening according as said arms are outwardly or inwardly swung.

17. In a combined impeller and closure as set forth in claim 16, a pair of coacting clutch elements respectively carried by the hub and controller for driving the hub from the shaft, said elements operatively engaging or disengaging according as said arms are outwardly or inwardly swung.

18. A combined impeller and closure as set forth in claim 16, said arms and links forming linkages substantially parallel with the shaft

when the arms are inwardly swung, and consequently resisting shifting of the blades from their seated relation to the margin of said opening.

19. In a combined impeller and closure of the type which is correlated with a member defining an opening for fluid flow and is adapted to alternatively impel fluid through or close such opening, and which comprises a plurality of blades, a hub carrying the blades, and a shaft substantially at the axis of said opening whereon the hub and blades are slidable as a unit to seat the blades at the margin of said opening for closure purposes or clear them from such margin for impelling purposes, the combination with said blades, hub, and shaft, of a controller on the shaft including a weight, centrifugally movable inwardly toward the shaft and outwardly from the shaft, means responsive to outward travel of the weight for shifting the hub to its position clearing the blades from said

margin, means responsive to outward travel of the weight for establishing a drive from the shaft to the hub, and means yieldably resisting outward travel of the weight.

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