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HINGE FOR SWINGING DOORS

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Fig. 1

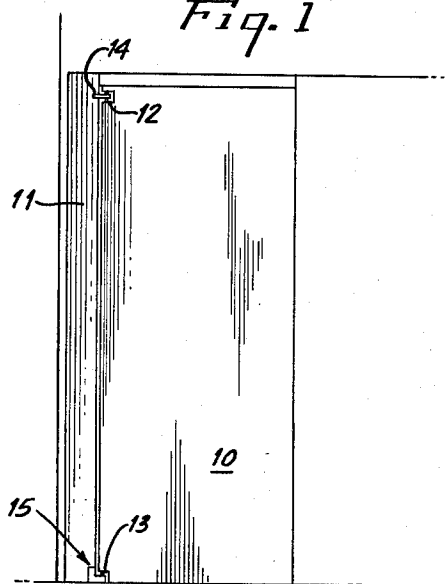


Fig. 5

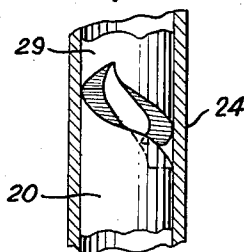


Fig. 4

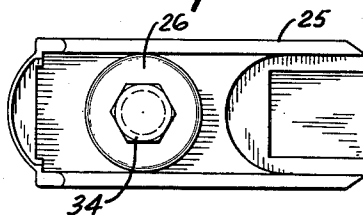


Fig. 2

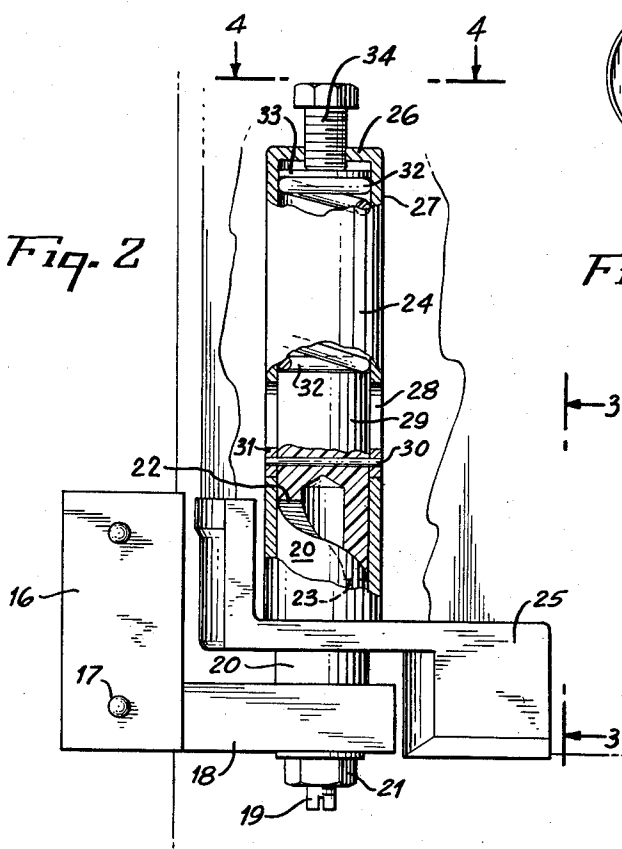
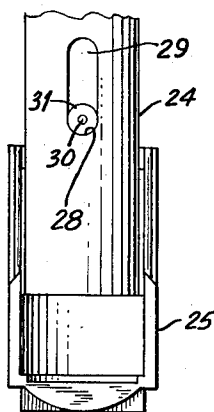


Fig. 3



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HINGE FOR SWINGING DOORS

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This invention relates to hinges, and more particularly to a hinge for swinging doors which tends to return the door to a predetermined rest position when the door is angularly displaced from that position.

The type of door for which this invention is eminently suitable is employed in public places where it is desired to obstruct the door passage into or out of a room at all times except during actual passage of a person through the door opening without depending on the diligence of the person for closing the door. Such doors are commonly employed in factories between a work space and an adjoining room to minimize air drafts, in restaurants between the kitchen and eating rooms to prevent kitchen odors and kitchen noise from entering the eating room, in clothing establishments to hide the interior of dressing rooms from outside view, and in public toilets.

Known types of such doors rely generally on the power of a return spring or on a cam arrangement and the weight of the door for returning the door to the desired rest position which in the applications enumerated above for the purpose of illustration is usually the closed position.

Doors which rely on gravity for supplying the motive power for the door necessarily involve movement of the door along the hinge axis during pivoting movement of the door about the axis. They cannot be employed where a fairly tight seal between the door and door frame is necessary as in the factory doors and kitchen doors mentioned above, but such axial door movement is also frequently undesirable in other applications because of the limitations it imposes on the manner of installation of the door in the door frame.

Spring actuated doors of several types have been commonly employed. All known types of such doors use hinge elements which have relatively great bulk so that they usually cannot be installed in the door itself, or when flat enough to fit into the thickness of the door extend relatively far in the main plane of the door.

It is the primary object of this invention to provide a spring actuated door hinge of the type described which includes a hinge element of small bulk which can be readily accommodated even in thin doors without extending unduly in the main plane of the door.

Another object is the provision of a hinge the working elements of which are protected against accidental damage during installation of the hinge on the door.

An additional object is the provision of a hinge for swinging doors the working elements of which are protected against contamination by the environment both before and after installation.

With these and other objects in view, the invention mainly resides in a hinge assembly which includes an elongated tubular housing enclosing a substantially closed cavity. A cam member is arranged in the cavity and is movable therein in the direction of the longitudinal axis of the housing. Its rotation about this axis is prevented. The cam member has a cam face which forms a helix about the housing axis and extends radially with respect to the axis.

A plug member is rotatable about this axis in the housing cavity and has a helical cam face which is capable of mating engagement with the cam face of the above-mentioned cam member. The two cam faces are urged into engagement by resilient means installed in the cavity.

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The housing and the plug member are fastened by suitable means to the door and the door frame respectively.

In its more specific aspects the invention contemplates giving a cylindrical shape of substantially equal diameter to the plug member, the cam member and the internal wall of the housing so that the plug member and the cam member form movable seals with corresponding portions of the wall. These seals may permit limited passage of air although this is not essential to the operativeness of the device, but they exclude contaminants of a solid or liquid nature, and retard passage of vapors.

To permit axial movement without rotation of the cam member, the housing is preferably formed with axially extending slots which guide projections on the cam member. The axial path of the latter is limited by the ends of the slots, and the axial length of the slots and the cam member is preferably selected in such a manner that the cam member in all operative positions thereof will prevent entry of contaminants through the slots into the housing cavity.

Other features and many of the attendant advantages of this invention will become apparent to those skilled in the art as the disclosure is made in the following detailed description of the annexed drawings, which illustrate a preferred embodiment of the invention, and wherein:

FIG. 1 is a front elevational view of a door equipped with the hinge assembly of the invention;

FIG. 2 shows a detail of the door of FIG. 1 with portions of the structure broken away to reveal the working elements of the hinge assembly;

FIG. 3 is a side-elevational fragmentary view of the hinge assembly of FIG. 2, the view being taken in the direction of the arrows 3-3;

FIG. 4 is a plan view of a portion of the apparatus of FIG. 2 taken in the direction of the arrows 4-4; and

FIG. 5 shows the apparatus of FIG. 2 in a fragmentary sectional view in a different operating position, the section being taken on the hinge axis.

Referring now to the drawings in detail, and initially to FIG. 1, there is seen a door 10 which substantially fills the opening of a door frame 11. One of the narrow upright sides of the door 10 has two recesses 12 and 13. A hinge bracket 14 engages the upper recess 12 in which it is pivotally secured to the door 10. The bracket 14 is fixedly mounted on the door frame 11 and thus holds the door in a fixed axial position. The upper door bracket 14 is entirely conventional and does not require more detailed description. The lower recess 13 accommodates a hinge assembly 15 with which this invention is more particularly concerned.

The hinge assembly is seen in FIGS. 2 to 5 in several operating positions. FIGS. 2 to 4 inclusive show the hinge in the rest position which in the example illustrated coincides with the position of the door seen in FIG. 1 in which the door is aligned with the door frame for closing the door opening. In FIG. 2 the hinge assembly appears in front elevation with portions broken away to reveal other elements of the hinge assembly. FIG. 3 shows a major part of the hinge assembly of FIG. 2 in side elevation, and FIG. 4 is a top plan view of the hinge assembly of FIG. 2. FIG. 5 is an axially sectional view of some hinge elements with the hinge assembly angularly moved away from its rest position.

The hinge assembly 15 comprises a bracket 16 which is fastened to the door frame 11 by two screws 17. The member 18 of the bracket 16 which projects into the recess 13 has an upright bore engaged by a stud 19 integral with a cylindrical plug 20. The plug is firmly fastened to the bracket member 18 by a nut 21 which clamps the bracket member against the lower radial face of the

plug. The upper portion of the plug is tubular and has a radial face which extends from a peak at 22 to a bottom point at 23 in two helices of opposite direction of rotation each extending over one half of the circumference of the plug. If developed into a plane, the cylindrical outer wall of the plug 20 would be represented by a rectangle topped by an isosceles triangle based on one side of the rectangle.

The plug 20 axially extends into an open lower end of a tubular cylindrical housing 24 which is fastened inside the door by a frame 25 with which it is integral. The frame 25 fits the contour of the door 10 about the lower recess 13 and is fixedly clamped on the body of the door. The upper end of the housing 24 is closed by a transverse wall 26. The cylindrical wall 27 of the housing 24 is continuous except for two diametrically opposite axially elongated slots 28.

A cam piece 29 is axially slidable in the cavity of the housing 24 and is of a diameter which is only very slightly smaller than the internal diameter of the housing 25, and approximately equal to the diameter of the plug 20 so that the cam piece and the plug form movable seals in the housing 24. A pin 30 passes diametrically through the cam piece 29. Each of its ends extends into a slot 28 and rotatably carries a small roller 31 the diameter of which is slightly smaller than the circumferential width of the slot 28. The resulting circumferential play of the roller 31 is too small to permit adequate pictorial representation on the scale of FIG. 3, but sufficient to permit rotation of the roller when moving along one axial wall of the slot 28 substantial without friction against the opposite wall. The outer surfaces of the pin 30 and of the rollers 31 are approximately flush with the outer surface of the housing 24.

The lower portion of the cam piece 29 is tubular and its radial face has the same shape as the upper radial face of the plug 20 so that in the rest position illustrated in FIG. 2 the lower radial face of the cam piece 29 has a peak at 23 registering with the bottom point of the corresponding plug face, and a bottom point at 22. The two helical face portions of the cam piece 29 between the peak and the bottom point are in contact over their entire lengths with the corresponding face portions of the plug.

The cam piece 29 is urged downward into engagement with the plug 20 by an abutting end portion of a strong helical spring 32 the other end of which is supported by a pressure plate 33 backed by a control screw 34 which is threadably movable in the transverse housing wall 26. The head of the control screw 34 is located outside the housing and the tension of the spring 32 may be adjusted by rotation of the head of the screw 34.

When the door is pivoted about the longitudinal axis of the housing 24, rotation of the plug 20 in the housing forces upward displacement of the cam member 29 against the constraint of the spring 32. Depending on the direction of angular movement from the position shown in FIG. 1, one or the other of the two helical face portions of the cam piece 29 will rotate with the door in contact with the corresponding face portion of the stationary plug 14, thereby axially lifting the other face portion of the cam piece 29 out of engagement with the corresponding face portion of the plug. The relative positions of the camming cooperating faces of the plug 20 and the cam piece 29 after the door has been swung out of its rest position are seen in FIG. 5. The bottom of the cam piece face has been lifted in a helical path above the peak of the plug face. Even after rotation of the door through a wide angle, there is still contact between the two camming faces of the plug 14 and the cam piece 29 over a substantial portion of their circumference.

The mounting of the hinge assembly of the invention on a door is very simple. The bracket 16 is mounted on the door frame 11 by the two screws 17. The door 10 is machined or otherwise shaped to provide the two re-

cesses 12 and 13. An axially extending cylindrical opening of a diameter approximately equal to the external diameter of the housing 24 is drilled or otherwise formed in the door body to communicate with the recess 13.

The housing 24 with all the working parts of the hinge assembly is slid into the cylindrical opening until the frame 25 envelops the door corner. The frame is clamped fast on the door to secure the housing in its proper position. The door is suspended from the upper hinge bracket 14. With the plug 20 pushed as far into the cavity of the housing 24 as possible, the door is aligned with the bracket member 18 until the stud 19 can be dropped into the bore of the bracket member 18 whereupon assembly is completed by mounting and tightening the nut 21.

Other mounting sequences for the hinge assembly of the invention will readily suggest themselves to those skilled in the art to suit prevailing conditions. Under all conditions the hinge assembly of the invention is mounted easily and in precise alignment even by unskilled personnel. The protection of the more sensitive working parts by the housing 24 effectively prevents any damage to the hinge elements during insertion in the door and during hanging of the door. An accidental blow which may damage the door itself will usually leave the hinge assembly unharmed so that it may be removed from the door and used on another door.

The sealing engagement between the plug 20 and the cam member 29 prevents penetration of contaminants into the cavity of the housing 24. As best seen from FIG. 2, the length of the slots 28, the axial length of the cam piece 29 and the position of the cam piece in the housing are such that no passage from the outside through the slots 28 into the cavity of the housing 24 is opened when the rollers 31 move over the entire length of the slots 28. The length of the slots is correlated with the axial spacing between the peak 22 and the bottom point 23 in such a manner that the path of swinging door movement may be limited by abutment of the rollers 31 against an axial end wall of the slot 28 to prevent overtravel of the cam faces.

The weight of the door is supported to a certain extent by the upper hinge bracket 14, but a substantial portion of the door weight is transmitted to the lower hinge bracket 16 by the spring 32. The spring must be properly selected or adjusted by means of the screw 34 with regard to the door weight so that it will permit upward displacement of the cam piece 29 without causing the pivot at the upper bracket 14 to bind. It will be appreciated that the axial position of the plug 20 in the housing cavity is substantially fixedly determined by the suspension of the door from the hinge bracket 14.

It should be understood of course that the foregoing disclosure relates to only a preferred embodiment of the invention and that it is intended to cover all changes and modifications of the example of the invention herein chosen for the purpose of the disclosure which do not constitute departures from the spirit and scope of the invention set forth in the appended claims.

What I claim and desire to be protected by Letters Patent of the United States is:

1. A hinge assembly comprising an elongated tubular housing having a longitudinal axis and an internal wall enclosing a substantially closed cylindrical cavity, said housing being formed with an axially elongated recess in said wall; a substantially cylindrical cam member axially movable in said cavity and having a radially extending helical cam face about said axis; a guide member radially projecting from said cam member and engaging said recess for securing said cam member against rotation about said axis; a plug member rotatable relative to said housing in said cavity about said axis and having a radially extending helical cam face about said axis matingly engageable with the cam face of said cam member;

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resilient means in said cavity for permanently urging said cam member into axial engagement of the cam face thereof with the cam face of said plug member; and fastening means for fixedly securing said housing and said plug member to a door and a door frame respectively for hinged movement of said door about said axis relative to said frame.

2. A hinge assembly as set forth in claim 1, wherein said plug member during rotation thereof sealingly engages said wall.

3. A hinge assembly as set forth in claim 1, wherein said cam member during axial movement thereof sealingly engages said wall.

4. A hinge assembly as set forth in claim 1, further comprising means for securing said plug member against axial movement in said cavity.

5. A hinge assembly comprising an elongated tubular housing having a cylindrical wall formed with an axially elongated slot passing therethrough and defining a substantially closed cavity; a cam member axially movable in said cavity and having a radially extending helical cam face about said axis; a guide member radially projecting from said cam member for engagement with said slot and axially slidable therein, said guide member and said slot constituting guide means for securing said cam member against rotation about said axis; a plug member rotatable relative to said housing in said cavity about said axis and having a radially extending helical cam face about said axis matingly engageable with the cam face of said cam member; resilient means in said cavity for permanently urging said cam member into axial engagement of the cam face thereof with the cam face of said plug member; and fastening means for fixedly securing said housing and said plug member to a door and to a door frame respectively for hinged movement of said door about said axis relative to said frame.

6. A hinge assembly as set forth in claim 5, wherein the axial lengths of said slot and of said cylindrical cam member are such that passage through said slot into said cavity is obstructed by said cam member in all axial posi-

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tions thereof, the axial movement of said cam member being limited by the length of said slot.

7. A hinge assembly as set forth in claim 5, the radial length of said guide member being not greater than the radial thickness of said wall.

8. A hinge assembly comprising a housing having a continuous cylindrical wall formed with two circumferentially spaced elongated slots, said housing having one open axial end and a transverse wall closing the other axial end; a cam member in said housing having a radially extending helical cam face about the axis of said wall; two guide members respectively axially slidable in said slots between the axial ends thereof, said guide members being fastened to said cam member for guiding axial movement of said cam member and securing the same against rotation about said axis; a plug member rotatable relative to said housing and having a radially extending helical cam face about said axis matingly engageable with the cam face of said cam member in said housing, a portion of said plug member axially projecting from the open end of said housing; a compression spring interposed in said housing between said transverse wall and said cam member and permanently urging the same into a position of engagement of said cam faces; fastening means for securing said housing to a door; and bracket means on said projecting portion of said plug member for securing the latter to a door frame.

9. A hinge assembly as set forth in claim 8, including control means mounted on said transverse wall for adjusting the effective axial length of said compression spring.

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