Oct. 27, 1953 E. A. MADER 2,656,971

COMBINED FLUID IMPELLER AND SELF-SEALING CLOSURE

Filed March 22, 1950 4 Sheets-Sheet 1

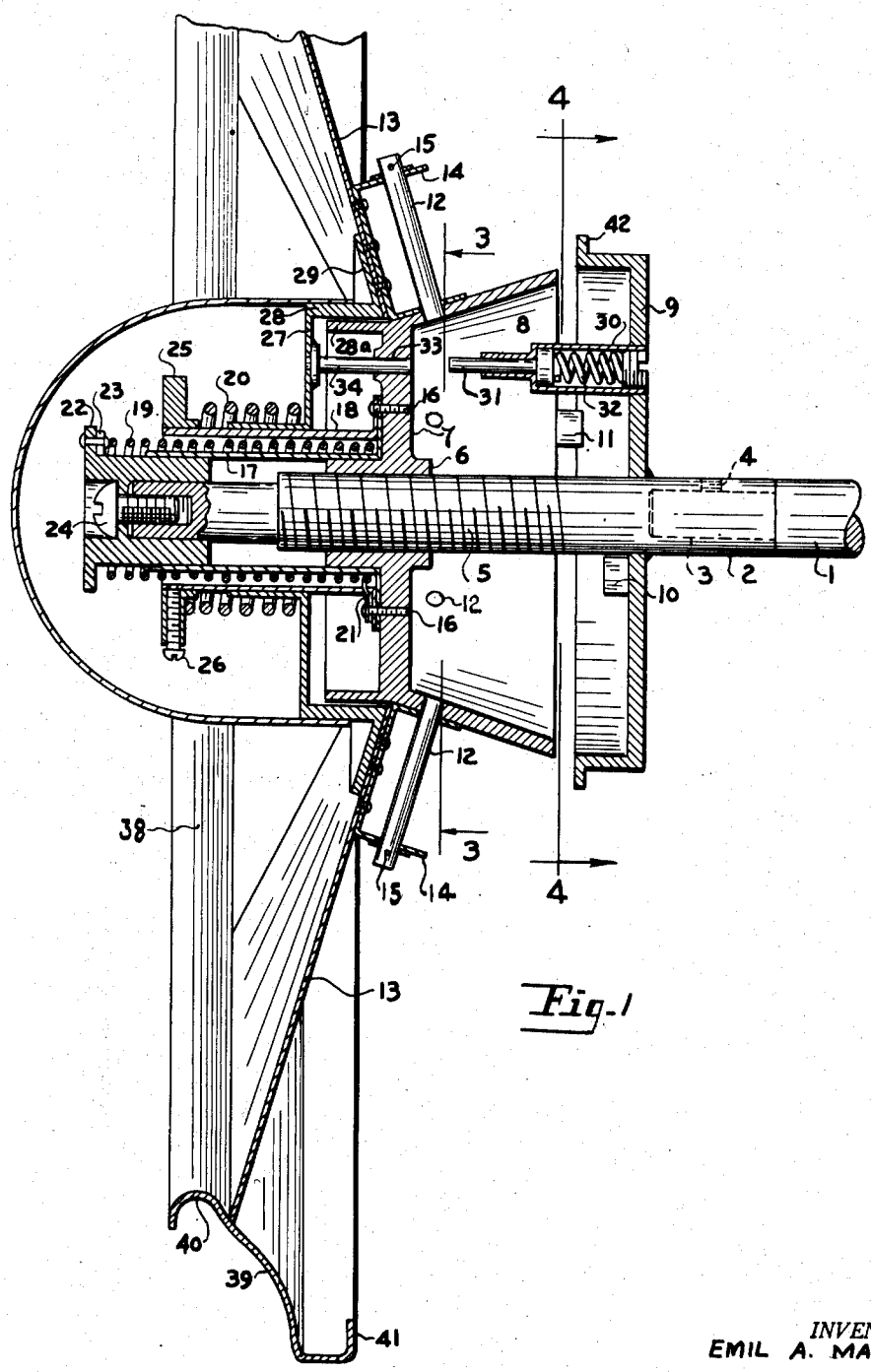


Fig. 1

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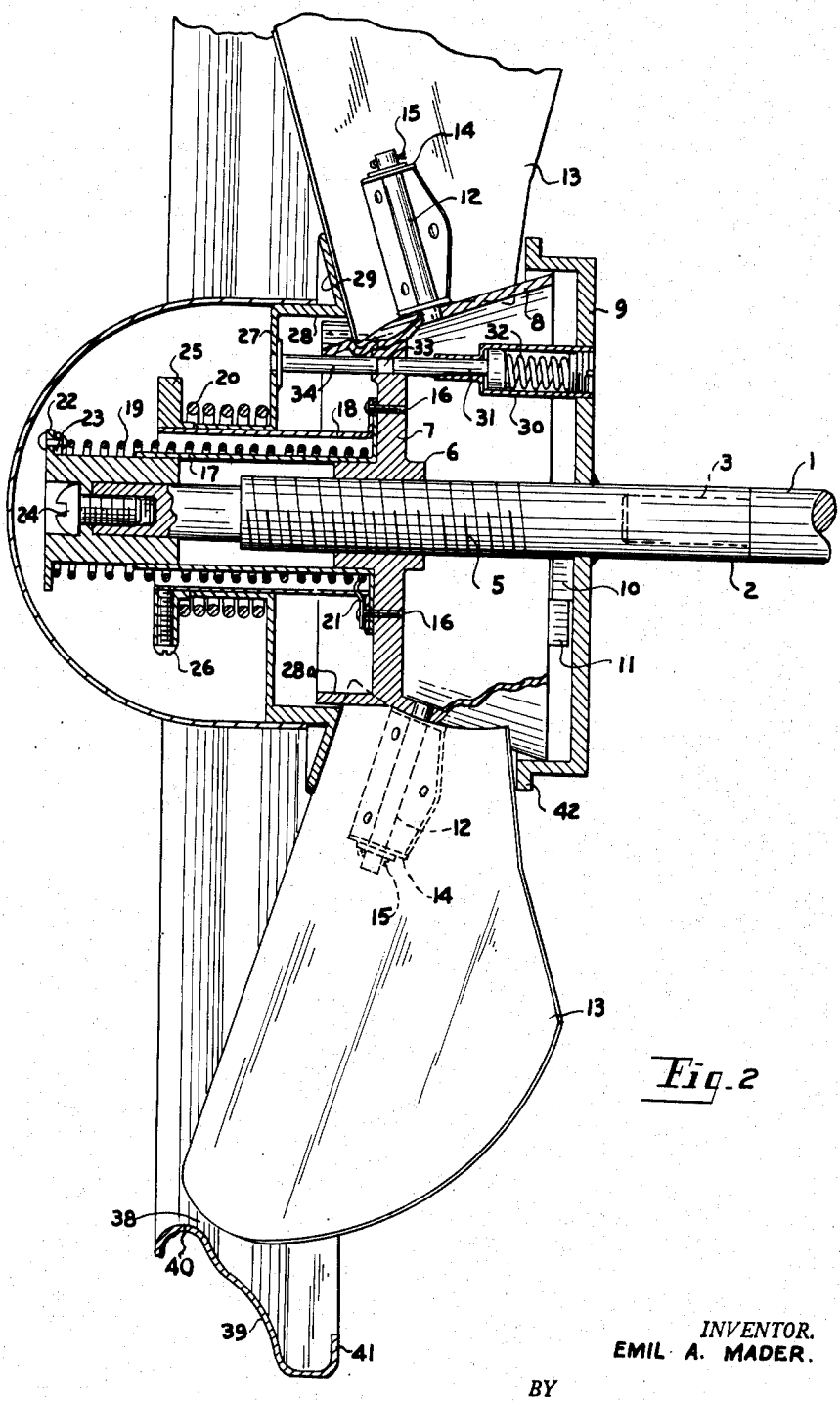


Fig. 2

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COMBINED FLUID IMPELLER AND SELF-SEALING CLOSURE

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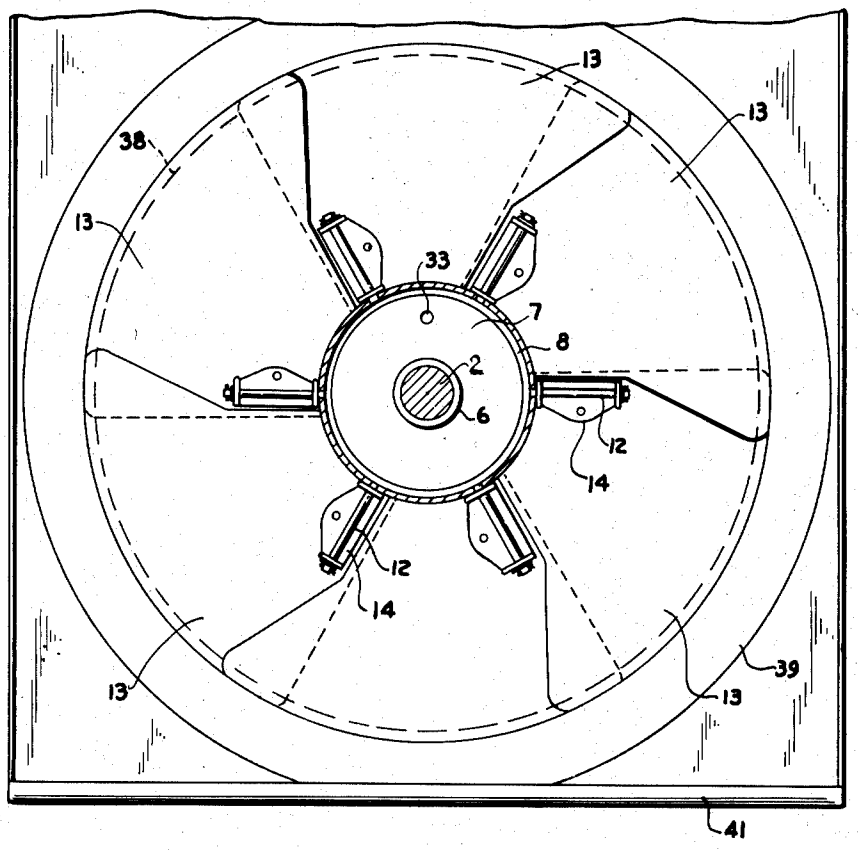


Fig. 3

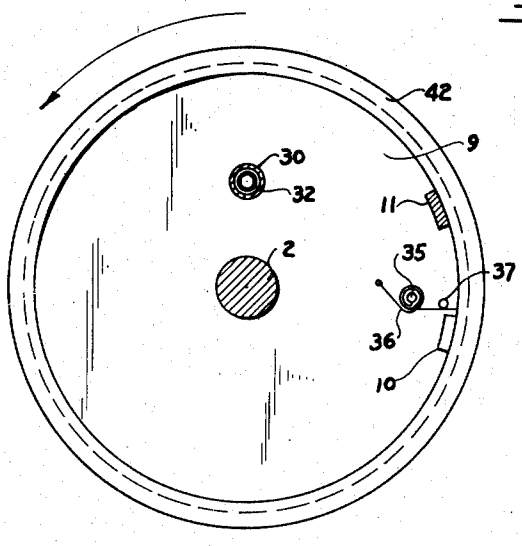


Fig. 4

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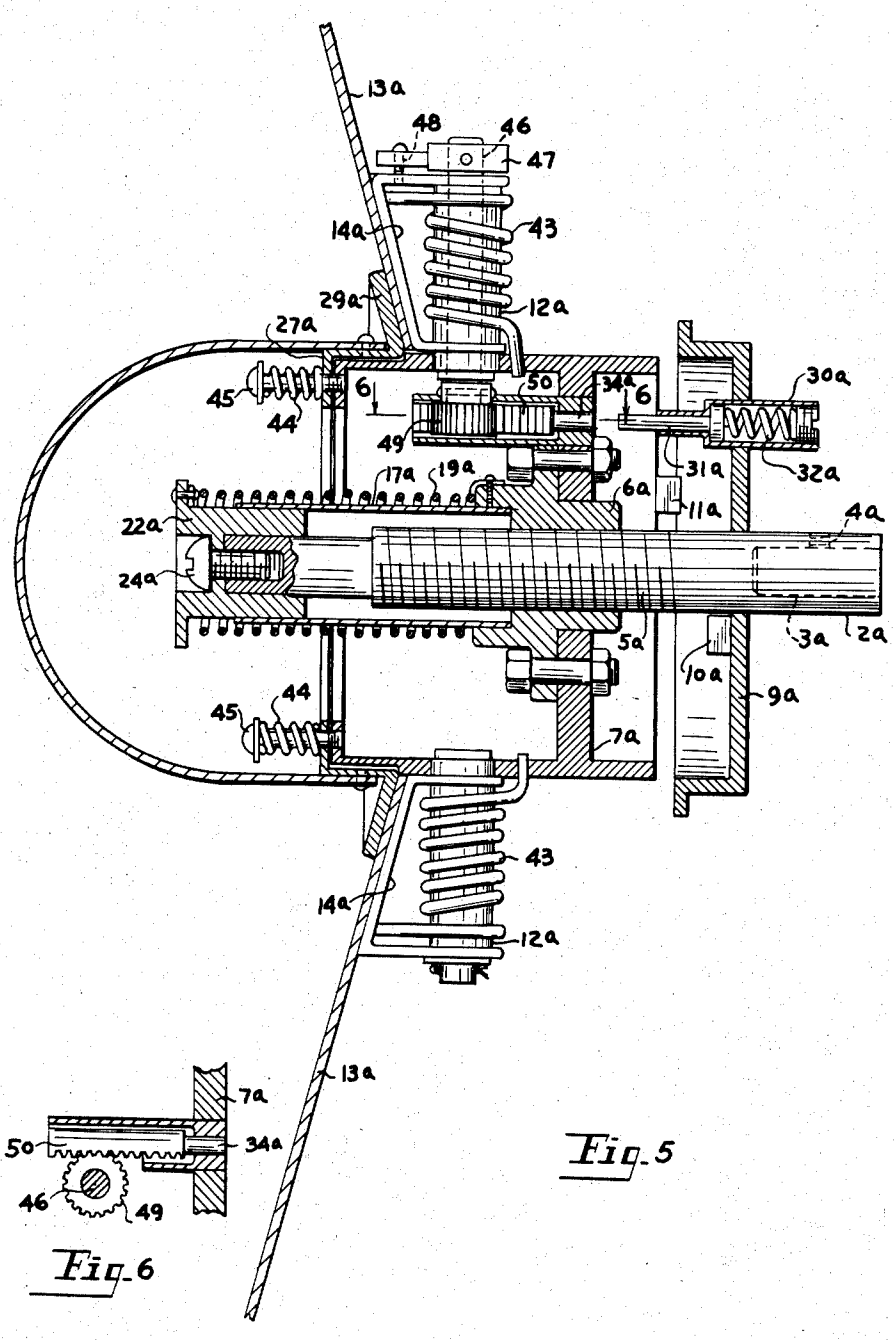


Fig. 5

Fig. 6

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COMBINED FLUID IMPELLER AND SELF-SEALING CLOSURE

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15 Claims. (Cl. 230—114)

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This invention relates to combined fluid impellers and closures, and particularly to a provision for establishing an effective seal, in a closure-forming position of a set of impeller blades, between such blades and the margin of an opening through which a fluid is impelled, such provision affording centrifugal shifting of the blades to their impelling position.

Various swivel-bladed impellers have been developed, employing spring means to swing the blades, when idle, to a closure-forming position, and centrifugally establishing their impelling positions upon impeller rotation, thus being adapted to either close an air flow opening or induce a flow through such opening. Such impellers, however, quite imperfectly exercise their closure function, not only lacking provision for firmly seating the propeller tips against the margin of said opening, but being unsuited to any such seating due to necessity of a clearance adequate for swivel travel of the blades between their two positions of use. With such prior constructions, moreover, any peripheral seating of the blades against a fixed surface for closure purposes would entail friction and undesirable noise upon application of a drive.

An object of the invention is to impose two distinct spring forces on a set of centrifugally actuable blades, one such force resisting response of the blades to centrifugal force, and the other maintaining a seal when the blades form a closure.

Another object is to subject a set of centrifugally actuable blades to two springs, one resisting centrifugal actuation of the several blades, and the other establishing and maintaining a seal when the blades are closed.

Another object is to adapt a set of centrifugally actuable impeller blades to peripherally have firm sealing engagement, when idle, with the margin of an opening closed by such blades, and to automatically shift the impeller bodily along its axis to break such engagement, upon the application of a drive and preliminary to centrifugal actuation of the blades.

Another object is to subject a set of centrifugally responsive impeller blades to a spring resisting their centrifugal actuation, such spring acting through an element slidable along the impeller axis and establishing a seal at the inner ends of the blades in their closure-forming position.

Another object is to employ interengaged screw threads on the hub and shaft of a closure-forming impeller to shift such impeller along its axis

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responsive to an initial driving force, thereby breaking a seal at the blade tips, and to adapt a torsion spring, in conjunction with said threads, to return the impeller to its seal-forming position, when the drive is cut off.

Another object is to provide a pair of coacting clutch elements respectively fixed on the impeller hub and shaft, and to automatically engage or disengage such elements by an axial travel of the impeller deriving from a screw-threaded engagement of said hub and shaft.

Another object is to afford said clutch elements considerable relative rotative play, and to lock the impeller hub against rotation relative to the shaft when the clutch elements assume their correct driving relation.

Another object is to automatically collapse a set of impeller blades to a frusto-conical closure form when power is cut off, and to establish leakage-resisting seals at the tips of the collapsed blades, at their inner ends, and at their lapped margins.

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

Fig. 2 is a similar sectional view, showing an impelling position of the blades and their clearance relation to said panel.

Fig. 3 is a rear elevational view of the impeller and panel, showing the closure-forming position of the blades, and hub being in section, as indicated by the line 3—3 of Fig. 1.

Fig. 4 is a view in front elevation and partial section of a drive element for the impeller, the plane of section being indicated by the line 4—4 of Fig. 2.

Fig. 5 shows in diametrical section the hub portion of a modified dual function impeller, occupying its closure position.

Fig. 6 is a sectional detail, taken on the line 6—6 of Fig. 5, and further illustrating a certain pin-actuating mechanism employed in said modification.

In these views, the reference character 1 designates the shaft of a motor (not shown) on which shaft is fixed an aligned 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 midportion of the impeller shaft is formed with a screw thread 5, meshing with the thread of a

feed-nut 6 formed centrally of a web 7 carried by an impeller hub 8. Between such hub and the motor shaft, there is fixed on the impeller shaft a clutch disk 9 laterally carrying a driving lug 10. The hub flares in a hollow frusto-conical form from its web toward the disk 9 and rigidly carries a clutch lug 11 to be driven by the lug 10. Rigidly mounted on said flared portion of the hub in a circular series, is any desired number of spaced pins 12 normal to and outwardly projecting from such portion, there being six such pins in the illustrated construction. Upon each pin 12 is swiveled an impeller blade 13 of substantially a sector shape, the mounting means being a bracket 14 fixed on the inner portion of the blade and elongated along one of its substantially radial margins. The described engagement is suitably maintained, as by cotter pins 15 set into the outer ends of the pins 12. The blades 13 are similarly circumferentially curved in a manner adapting them to jointly assume a hollow frusto-conical form when swiveled to their closure-forming position, best appearing in Fig. 1.

Rigidly secured to the web 7 by screws 16 are inner and outer spaced sleeves 17 and 18 coaxial with and outwardly spaced from the shaft 2. Such sleeves extend toward the free end of said shaft, the inner sleeve mounting a torsion spring 19 and the outer one a compression spring 20. The ends of the torsion spring are secured respectively to the web 7 at 21 and to a collar 22 at 23, such collar being clamped by a screw 24 against the free end of the shaft 2. Upon loosening said screw, the torsional stress of the spring 19 may be regulated by a rotative adjustment of the collar. An outer abutment for the spring 20 is formed by a collar 25 fixed on the corresponding end of the sleeve 18 by a set screw 26. Slidable on the sleeve 18 under pressure of the spring 20 is a blade-closing annulus 27 having an outer portion 28 encircling a cylindrical portion 28a of the hub, and having a coned flange 29 parallel to the pins 12 for applying pressure to the blades.

The disk 9 rigidly carries a tubular guide 30 for a latch pin 31 slidable to and from the web 7 and urged by a spring 32 toward the web. In the latter is an orifice 33 so located as to register with said pin when the clutch lugs 10 and 11 are interengaged. For ejecting the pin 31 from said orifice preliminary to disengagement of said clutch lugs, an ejector pin 34 is fixed on the annulus 27, in permanent registration with the orifice 33, so as to enter or withdraw from the latter according as the annulus occupies its maximum or minimum proximity to the pins 12. As will presently more fully appear, the purpose of the latch pin and its coacting ejector pin is to prevent a premature release of energy stored in the torque spring 19.

It is desirable to reduce and cushion the force of impact as the lug 10 encounters the lug 11, to avoid consequent undue noise and wear. Thus the disk 9 carries on a pin 35 a small coiled spring 36 having an end portion urged to a position against a stop pin 37 and spaced in such position slightly from the lug 10 in its driving direction under non-driving conditions. Said spring is forced back against the lug 10 as the latter closely rotatively approaches the driven lug 11, thus reducing the impact force.

The described impeller serves, when driven, to draw air through a circular opening 38 in a sheet metal panel 39, and provides a closure for such opening under non-driving conditions. Marginally of its opening 38, the panel has a Venturi-shaped portion 40 against which the blades 13 seat firmly as their rotation ceases. The horizontal bottom margin of said panel forms a trough 41 receiving any small amount of moisture that may occasionally leak past the closed blades.

In operation of the described device, the impeller, when idle, lies in its limiting position of axial travel shown in Fig. 1, the clutch lugs 10 and 11 occupying different planes of rotation, the spring 19 being largely relieved of torsional stress, and the spring 20 acting through the annulus 27 to firmly hold the blades in conical closure form, tightly lapping one another. The blade tips are firmly sealed against the venturi 40 responsive to a stress applied to the feed nut 6 by the thread 5. The ejector pin 34 is entered in the orifice 33 and the latch pin 31 withdrawn from such orifice.

Upon applying a drive to the impeller shaft, the hub 8 is shifted by one or several initial revolutions of said shaft to its position shown in Fig. 2, due to interengagement of the feed nut 6 and screw thread 5. The described shifting breaks the seal between the propeller tips and venturi 40, establishing ample clearance for a subsequent swiveling of the blades on the pins 12 and for free rotation of the impeller. Also such axial shifting establishes the clutch lug 11 in the rotative path of the lug 10, whereby an impeller drive is established. At the instant of interengagement of said lugs the latch pin 31 snaps into the orifice 33, preventing further relative rotation of the hub and shaft. The described initial rotation of the shaft relative to the hub 8 materially increases torsional stress acting in the spring 19. As the impeller picks up speed, the blades swing centrifugally on their pins 12, reacting on the annulus 27 to increasingly space it from said pins and impose increased compression on the spring 20. The inclination of the pins 12 is such that the blades acquire their most effective position for air impulsion, in centrifugally swiveling on such pins, and it is preferred to positively establish said effective position by engaging the free radial edges of the blades with an annular flange 42, peripherally formed on the disk 9.

Upon discontinuance of the drive, the centrifugal effect on the blades rapidly decreases, permitting their return to a frusto-conical form under thrust of the spring 20. In applying such thrust, the annulus 27 slides toward the pins 12, permitting the pin 34 on such annulus to eject the latch pin 31 from the orifice 33, whereupon the torsion spring 19 releases its stored energy, rotating the impeller relative to its shaft to feed the nut 6 and hence the entire impeller to its closure position (Fig. 1), establishing tight sealing engagement between the blades and venturi 40. The function of the latch pin 31 is to assure a unitary deceleration of the shaft and impeller, after discontinuance of a drive, until the spring 20 overcomes the diminishing centrifugal swiveling effort of the blades, and establishes their frusto-conical closure form. As has been described, this ejects the latch pin 30 from the orifice 33, and the torsional energy stored in the spring may then sufficiently rotate the impeller relative to its shaft to screw-feed the impeller into a firm sealing engagement with the venturi 40. When such sealing engagement is established, deceleration of the impeller is so nearly completed that friction arising between the blade tips and venturi is negligible. If the latch pin

31 were not provided, the torsion spring might take effect prematurely, throwing the blades against the venturi while still under centrifugal influence and prior to their reduction to a conical form. This would cause considerable noise, with undue wear and possibly more serious damage.

When an impeller of the described type is functioning as a closure there are three possibilities of air leakage. It has been explained how the torsion spring 19 serves to tightly seal the blade tips against the venturi, and how the compression spring 20 seats the blades firmly one upon another. The third leakage possibility occurs at the juncture of the blades with the hub, it being impossible to conform the inner margins of the blades fully to the hub, since clearance must be adequate for swiveling of the blades, in responding to centrifugal force. The annulus 27, and particularly its flange 29, so firmly engages the inner ends of the blades in their closure-forming position as to eliminate any material air flow past said ends.

Describing now the modification shown in Figs. 5 and 6, the shaft 2*a* with screw thread 5*a*, the feed nut 6*a*, web 7*a*, clutch disk 9*a*, blades 13*a*, sleeve 17*a*, torsion spring 19*a*, and collar 22*a* all conform to the preceding description. The modified hub 8*a* is fully cylindrical and rigidly carries a circular series of pins 12*a* which are normal to the hub axis. Brackets 14*a* which swivel the blades on the pins have blade-engaging portions so divergent to the pins as to impart the desired conical inclination to the blades, when non-rotating. Torsion springs 43 on said pins urge the blades to their coned closure position, and upon imposing a sufficient driving velocity, the blades swivel centrifugally on the pins 12*a* to their impelling position. An annulus 27*a*, having a flange 29*a* coned to conform to the closed blades, serves in this modification solely for sealing the inner ends of the blades, and hence requires only a set of relatively light springs 44 to urge it against the blades. Said springs are carried by pins 45 fixed on the hub and serving also as slide guides for the annulus. One of the pins 12*a* is tubular and receives a rockshaft 46 having a collar 47 fixed on its outer end and pinned at 48 to the bracket 14*a* mounting a blade on said pin, whereby any swivel actuation of such blade entails a corresponding rocking of the shaft 46. The latter extends sufficiently into the hub to rigidly carry a pinion 49 meshing with a rack bar 50. This carries an ejector pin 34*a* corresponding fully in function to the previously described pin 34. The pin 34*a* ejects a latch pin 31*a* from a hub orifice 33*a*, following discontinuance of a drive and such diminution of centrifugal influence as permits swiveling of the blades to their closure position. In starting the impeller, centrifugal swiveling of the blades to their impelling position withdraws the pin 34*a* from the orifice 33*a* and allows entry of the latch pin 31*a*.

The described invention, in eliminating the considerable leakage that has characterized prior dual function impellers, when serving as closure, imparts to such impellers a practicality they have lacked. Heretofore, louver type closures have been extensively used in conjunction with ventilating impellers to close the air flow openings, when the impellers were idle. By deriving a closure function from the impeller blades, a much neater and more compact installation is achieved than permitted by use of louvers, and the present

invention assures a more perfect seal, automatically established, than has as yet been derived by louver use.

What I claim is:

1. A combined impeller and closure comprising a hub, means for rotatively driving the hub, a set of circumferentially spaced pins fixed on and outwardly projecting from said hub and substantially normal to the hub axis, and having their axes in substantially the same rotational plane, a set of impeller blades outwardly projecting from the hub at a like divergency to said plane, means swiveling the blades respectively on the respective pins to alternatively assume an idle position, in which said blades lap one another to form an approximately conical closure, and an impelling position in which said blades are circumferentially spaced and diagonal to the plane of rotation of said pins, and spring means on said hub and including means engaging said blades for urging the blades about their swivel axes toward said idle position, the impelling positions of the blades being centrifugally established responsive to a predetermined applied rotational velocity.

2. In a combined impeller and closure of the type comprising a hub, a set of impeller blades outwardly extending from the hub, elements carried by the hub in a circumferentially spaced and approximately radial relation to the hub and establishing circumferentially spaced axes approximately radial to the hub, means swiveling the respective blades on the respective elements for travel about said axes between closure-forming and impelling positions, spring means urging the blades about said axes toward their closure-forming position, and means connected to the hub for rotatively driving the impeller, the blades being centrifugally actuable about said axes to their impelling position responsive to a predetermined velocity applied by said driving means, the combination with said hub, blades and spring means, of an annulus engaged by the spring means and transmitting the effort of such means to the blades and lapping their inner ends to establish a seal in their closure position, and means mounting such annulus on the hub to slide relative to the hub along the impeller axis.

3. A combined impeller and closure as set forth in claim 2, said means mounting the annulus being a sleeve coaxial with and forming an extension of the hub.

4. In a combined impeller and closure of the type comprising a hub, a set of impeller blades outwardly extending from the hub, elements carried by the hub in a circumferentially spaced and approximately radial relation to the hub and establishing circumferentially spaced axes approximately radial to the hub, means swiveling the respective blades on the respective elements for travel about said axes between closure-forming and impelling positions, spring means on said hub and including means engaging said blades for urging the blades about said axes toward their closure-forming position, and driving means connected to the hub for rotating the impeller, the blades being centrifugally actuable about said axes to their impelling position responsive to a predetermined velocity applied by said driving means, the combination with said blades and hub, of a sealing means coacting with the blade tips to derive their closure-forming function, said driving means affording the impeller a travel along the impeller axis and means responsive to

initial energization of the driving means for shifting the impeller along said axis and thus clearing the blades from said sealing means, and automatically responsive to deenergization of the driving means for reversely shifting the impeller to engage the blades with the sealing means.

5. In a combined impeller and closure of the type which is correlated with a member defining an opening for fluid flow, and which comprises a hub, a set of impeller blades outwardly extending from the hub, in a circumferentially spaced and approximately radial relation to the hub and establishing circumferentially spaced axes approximately radial to the hub, means swiveling the respective blades on the respective elements for travel about said axes between closure-forming and impelling positions, spring means on said hub and including means engaging said blades for urging the blades about said axes toward their closure-forming position, and driving means connected to the hub for rotating the impeller, the blades being centrifugally actuable about said axes to their impelling position responsive to a predetermined velocity applied by said driving means, the combination with said hub, blades, swiveling elements, and spring means, of a shaft included in the impeller-driving means and affording the impeller a limited travel along the shaft to engage the blades with the margin of said opening for closing the opening, or to clear them from such margin for exercise of their impelling function, said driving means also including a pair of coacting clutch elements respectively carried by the hub and shaft, operatively engageable or disengageable according as impeller travel along the shaft clears the blades from or engages them with said margin, and means automatically responsive to initial energization of said driving means for shifting the impeller along its axis of rotation and thus clearing the blades from said margin, and automatically responsive to deenergization of the driving means for reversely shifting the impeller to seal the blades against said margin.

6. A combined impeller and closure as set forth in claim 5, the last-mentioned means including a spring urging the impeller along its axis of rotation toward sealing engagement with said margin.

7. In a combined impeller and closure of the type which is correlated with a member defining an opening for fluid flow, and which comprises a hub, a set of impeller blades outwardly extending from the hub, elements carried by the hub in a circumferentially spaced and approximately radial relation to the hub and establishing circumferentially spaced axes approximately radial to the hub, means swiveling the respective blades on the respective elements for travel about said axes between closure-forming and impelling positions, spring means on said hub and including means engaging said blades for urging the blades about said axes toward their closure position and driving means connected to the hub for rotating the impeller, the blades being centrifugally actuable about said axes to their impelling position responsive to a predetermined velocity applied by said driving means, the combination with said hub and blades and a shaft included in said driving means and affording the impeller a limited travel along the shaft to engage the blades with the margin of said opening for closing the opening or to clear them from such margin for exercise of their impelling function, of means establishing or cutting off a drive from the shaft to the hub according as said limited travel of the impeller clears the blades from or engages them with said margin, and means for storing energy responsive to clearance actuation of the impeller and for employing such energy to shift the impeller to its closure relation to said margin.

8. A combined impeller and closure as set forth in claim 7, the hub being screwthreaded on the shaft to induce said travel of the impeller along the shaft.

9. A combined impeller and closure as set forth in claim 7, the last-mentioned means being a coiled spring interconnecting the shaft and hub and torsionally stressed in accelerating the impeller.

10. In a combined impeller and closure as set forth in claim 7, a device for retarding release of said stored energy until deceleration of the impeller has substantially relieved the blades of centrifugal bias.

11. In a combined impeller and closure as set forth in claim 7, a latch device automatically interconnecting the shaft and hub for rotation in unison in the impelling position of the impeller, and means for automatically unlatching such device responsive to recovery of the blades from a centrifugal actuation.

12. In a combined impeller and closure as set forth in claim 7, said means establishing or cutting off a drive including a drive element fixed on said shaft, a pin slidable on such drive element to and from the hub, the hub having an orifice to register with and receive the pin, a spring urging the pin toward the hub to enter the pin in said orifice, and means for ejecting the pin from the orifice responsive to recovery of the blades from their centrifugal actuation.

13. A combined impeller and closure as set forth in claim 12, said shaft having a portion in screwthreaded engagement with the hub, to effect said limited travel of the impeller along the shaft responsive to shaft rotation.

14. In a combined impeller and closure of the type which is correlated with a member defining an opening for fluid flow, and which comprises a hub, a set of impeller blades outwardly extending from the hub, elements carried by the hub in a circumferentially spaced and approximately radial relation to the hub and establishing circumferentially spaced axes approximately radial to the hub, and means swiveling the respective blades on the respective elements for travel about said axes between closure-forming and impelling positions, spring means on said hub and including means engaging said blades for urging the blades about said axes toward their closure position and driving means connected to the hub for rotating the impeller, the blades being centrifugally actuable about said axes to their impelling position responsive to a predetermined velocity applied by said driving means, the combination with the hub and blades and a shaft included in said driving means, such shaft having a portion in screwthreaded engagement with the hub to axially shift the impeller responsive to shaft rotation between an idle position of the impeller, sealing the blades against the margin of said opening, and an impelling position affording them clearance from said margin for impelling rotation and for swivel travel about said axes, of means including clutch elements on the shaft and hub for establishing or cutting off a drive from the shaft to the hub according as the im-

peller is at its impelling or closure-forming limit of said axial travel, inner and outer spaced sleeves fixed on the hub coaxially with the shaft, and a torsion spring carried by said inner sleeve and interconnecting the shaft and hub to store energy as the impeller is screw-fed by the shaft to its impelling position, and to screw-feed the impeller to its idle position by release of said energy upon cutting off the drive, said spring means swivelly urging the blades toward their closure position being carried by said outer sleeve.

15. In a combined impeller and closure of the type which is correlated with a member defining an opening for fluid flow, and which comprises a hub, a set of impeller blades outwardly extending from the hub, elements carried by the hub in a circumferentially spaced and approximately radial relation to the hub and establishing circumferentially spaced axes approximately radial to the hub, and means swiveling the respective blades on the respective elements for travel about said axes between closure-forming and impelling positions, spring means on said hub and including means engaging said blades for urging the blades about said axes toward their closure position, and driving means connected to the hub for rotating the impeller, the blades being centrifugally actuable about said

axes to their impelling position responsive to a predetermined velocity applied by said driving means, the combination with said defining member, hub, blades, swiveling elements and spring means, of a shaft included in said driving means mounting the impeller and affording it a limited sliding travel along the shaft to engage the blades with the margin of said opening or to clear them from such margin for exercise of their impelling function, said driving means including a pair of coacting driving and driven clutch elements respectively fixed on the shaft and hub to drive the impeller, such elements being engaged or disengaged according as the impeller is at its impelling or closure limit of sliding travel, and means carried by the driving clutch element for limiting swivel response of the blades to centrifugal force.

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