United States Patent

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[72] Inventor **James R. Root**
Independence, Mo.

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[73] Assignee **Ruskin Manufacturing Company**
Grandview, Mo.

[54] **SMOKE DAMPER**
10 Claims, 6 Drawing Figs.

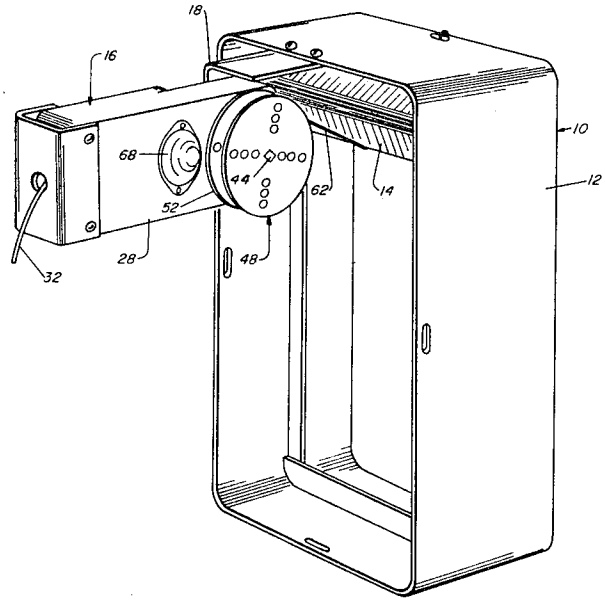
[52] **U.S. Cl.** **160/1,**
160/235, 160/310
[51] **Int. Cl.** **E05f 15/20,**
E06b 9/204
[50] **Field of Search** 160/1, 5, 6,
7, 8, 9, 310, 235; 318/360, 436, 540; 49/1, 4, 7, 8

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Primary Examiner—Peter M. Caun
Attorney—Don M. Bradley

ABSTRACT: A damper for automatically sealing building passages against the flow of fluids such as smoke. The damper comprises a plurality of blades held in a standby position by an energized motor and which automatically move to the closed position when the electrical energy to the motor is interrupted. Axial shifting of the motor responsive to electromagnetic forces effects the holding and release of the blade assembly.



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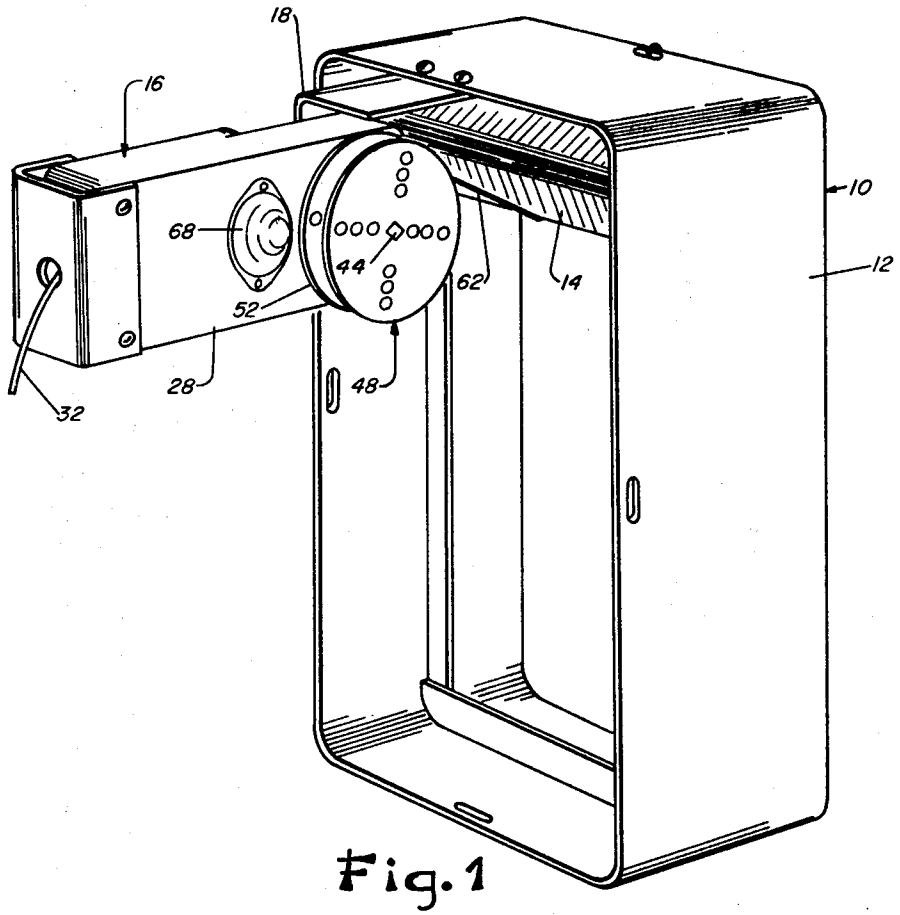


Fig. 1

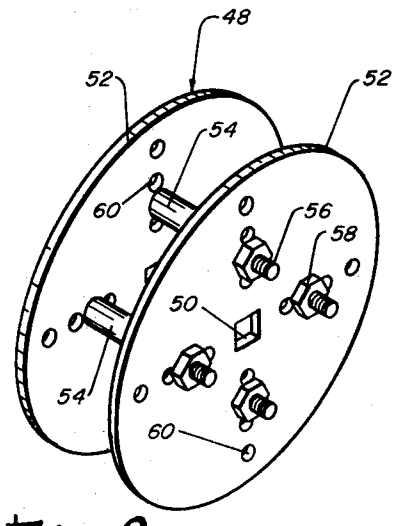


Fig 2

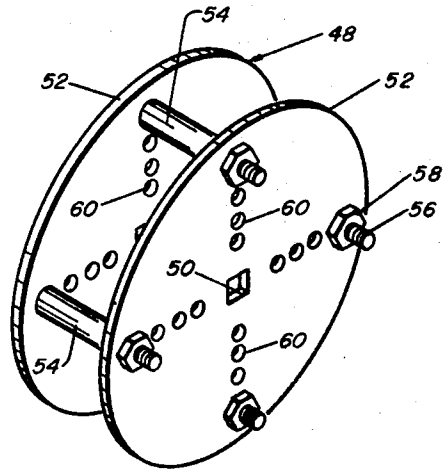


Fig. 3

INVENTOR
James R. Root

BY Don M. Bradley
ATTORNEY

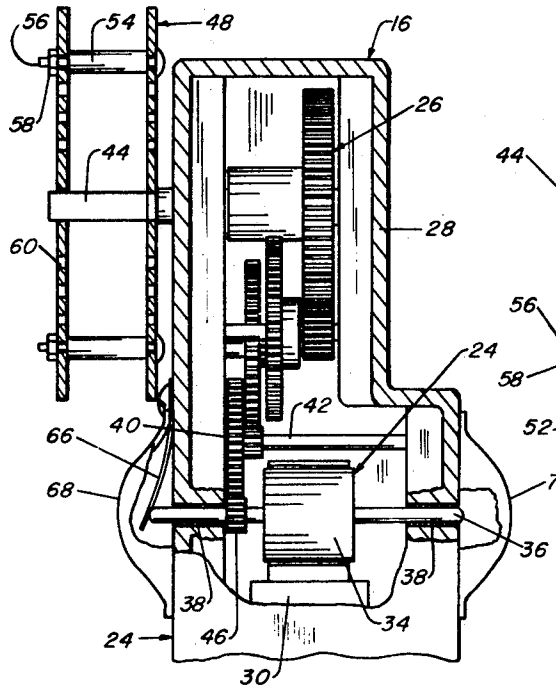


Fig. 4

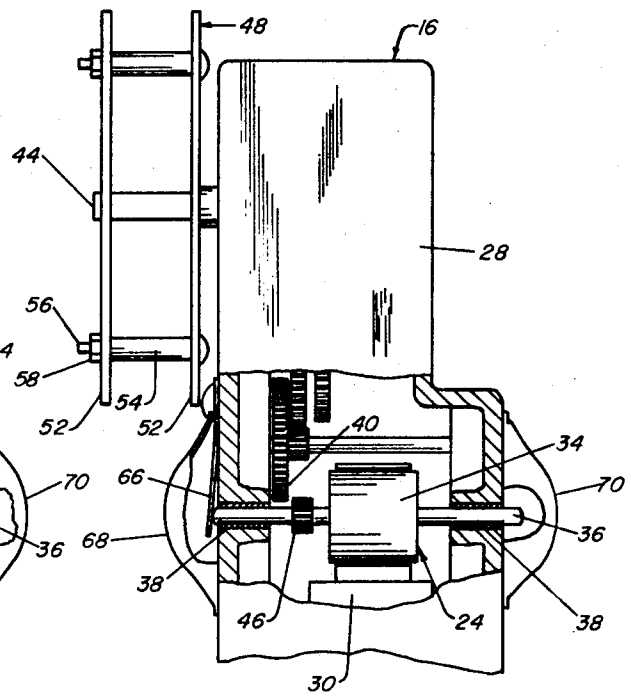


Fig. 5

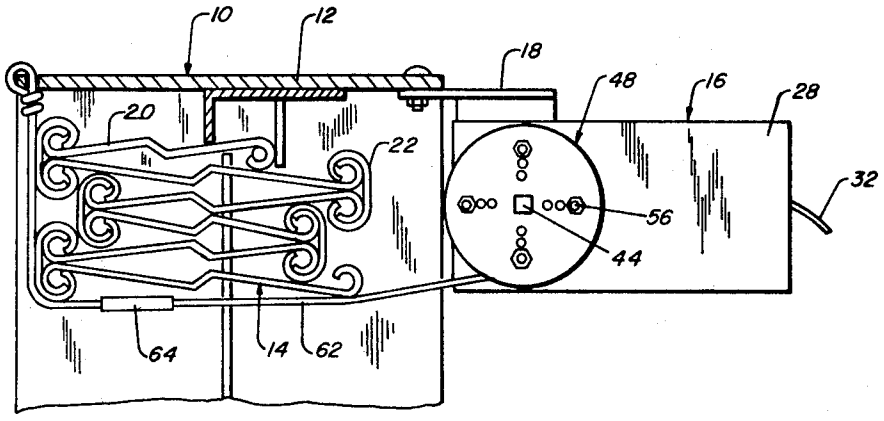


Fig. 6

INVENTOR
James R. Root

BY Don M. Bradley

ATTORNEY

SMOKE DAMPER

This invention relates to dampers, and more particularly to a damper which is held in a standby position until automatically permitted to close upon the occurrence of an interruption in the electrical system to which the damper is coupled.

Buildings for hospitals and other institutions are commonly equipped with automatic devices interposed in ventilating, heating and air conditioning ducts and the like for closing these passages in the event of a fire or other disaster. Dampers having heat responsive operating elements have long been utilized for this purpose. However, it is desirable that the transfer of smoke or other dangerous fluids through the building be prevented when a disaster strikes, even in those portions of the building which may not actually experience a fire capable of elevating the temperature to the critical level for closing the temperature responsive dampers.

The damper of this invention is held in a standby position while electrical energizing current is available. When, however, a disaster strikes interrupting the current or causing an operator to throw a master switch to cut off the current, the damper automatically closes to prevent transfer of the dangerous fluids through the building. Such dampers are commonly referred to in the trade as "smoke dampers."

Attempts have been made to provide smoke dampers which are operated by solenoids. These have the disadvantage of chattering or humming when energized and require different sized solenoids for various sized dampers. There is also a possibility of solenoids becoming stuck after relatively long periods during which they are not operated.

The advent of dampers having a screen comprised of a plurality of hinged together, folding blades has complicated the problem. No convenient and practical way has been found until now to utilize rotary motors for moving the blades to their standby positions. Further, motors large enough for producing ample torque for holding the relatively heavy blade assembly in its standby position are impractical or require a gear reduction drive which makes the damper sluggish or inoperative wher current to the motor is interrupted.

Accordingly, it is the primary object of the present invention to provide a smoke damper having an operating motor which is automatically disengageable from the drive to permit free wheeling of the latter when the blade assembly moves to its flow blocking position.

Still another object of the present invention is the utilization of the inherent electromagnetic forces generated in an electric motor for automatically coupling the motor with the blade assembly when the motor is energized.

Another important object of the invention is the provision of novel means for effectively coupling the motor with a folding blade curtain.

A yet further object of the present invention is the provision of an adjustable torque transfer mechanism for quickly and easily, as well as economically adapting a motor of standardized characteristics for use with various sized blade curtain assemblies.

These and other important objects of the present invention will be further explained or will become apparent from the following specification and claims and from the drawings. In the drawings:

FIG. **1** is a perspective view of a smoke damper embodying the principles of this invention;

FIG. **2** is an enlarged, perspective view of an adjustable reel for the damper;

FIG. **3** is a view similar to FIG. **2** but showing the reel spool adjusted to a different position;

FIG. **4** is a fragmentary, vertical cross-sectional view through the motor and drive assembly;

FIG. **5** is a fragmentary side elevational view of the motor and drive assembly, the shaft covers having been removed and parts broken away to show the components in the position thereof with the motor deenergized; and

FIG. **6** is a fragmentary, vertical cross-sectional view through the damper and on a reduced scale. A smoke damper

embodying the principles of this invention is broadly designated in the drawings by the reference numeral **10** and comprises a perimeter frame **12**, a blade assembly **14** mounted in frame **12** and a motor and drive assembly **16** secured to frame **12** by means of a bracket **18**. Assembly **14** includes a plurality of elongated generally planar blades **20** interconnected along their longitudinal marginal edges as, for example, with connectors **22**. The uppermost blade **20** is secured to frame **12** by pivot means whereby the blades may be folded out into a substantially flat curtain extending across the opening defined by frame **12**. A blade and frame assembly of the type with which the principles of this invention may be utilized is shown and described in U. S. Pat. No. 3,401,734 issued Sept. 17, 1968, to which reference may be had if desired for a more complete description of the frame and blade assembly.

Assembly **16** includes a motor **24** and a drive **26**. The motor **24** and drive **26** may utilize a common housing **28** which is, in turn, secured to bracket **18**.

Motor **24** includes a stator **30** adapted to be coupled with a source of electrical energy by electric wires **32**. The rotor **34** is carried on an elongated shaft **36** which is mounted for rotation in housing **28** by bushings **38**. The latter also mounts shaft **36** for shifting movement with rotor **34** in a direction longitudinally of shaft **36** as will be more fully explained hereinafter.

As is illustrated in FIG. **4**, drive **26** may comprise a plurality of gears **40** and shafts **42** for effecting a speed reduction and consequent torque increase at a polygonal output shaft **44**. A cog **46** rigidly carried by shaft **36** is adapted to engage with the input gear **40** as is illustrated in FIG. **4**. The engagement of cog **46** with the input gear **40** effectively couples motor **24** with the drive **26** for operating the latter. A reel broadly designated **48** is provided with an axial opening **50** adapted to be complementally received over shaft **44** so that the reel is driven by shaft **44** as will be understood by those skilled in this art. Means (not shown) may be provided for releasably securing reel **48** to shaft **44**.

Reel **48** comprises a pair of spaced apart discs **52** presenting end flanges for the reel. The flanges are held in spaced apart relationship by a plurality of tubular spacers **54** which are mounted on bolts **56** extending transversely between the discs **52**. Nuts **58** releasably secure the bolts **56** in aligned apertures **60** extending transversely through the discs **52**.

It may be seen from FIGS. **2—4** of the drawings that apertures **60** are presented in rows comprised of a series of spaced apart apertures which rows extend radially from the center of reel **48**. Manifestly, the bolts **56** and spacers **54** comprise the spool for the reel and the diameter of the spool may be adjusted in accordance with the particular apertures **60** selected for receiving the bolts **56**. It will be noted that the reel of FIG. **3** has a spool of substantially greater diameter than the reel of FIG. **2** simply as a result of the particular locations of the respective bolts **56** with respect to the central axis of the reel.

An elongated element **62** has one end thereof secured in frame **12** and the other end is secured to reel **48**, preferably by being tied around a spacer **54**. Element **62** may take the form of a cable or the like and it is looped around the blade assembly **14** in the path of travel of the latter in movement from the standby position to its closed position across the frame opening. A fusible link **64** is interposed between the ends of element **62** so that the blades assembly is permitted to gravitate to its closed position should the damper be exposed to temperatures above a predetermined limit.

Referring now to FIGS. **4** and **5**, it may be seen that rotor **34** which is carried by shaft **36** is shifted to the left with cog **46** engaged with gear **40**. This is the position attained by the rotor and shaft upon energizing of the stator of motor **24**. The electromagnetic forces generated in the stator **30** result in the shifting of the rotor and shaft to this position as will be understood by those skilled in the art. A spring **66** is mounted on housing **28** exteriorly of the latter and in the path of travel of shaft **36** when the latter moves longitudinally thereof under the influence of the electromagnetic forces mentioned above. A cover **68** may be provided to enclose spring **66** and the

proximal projecting end of shaft 36. A similar cover 70 may also be provided for the opposite end of shaft 36 when the same is returned to the position thereof illustrated in FIG. 5. The shaft and rotor moves to the position illustrated in FIG. 5 under the influence of spring 66 when motor 24 is deenergized. Spring 66 positively shifts shaft 36 and rotor 34 to this position to thereby disengage cog 46 from gear 40 as a result of such deenergizing of motor 24.

In operation, damper 10 is installed in a fluid passage such as a ventilating duct in a building. Wires 32 are coupled with a source of electrical energy. When this energy is applied to motor 24, the electromagnetic forces in the stator 30 shift the rotor 34 and shaft 36 to the position shown in FIG. 4 whereupon rotation of rotor 34 as a result of application of the electrical energy operates drive 26. This turns reel 48 in a direction to wind element 62 on the spool. The tensioning of element 62 lifts the blade assembly to fold the latter as illustrated in FIG. 6. So long as energy is applied to motor 24, the blade assembly 14 is held in this position which is the standby position permitting substantially uninhibited flow of fluid through the frame opening and consequently through the ventilating passage.

Should, however, electrical energy to motor 24 be interrupted for any reason whatever, the electromagnetic forces acting on rotor 34 are also interrupted. This permits spring 66 to shift the shaft to the right as viewed in FIG. 5 disengaging motor 24 from drive 26. The latter may thereupon free wheel under the influence of the weight of assembly 14 acting on element 62 so that the blade assembly 14 moves to its position closing the ventilated passage. Since motor 24 is disengaged from the drive, there is very little torque resisting movement of the blade assembly to its closed position.

Manifestly, it is contemplated that damper 10 may be installed in a horizontal position. For this reason, or should it be determined that the weight of the assembly 14 is not, by itself, sufficient to cause the blade assembly to move to its flow blocking position, springs may be attached to the assembly for effecting the unfolding of the curtain when the tension on element 62 is released. The operation of damper 10 is the same whether spring power or gravity is relied upon for this purpose.

The size of the opening defined by the frame 12 is governed by the size of the duct sought to be protected. Consequently, the weight of assembly 14 is governed by the size of the particular passage defined by frame 12. It is therefore desirable that the torque available from reel 48 for tensioning element 62 be suited for overcoming the weight of assembly 14. This tensioning torque may be quickly and easily changed simply by moving the bolts 56 and spacers 54 either inwardly or outwardly from the center of shaft 44.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

I claim:

1. In a damper including a blade assembly movable from a standby position to a flow blocking position, means for releasably holding said assembly in said standby position comprising:

a movable drive;

means operably coupled with the drive and disposed to engage said assembly for preventing the movement of the assembly toward said blocking position when the drive moves in one direction and to permit movement of the assembly to said blocking position when the drive moves in the opposite direction;

an electrically operated motor having a rotatable shaft engageable upon energization of said motor with the drive means for moving the latter in said one direction; and

means operably coupled with said shaft for disengaging the latter from said drive upon deenergization of the motor to permit movement of the drive in said opposite

direction, said motor including a stator and a rotor, the shaft being secured to the rotor for movement therewith, and means mounting the rotor and shaft for movement longitudinally of the shaft responsive to electromagnetic forces generated in the stator upon energization of said motor for engaging the shaft with said drive.

2. The invention of claim 1, wherein said disengaging means includes spring means disposed in the path of movement of said shaft toward the position thereof engaged with the drive for yieldably biasing the shaft toward said disengaged position.

3. The invention of claim 2, wherein said motor includes a housing, said spring means comprising a leaf spring secured to the housing and extending into the path of travel of said shaft.

4. The invention of claim 3, wherein is included a cover carried by said housing and extending over the spring.

5. The invention of claim 1, wherein said means disposed to engage the assembly for preventing movement thereof comprises an elongated, flexible element having one end anchored in a fixed position, and wherein said drive includes a windup reel, the other end of said element being secured to the reel whereby energization of the motor winds the reel tensioning the element to the position for holding said assembly.

6. The invention of claim 5, wherein is included a temperature fusible link interposed between the ends of said element.

7. The invention of claim 5, wherein said damper includes a frame, and wherein the assembly includes a plurality of blades hinged to one another along longitudinal marginal edges to present a foldable curtain, the end blade of said curtain being pivotally secured to said frame.

8. The invention of claim 7, wherein said one end of the flexible element is secured to the frame.

9. The invention of claim 5, wherein said reel comprises a pair of end flanges and a spool extending between the flanges, and wherein is included means for adjusting the diameter of the spool for regulating the torque imparted to the element for tensioning the latter.

10. The invention of claim 1, wherein said drive includes a gear, and wherein is included a cog carried by the shaft and engageable with the gear upon energization of the motor for coupling the shaft to the drive.