Aug. 21, 1945. E. A. MADER 2,383,004

COMBINED IMPELLER AND CLOSURE

Filed June 16, 1943 2 Sheets-Sheet 1

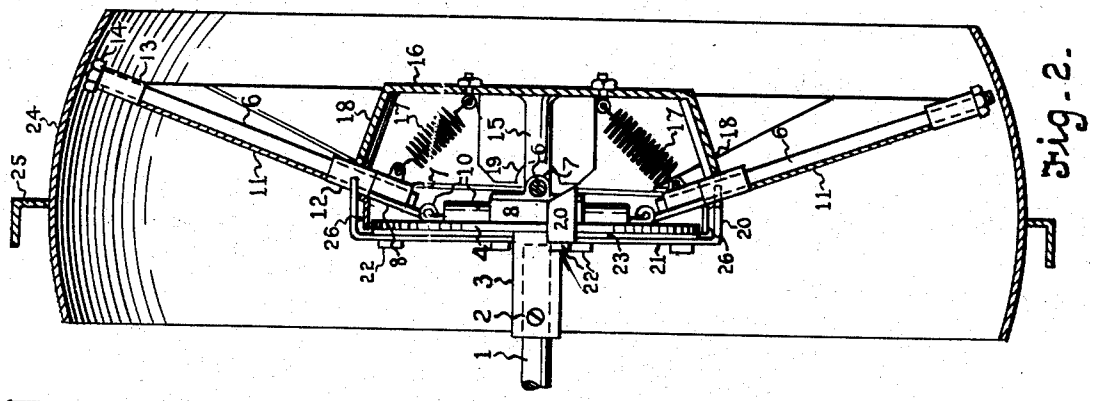


Fig. 2.

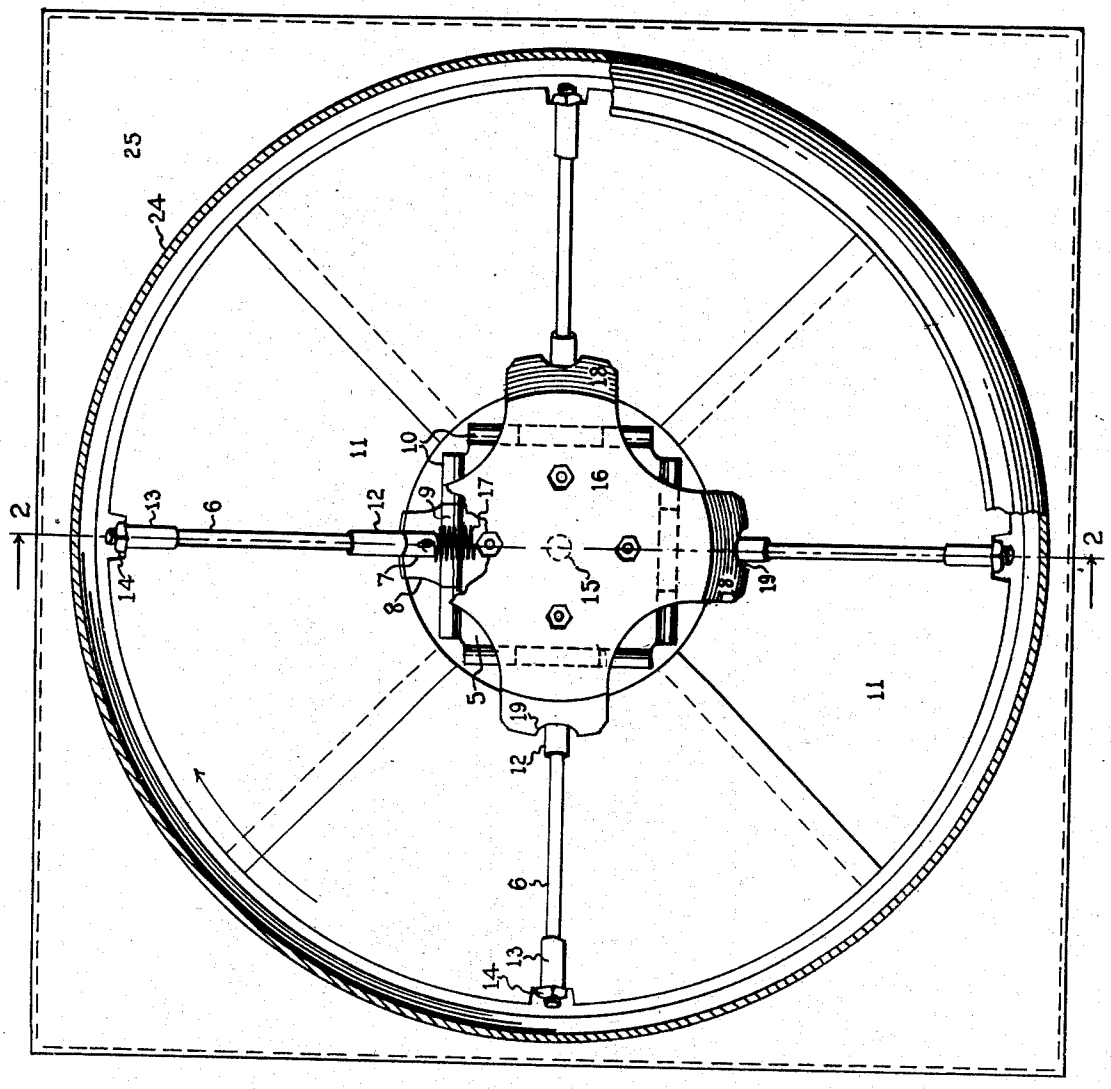


Fig. 1.

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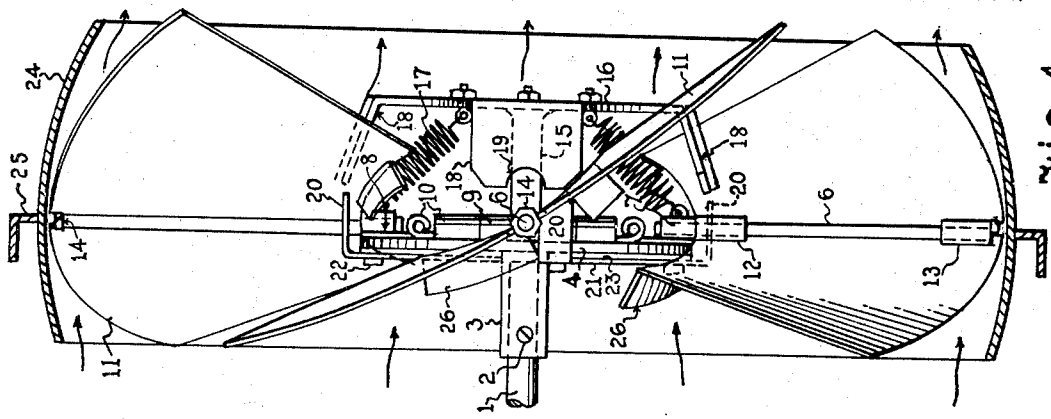


Fig. 4.

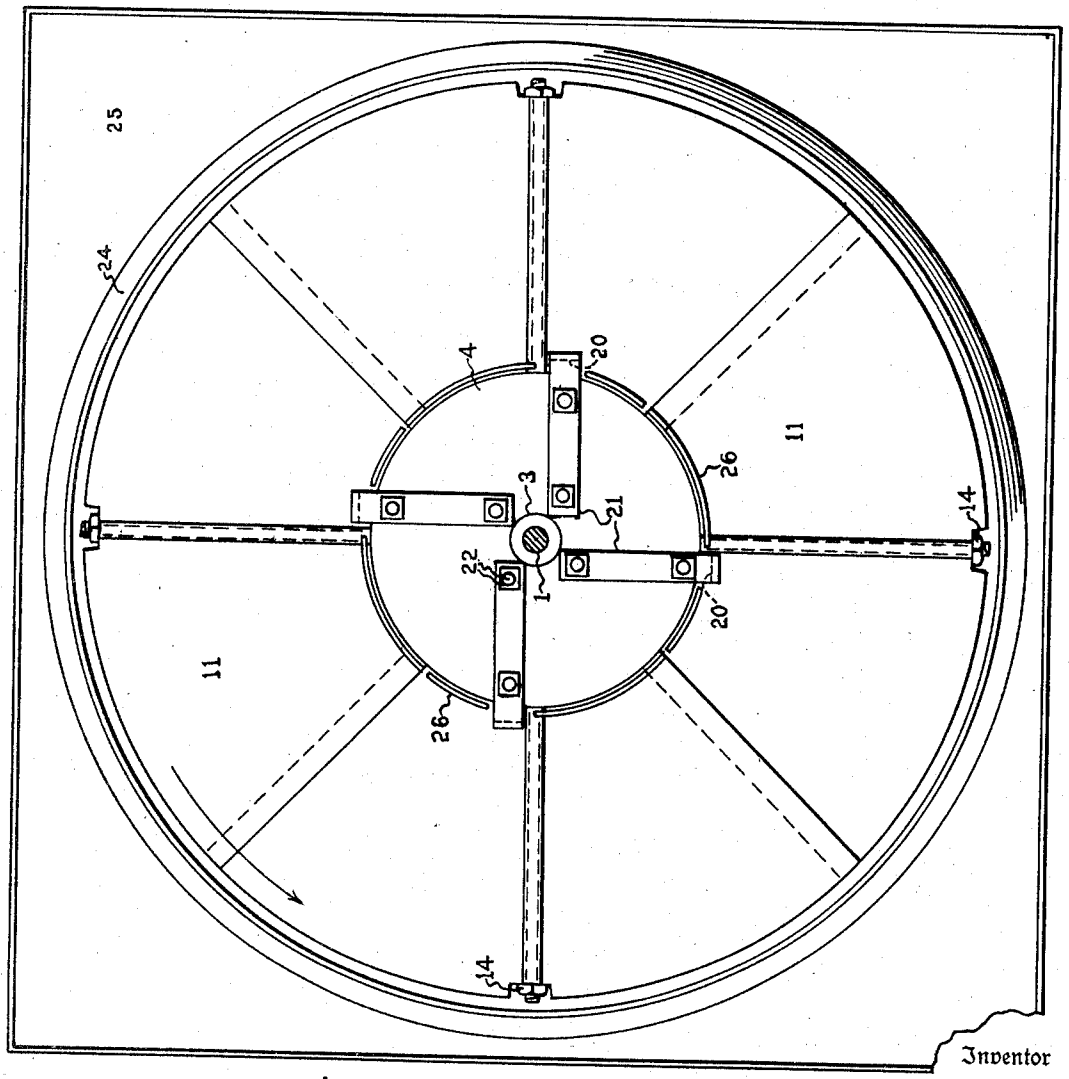


Fig. 3.

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# UNITED STATES PATENT OFFICE

2,383,004

## COMBINED IMPELLER AND CLOSURE

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Application June 16, 1943, Serial No. 491,264

9 Claims. (Cl. 230—114)

This invention relates to impellers and particularly impellers for driving a fluid through openings and serving when idle to automatically close such openings.

An object of the invention is to provide a bladed rotary impeller, the blades of which are yieldably urged to a closure-forming position assumed when the impeller is idle, and to adapt the blades to each swing about two different axes to centrifugally assume an impelling position when the impeller is driven.

Another object is to provide a rotary impeller comprising blades yieldably urged to a closure-forming position when the impeller is idle and to mount the blades to swing to impelling positions on pivotal supports radiating from the impeller axis and to pivot said supports to swing about their inner ends responsive to centrifugal force, arising when the impeller is driven, the swinging of the blades with said supports being utilized to pivot them on the supports.

Another object is to provide an impeller having blades individually pivoted on supports conically converging toward the impeller axis when the impeller is idle, said blades then jointly forming a closure, the blades and supports being adapted to centrifugally swing substantially into the plane of impeller rotation when the impeller is driven, and such swinging being utilized to pivot the blades on the supports to give them impelling effect.

Other objects are to dispose said supports in a substantially bisecting relation to the blades and to equip the blades with sealing means at their inner ends.

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

Fig. 1 is a view of that side of the impeller from which a fluid is to be driven, the blades being shown in their closure position.

Fig. 2 is a diametrical sectional view of the impeller, taken on the line 2—2 of Fig. 1.

Fig. 3 is a view of the reverse side of the impeller to that shown in Fig. 1.

Fig. 4 is a diametrical sectional view similar to Fig. 2, but showing the impelling position of the blades.

In these views, the reference character 1 designates a shaft rotatively driven by an electric or other motor (not shown). Fixed on such shaft by a set screw 2 or the like is a sleeve 3 closed at one end which fixedly carries a disk-shaped impeller hub 4. Welded or otherwise centrally secured to such hub is a hinge plate 5 of polygonal form, pivotally mounting a plurality of equiangularly spaced rods 6 radiating from the hub and adapted to swing transversely to the plane of impeller rotation. In the illustrated mounting of said rods, their inner ends are fixedly inserted in socket members 7 fixed on hinge leaves 8 whereof the barrels 9 are pinned in the usual manner to barrels 10 formed marginally on said hinge plate. The rods 6 pivotally support segmental impeller blades 11 and occupy a bisecting relation to such blades. Preferably each blade carries bearings 12 and 13 respectively at its inner and outer margins to accommodate the corresponding rod 6, and the latter have nuts 14 threaded on their outer ends to retain the blades on the rods.

The sleeve 3 has a reduced extension 15 from its closed end serving to mount a spider 16 in spaced coaxial relation with the hub 4. Coiled springs 17 extended to said spider from the socket members 7 urge the rods 6 and blades toward said spider, and response of the rods and blades to said springs is limited by stops 18 carried marginally by the spider and projecting in approximate parallelism to the impeller axis. Said stops have their free ends notched as indicated at 19 so that such ends, in establishing a limiting position of the blades, may engage the latter in a straddling relation to the bearings 12. This assures a stable equilibrium for the blades with respect to the pivotal axes established by the rods 6. The spider and hub are spaced apart a distance suited to accommodate the springs 17, and it is preferred to converge the springs toward the impeller axis since this reduces requisite spacing of the spider and hub. The blades are so shaped and proportioned that, when occupying said limiting position their radial margins will be lapped slightly and they will jointly assume a frusto-conical form. In this form, their inclination to the rotational plane of the impeller preferably approximates twenty degrees.

The discussed limiting position of the blades is assumed when the impeller is idle, and when a drive is applied, centrifugal force overcomes the springs 17 causing the rods 6 to swing about their hinged inner ends and assume a transverse relation to the impeller axis, as illustrated in Fig. 4. When said relation is established, the hinge leaves 8 seat flat against the hub 4, limiting further motion of the rods and counteracting any tendency of the blades and rods to vibrate transversely to the rotational plane as the

impeller is driven. Centrifugal force further tends to establish the blades, so far as their curvature permits, in the rotational plane of the rods, but stops **20** are so mounted on the hub as to correspondingly engage the blades to one side of the pivot rods and thus compel a predetermined pitch of the blades to the rotational plane. These stops, as illustrated, are formed by the transversely bent ends of bars **21** which are radially secured to the hub by bolts and nuts **22**. By inserting one or more shims or spacers **23** between each bar **21** and the hub, regulation may be effected of the projecting extent of the stops **20** and thus the impelling pitch of the blades may be regulated. Preferably the stops **20** are positioned slightly outward from the hub, being thus adapted to engage inner portions of the blades, and it is further preferred to bevel the blade-engaging ends of said stops conformingly to the desired pitch of the rotating blades.

The function of the impeller, as illustrated, is to induce a flow of air or other fluid through an opening when a drive is applied and to close such opening when the impeller is idle. In the construction illustrated, the opening aforementioned is formed by a sheet-metal annulus **24** coaxial with the impeller, said annulus being set rigidly into a sheet metal plate **25** mounted in any desired manner. The annulus is curved transversely to its circumference so that it may have substantially the same slight clearance from the outer edges of the blades throughout the extent of said edges, when the blades are in their impelling position. When the blades are in their closure-forming position, their outer edges substantially form a circle parallel to the medial plane of the annulus **24**, the width of the latter being preferably adequate to fully surround the plates in their impelling position.

To prevent material leakage of air or other fluid between the hub and blades when the latter are idle, it is preferred to provide the inner edges of the blades with sealing flanges **26** projecting from the convex faces of the blades and proportioned to closely approach the periphery of the hub when the impeller is at rest. Since one half of each flange **26** must clear the hub when the blades pivot on the rods **6**, the radius of said flanges slightly exceeds that of the hub.

It will be noted that the stops **18**, in limiting response of the blades and their pivot rods to the springs **17**, predetermine the conical inclination of the blades and assure that this inclination will be the same for all of the blades thus adapting them to jointly form an effective closure. Pressure under which the blades are held against said stops is adequate to assure against any rattling of the blades, when idle, due to any ordinary cause such as atmospheric air currents or vibrations induced by machinery.

The general direction of fluid flow induced when the impeller is driven is indicated by the arrows in Fig. 4, and it will be noted that the concaved faces of the blades apply the pressure inducing such flow, this being obviously desirable.

In adapting the blades to jointly form a closure when the impeller is at rest, there is eliminated necessity for pressure-responsive pivotal louvers, now commonly employed to close or open air passages according as a fan delivering air to such passages is idle or driven.

When the described construction is installed in an exterior wall for ventilating purposes, the seal established is particularly vital in preventing rain, snow, dust, and exterior air from gaining access to a building. In such an installation, the lapped relation of the blades is also particularly vital for same reasons.

While the construction has been described as applied to alternately impel air and close an opening through which the air is impelled, it is obvious that the same functions may be exercised with respect to various other fluids. It is further to be noted that the construction may be installed at any desired point within a duct as well as within or upon a wall.

The expression "plane of impeller rotation" in following claims signifies any plane transverse to the impeller axis, and the expression "radial to the hub" in said claims is used in a materially broader sense than "transverse to the impeller axis."

What I claim is:

1. An impeller comprising a hub, a plurality of blades, supports for said blades outwardly extending from the hub, means pivoting said supports on the hub to swing toward and from the plane of impeller rotation, means pivoting the blades respectively on the respective supports for movement between a position of effective impelling pitch and an idle position of substantially no pitch, means yieldably urging said supports from the plane of impeller rotation, means limiting response of the supports to said urging means and establishing for the blades said position of substantially no pitch, the supports and blades being movable, upon driving the impeller, toward the plane of impeller rotation responsive to centrifugal force, and means for pivotally actuating the blades on the supports responsive to movement toward said plane to establish an effective pitch of the blades.

2. An impeller comprising a hub, a plurality of blades extending substantially outwardly from the hub, and a provision for mounting the blades on the hub, including means yieldably urging the blades to a predetermined divergency to the plane of impeller rotation, the blades being spaced from the hub in a direction substantially transverse to the plane of impeller rotation responsive to said urging means, a provision for substantially closing such space to provide a seal against fluid leakage when the impeller is idle, means affording the blades a pivotal movement toward and from said plane about axes substantially transverse to that of the hub, and means affording the blades pivotal movement about axes substantially normal to the first-named axes. the impeller further comprising means for inducing and limiting the last-mentioned pivotal movement, responsive to the first-mentioned pivotal movement, the blades being substantially without pitch when the impeller is idle, and centrifugal force being utilized to pivot the blades toward the plane of impeller rotation when the impeller is driven.

3. An impeller comprising a hub, a plurality of blades extending substantially outwardly from the hub, and a provision for mounting the blades on the hub, including means yieldably urging the blades to a predetermined divergency to the plane of impeller rotation, the blades being spaced from the hub in a direction substantially transverse to the plane of impeller rotation responsive to said urging means, a provision carried by the blades for substantially closing such space to provide a seal against fluid leakage when the impeller is idle, means affording the blades a pivotal movement toward and from said plane about axes substantially transverse to that of the hub, and

means affording the blades pivotal movement about axes substantially normal to the first-named axes, the impeller further comprising means for inducing and limiting the last-mentioned pivotal movement, responsive to the first-mentioned pivotal movement, the blades being substantially without pitch when the impeller is idle, and centrifugal force being utilized to pivot the blades toward the plane of impeller rotation when the impeller is driven.

4. An impeller comprising a hub, a plurality of blades, supports for said blades outwardly extending from the hub, means pivoting said supports on the hub to swing toward and from the plane of impeller rotation, means pivoting the blades respectively on the respective supports for movement between a position of effective impelling pitch and an idle position of substantially no pitch, means yieldably urging said supports from the plane of impeller rotation, said urging means including coiled springs and an anchorage member for such springs spaced from the hub, the impeller further comprising stops carried by said anchorage member limiting response of said supports to the urging means and establishing for the blades said position of substantially no pitch, the supports and blades being movable, upon driving the impeller, toward the plane of impeller rotation responsive to centrifugal force, and means for pivotally actuating the blades on the supports responsive to movement toward said plane to establish an effective pitch of the blades.

5. An impeller comprising a hub, a plurality of blades, supports for the blades outwardly extending from the hub, means pivoting said supports to swing to or from the hub axis about axes substantially transverse to the hub axis, means pivoting the blades respectively on the respective supports for movement between a position of effective impelling pitch and a position of substantially no pitch, stop means effective on the supports to limit their angular approach to the hub axis, springs respectively effective on the respective supports to bias the supports angularly toward said stop means, an anchorage member to which all of said springs are connected, the springs being yieldable to centrifugal force acting on the blades and supports when the impeller is effectively driven, and means for pivotally actuating the blades on the supports and thereby establishing an effective pitch of the blades, responsive to a predetermined centrifugal actuation of the blades.

6. An impeller as set forth in claim 5, said anchorage member being spaced from the hub along the extended axis of the hub.

7. An impeller comprising a hub, a plurality of blades, supports for the blades outwardly extending from the hub, means pivoting said supports to swing to or from the hub axis about axes substantially transverse to the hub axis, means pivoting the blades respectively on the respective supports for movement between a position of effective impelling pitch and a position of substantially no pitch, stop means effective on the supports to limit their angular approach to the hub axis, means yieldably biasing the supports about their pivot means toward said stop means, such biasing means being yieldable to centrifugal force acting on the blades and supports when the impeller is effectively driven, and means for pivotally actuating the blades on the supports and thereby establishing an effective pitch of the blades responsive to a predetermined centrifugal actuation of the blades, the hub having at least one extension outwardly beyond the pivot axes of the supports, limiting outward swinging of the supports about such pivot axes.

8. An impeller comprising a hub, a plurality of blades, supports for the blades outwardly extending from the hub, means pivoting said supports to swing to or from the hub axis about axes substantially transverse to the hub axis, means pivoting the blades respectively on the respective supports for movement between a position of effective impelling pitch and a position of substantially no pitch, stop means effective on the supports to limit their angular approach to the hub axis, means yieldably biasing the supports about their pivot means toward said stop means, such biasing means being yieldable to centrifugal force acting on the blades and supports when the impeller is effectively driven, and means for pivotally actuating the blades on the supports and thereby establishing an effective pitch of the blades, responsive to a predetermined centrifugal actuation of the blades, and an annulus wherein the impeller is installed, curved transversely to maintain substantially a minimum clearance from the blades in their centrifugally induced travel.

9. An impeller comprising a plurality of blades, a hub, a plurality of rods radiating from the hub and respectively substantially bisecting the respective blades, means pivotally mounting the blades on the rods, means pivoting the rods on the hub to turn about axes substantially transverse to the hub axis, spring means urging a pivotal movement of the rods about the last-mentioned axes, stop members engageable with the blades in a straddling relation to the rods to limit such pivotal movement, said stop members establishing a predetermined conical inclination of the rods to the hub axis, the blades and rods being responsive to centrifugal force, upon rotation of the impeller, to effect their outward swinging in opposition to said spring means, and stops carried by the hub engaged by the blades in their centrifugal actuation to pivot the blades on the rods and establish a desired impelling pitch of the blades.

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