United States Patent [19]

Scharres

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[54] **FIRE, SMOKE AND BLAST DAMPER**

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[52] **U.S. Cl.** **98/1,** 98/86, 137/75, 160/1, 160/133

[51] **Int. Cl.** **F16k 13/04**

[58] **Field of Search** 98/1, 86; 126/287.5; 160/1, 133; 137/625.28, 75

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[57] **ABSTRACT**

A fire, smoke and blast damper for air ducts or passages including a metal curtain which is inwardly rolled upon itself from its lowermost end and is normally secured in such rolled condition by a line having a fusable element that is destructible when subjected to a predetermined temperature. Upon destruction of the fusable element, the curtain is released and rapidly unrolls to bear against a pair of side stop members. Gasket material is provided between the stop members and the edges of the curtain, and between individual slats of the metal curtain, to effectively seal the duct from the further passage of air when the curtain has completely unrolled. In one embodiment, the curtain includes an elongated spring member which is secured to and rolled with the curtain, providing a spring force effective in unrolling the curtain.

14 Claims, 8 Drawing Figures

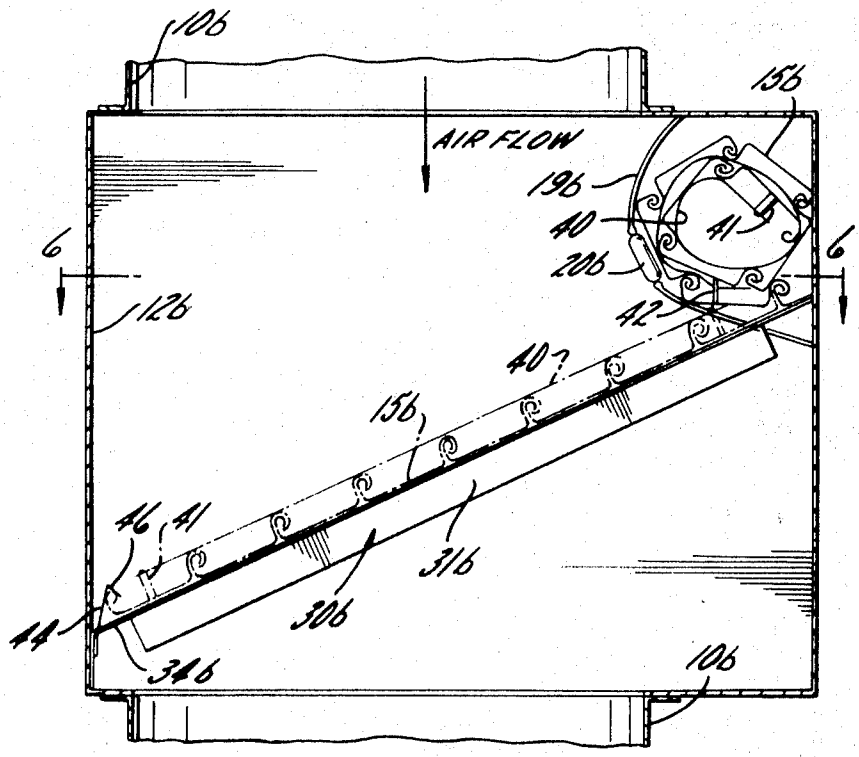


Fig. 1.

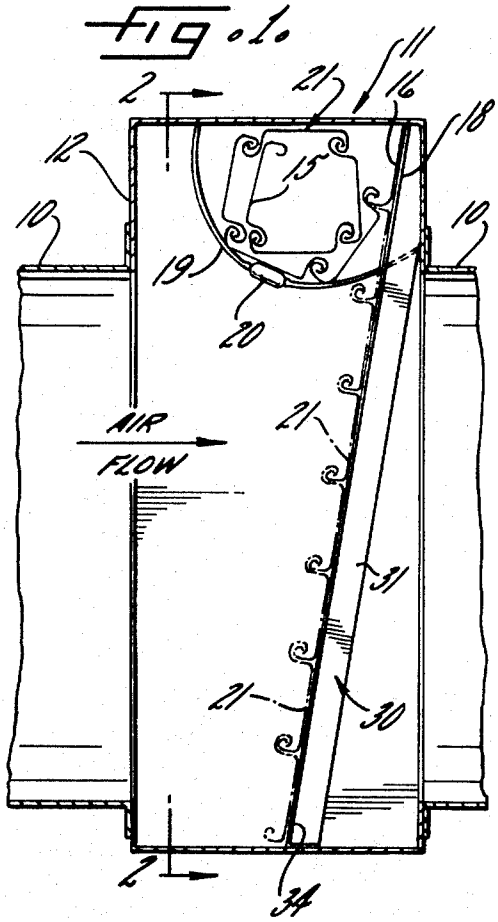


Fig. 2.

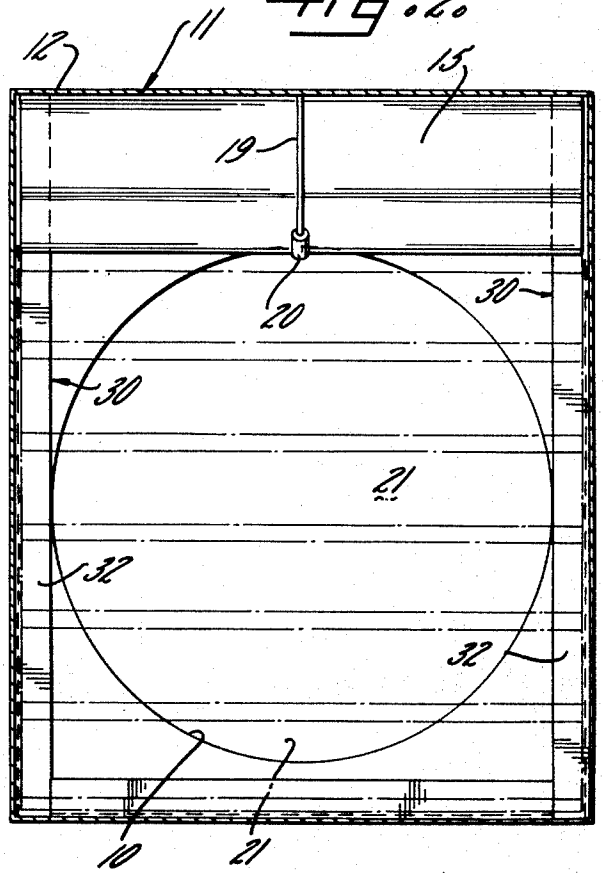


Fig. 3.

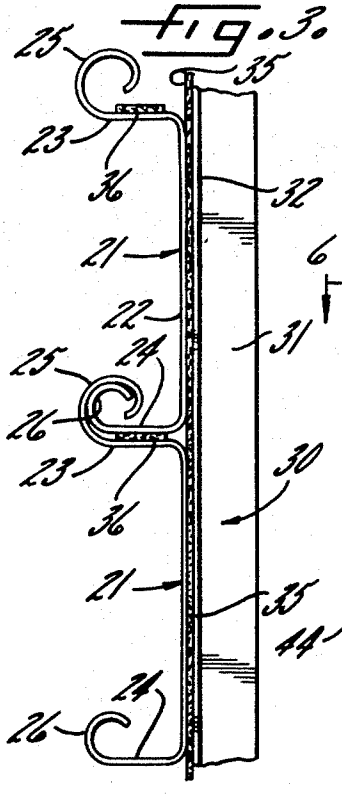


Fig. 4.

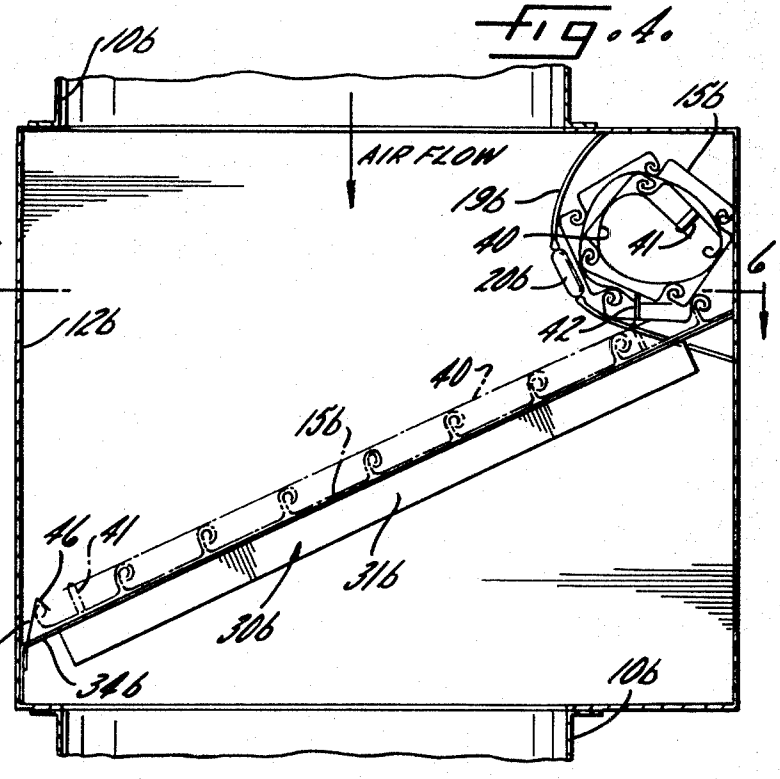


Fig. 5.

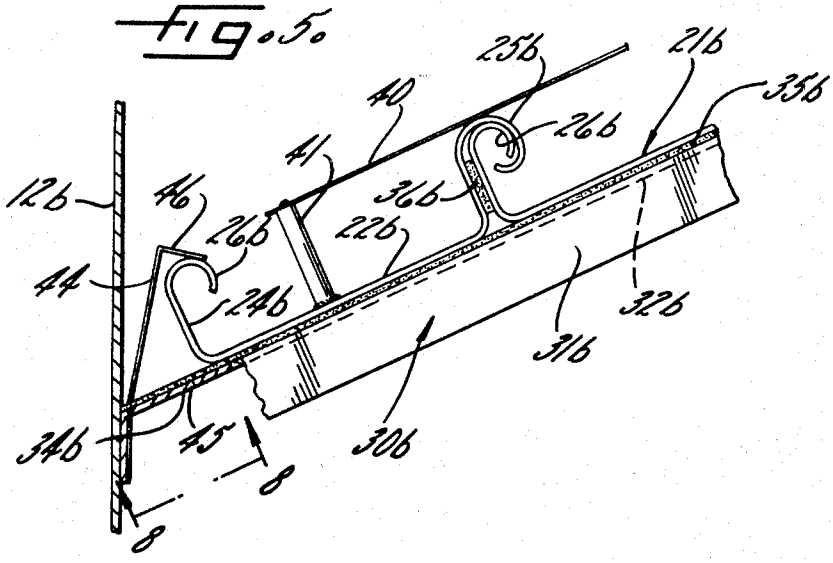


Fig. 6.

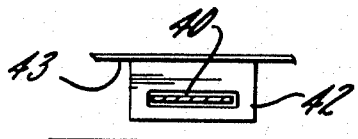


Fig. 7.

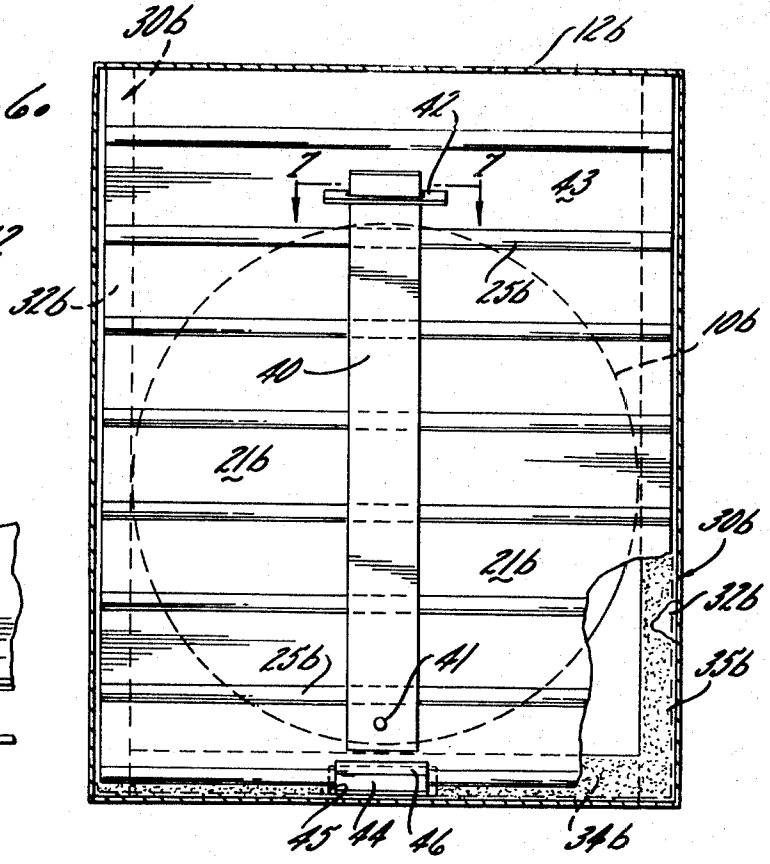
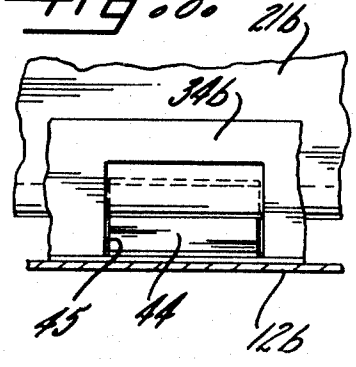


Fig. 8.



FIRE, SMOKE AND BLAST DAMPER

DESCRIPTION OF THE INVENTION

The present invention relates to fire, smoke and blast dampers, and more particularly, to dampers which are utilized in forced air ducts and are automatically actuated to close the duct when the temperature herein exceeds a predetermined value, when smoke is detected or when a blast condition is impending.

In the past, fire, smoke, and blast dampers have been designed for the same general purpose as that of the instant invention. These known devices, however, often have experienced problems of hanging up or sticking when they are actuated so that the damper does not completely close off the duct, or when such dampers do close, they frequently fail to adequately seal the duct from the passage of air. When guidetracks have been employed to captively receive and secure the edges of a damper curtain to create a more effective seal, the edges of the curtain often bind in the track, preventing full unfolding or unrolling of the curtain. When such guide tracks have not been employed, excessive leakage of air commonly occurs around the outer edges of the damper curtain. In addition, in prior damper curtain constructions air frequently passes through the joints of the metal slats which form the curtain, thereby diminishing the effectiveness of the damper.

It is an object of the invention to provide an automatically actuatable damper adapted to reliably close off a duct without sticking or hang-up and form a relatively tight seal with the duct to effectively prevent the further passage of air or gases through the duct.

Another object is to provide a damper as characterized above which freely and quickly moves to close off the duct and which forms a relatively tight seal with the duct without the edges of the damper curtain being captively secured.

A further object is to provide a damper of the foregoing type in which relatively tight seals are provided between the individual slats of the damper curtain, as well as between the outer edges of the damper curtain and the duct.

Still another object is to provide a damper of the above kind which is power actuated by means such as a spring for insuring that the damper curtain completely closes the duct without hang-up.

Other objects and advantages of the invention will become apparent from the following detailed description and upon reference to the drawings, in which:

FIG. 1 is a fragmentary vertical section of a horizontal air duct having a damper embodying the present invention, with the damper curtain shown in solid lines in its rolled duct open position and in phantom in its unrolled duct closing position;

FIG. 2 is a vertical section taken in the plane of line 2—2 in FIG. 1;

FIG. 3 is an enlarged section of a portion of the damper curtain shown in FIG. 1 when in its open position and unrolled duct closing position in phantom;

FIG. 4 is a fragmentary section of a vertical duct having a damper similar to that shown in FIG. 1, again showing the curtain in solid lines in its rolled condition and in phantom in its unrolled duct closing position;

FIG. 5 is an enlarged fragmentary section showing the spring clip means which secures the end of the damper curtain shown in FIG. 4 when in its unrolled duct closing position;

FIG. 6 is a horizontal section through the damper assembly shown in FIG. 4 showing the damper curtain in its unrolled duct closing position;

FIG. 7 is an enlarged fragmentary section taken in the plane of line 7—7 in FIG. 6; and

FIG. 8 is an enlarged fragmentary section taken in the plane of line 8—8 in FIG. 5.

While the invention is susceptible of various modifications and alternative forms, certain specific embodiments thereof are shown by way of example in the drawings and will be described herein. It should be understood, however, that it is not intended to limit the invention to the particular forms disclosed, but on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention.

Referring more particularly to FIGS. 1–3 of the drawings, a horizontal passage or air duct **10** herein shown of circular cross-section has mounted therein a fire, smoke, and blast damper constructed according to the present invention. The direction of normal air flow through the duct is indicated by the arrow in FIG. **1**. The damper **11** includes a rectangular frame enclosure **12** which is larger than the diameter of the duct **10** and contains a metal damper curtain **15** attached at one end **16** to a plate **18** secured to a top panel of the frame enclosure **12**. The damper curtain **15** in its normally stored condition, shown in solid lines in FIG. **1**, is disposed in an upper corner of the frame enclosure **12** so as not to obstruct the flow of air through the duct **10**. The curtain **15** is maintained in such a stored position by a line **19** attached to adjoining walls of the frame enclosure **12**. The line **19** includes a releasable element **20** which may be a fusable link designed to melt upon exposure to a predetermined temperature, or a solenoid or mechanical latch operable electrically or mechanically by a smoke or blast detector to break the line **19** and release the curtain **15**.

In accordance with the present invention, the damper curtain is inwardly rolled upon itself from its free end and upon release the curtain unrolls to close the duct and block the further passage of air or gases. The illustrated curtain **15** comprises a plurality of metal slats **21** which each have a flat web **22** and upstanding hinge flanges **23** and **24** extending perpendicular to the web **22** along the opposite longitudinal edges thereof. The hinge flange **23** along one edge of each slat is formed with a rounded female hook **25** at its outer end, and the hinge flange **24** along the opposite edge is formed with a rounded male hook **26**. The curtain slats **21** are connected together in a series with the male hook **26** of one hinge flange **24** being received in the female hook **25** of the adjacent slat. The lowermost end of the curtain in this case is rolled upon itself with the upstanding hinge flanges **23, 24** being directed inwardly into the roll.

When the rolled curtain **15** is released as a result of opening of the element **20**, the curtain rapidly unrolls under its own weight to a duct closing position shown in phantom in FIG. **1**. Since the upstanding hinge flanges **23, 24** of each curtain slat **21** extend from a common side of the web **22**, on the reverse side of the unrolled curtain **15** the webs form a substantially flat surface. Furthermore, since the curtain descends under its own weight the weight of the unrolled portion tends to act on each hinge joint successively to insure that it is fully extended so that no kinks or bulges remain in

the curtain. As the curtain continues to unroll, the momentum which builds up further tends to assist in completely unrolling the curtain into a flat sheet.

In keeping with the invention, downwardly inclined elongated straight stop members **30** are mounted on opposite sidewalls of the frame enclosure **12** to guide the curtain as it unrolls and support the curtain in its unrolled position. The stop members **30** in this case are angle irons each having one flange **31** secured to the sidewall of the frame **12** and the other flange **32** extending perpendicularly from the frame wall for supporting the metal curtain as it unrolls. An end stop **34** also is provided at the bottom of the frame **12** for supporting the lower end of the unrolled curtain when it comes to rest. The flat back surface of the curtain defined by the webs **22** cooperates with the flat flanges of the stop members **30** and end stop **34** to substantially prevent the passage of air around the edges of the curtain. The stop members are inclined at an angle from the vertical such that the downward component of the weight of the metal curtain exerts pressure against the inclined stop members **30** to hold the curtain generally against flutter or movement as a result of air pressure incurred in the duct, even though the curtain edges are not captively secured.

One of the major features of the invention is the provision of sealing elements both between the slats of the damper curtain and between the curtain and the frame enclosure which are brought into cooperative relationship as the curtain unrolls to its closed position to create a substantially air-tight seal against air flow along the duct. To this end, for sealing the edges of the curtain, gasket strips **35,** preferably made of resilient fireproof material such as asbestos, are provided along the upper surfaces of the stop members **30** and the end stop **34.** The downward component of the weight of the unrolled curtain acting on the top surface of the stop members **30, 34** compresses the gasket strips **35** to provide a tight seal between the edges of the curtain and the stop members. In addition, to prevent the flow of air through the hinge joints between the curtain slats, gasket strips **36** are secured to the vertical flange **23** of each slat. As the curtain is unrolled, the flanges **23** and **24** of adjacent slats are moved into close parallel relation, squeezing the gasket strips **36** therebetween.

Referring now to FIG. **4,** there is shown a damper similar to that described above except mounted in a vertical duct, and parts have been given reference numerals corresponding to those previously described with the distinguishing suffix *b* added. In this embodiment, the damper frame enclosure **12***b* again is rectangular shaped and larger than the circular vertical duct **10***b*. A damper curtain **15***b* is inwardly rolled upon itself from its free end and is maintained in a stored position in the right-hand side of the frame enclosure **12***b* by a line **19***b* having a releasable element **20***b*.

Upon release of the curtain **15***b*, the curtain unrolls along a pair of stop members **30***b* secured to opposite sides of the frame **12***b* so that when the curtain is unrolled it extends completely across the frame enclosure **12***b* and prevents the further passage of air through the vertical duct **10***b*.

It can be seen that the curtain in the horizontal duct embodiment of FIG. **1** unrolls along steeply inclined stop members, and substantially the full weight of the curtain will act to achieve rapid, reliable, and complete unrolling of the curtain. At the same time, the angle of inclination from the vertical is such that a sufficient portion of the weight of the curtain is supported by the stop means so that a relatively stable seal will be maintained. Where the curtain is mounted in a vertical duct as in FIG. **4,** however, as the angle of inclination of the stop members approaches the horizontal, while the weight of the curtain acts to provide a relatively stable seal, less of the weight of the curtain is available to unroll the curtain. In such arrangements particularly, it may be desirable to provide a power actuator to unroll the curtain, herein shown in FIGS. **4–8** as a spring **40** fastened to the curtain. As there illustrated a spring steel tape **40** assists the rapid and complete unrolling of the curtain **15***b* when it is released by the line **19***b*. The spring **40** in this case is secured adjacent the tops of the hooks **25***b* along the length of the curtain in a direction transverse to the elongated slats. One end of the spring tape **40** is secured to the curtain by a rod **41** riveted to the web **22***b* of the lowermost slat of the unrolled curtain, as best shown in FIG. **5.** The other end of the spring tape **40** is slidably held in a slot formed in a plate **42** secured to the web **43** of one of the upper slats, as best shown in FIGS. **6** and **7.**

When the curtain **15***b* is rolled during its original assembly, the spring tape **40** is rolled with the curtain into a coil building up potential energy. The slidable connection between the spring tape **40** and the plate **42** permits movement of the tape relative to the curtain as may be necessary as a result of rolling the two together. It can be seen that the potential energy stored in the coiled spring **40** will unroll the curtain, and any kinetic energy due to the weight of the curtain will assist in unrolling the curtain **15***b* when it is released from its stored position. It will be understood that although preferably the stop members **30***b* are inclined to the horizontal so that the curtain unrolls under its own weight, when the spring tape **40** is employed the stop members may be horizontally disposed in a vertical duct with the spring tape **40** providing the power for unrolling the curtain to the duct closing position.

To positively secure the unrolled curtain, a spring latch **44** is provided for securing the end of the curtain **15***b*. The spring latch **44** shown is secured to the frame **12***b* and extends through a notch **45** in the end stop **34***b*. The end of the latch **44** is formed with a flange **46.** When the end of the unrolling curtain strikes the flange **46,** it forces the latch **44** open to receive the hook **26***b* of the lowermost slat. The resiliency of the spring latch **44** then causes the flange to return to its initial position to positively retain the end of the curtain. While a single latch is shown for securing the lower end of the curtain, similar spring latches, operating in the same manner as the latch **44,** may be used to engage the sides of the curtain as the curtain unrolls.

When a fusable link is employed for the releasable element **20** or **20***b*, it conventionally operates when a predetermined temperature is reached within the duct to release the curtain. It is contemplated that a latch or the like, electrically or mechanically operated by a smoke or blast detector mounted in the passage or air duct, may be employed to open the line **19** or **19***b* responsive to smoke or blast conditions in the duct. The invention insures reliable operation when the line is so opened even after years of installation without movement of the stored, rolled curtain since the kinetic energy due to the weight of the curtain causes the curtain to unroll, and the increasing momentum of the un-

rolling curtain insures the complete extension of the curtain to its closed position. The invention also provides force producing means shown as a spring, and a latch, to positively unroll and then secure the damper curtain, which affords even a higher degree of reliability of operation, if desired, and a curtain which is secured against movement in response to back pressure or reverse air flow under blast conditions.

In duct systems, there is a normal direction of air flow and it will be appreciated that the damper should be mounted so that the air pressure in that normal direction acts to seat the curtain against the stops.

In determining the angle of incline of the stop members, certain basic considerations should be taken into account, whether the curtain is to be free falling under its own weight, power actuated, or a combination of both. Where the curtain is free falling under its own weight, best results will be obtained when the downward angle of incline of the stop members is between 15° and 75° from the vertical. In order to have a curtain with a relatively short length, which thereby completes unrolling faster, in horizontal duct systems the angle of incline preferably should be between 15° and 30° and in vertical duct systems the angle should be between 60° and 75°.

It will be appreciated that the greater the angle of the inclined stop members from the vertical, the greater proportion of curtain weight will act to hold the curtain against the stops to achieve a seal. Thus, various damper mounting arrangements, curtain angles and options such as power actuation and latching are available utilizing the present invention, to provide sealed fire, smoke and blast dampers which will be reliable in operation and will meet widely varying code requirements, or manufacturing and commercial considerations.

I claim as my invention:

1. In a fire, smoke and blast damper having a frame enclosure for mounting in a duct, a damper curtain including a plurality of metal slats secured at one end to said frame enclosure and being adapted to be rolled inwardly upon itself from the other end so as not to significantly obstruct the flow of air through said duct, and holding means for releasably securing said curtain in said rolled condition, said curtain upon release being unrollable to a duct closing position, the improvement comprising stop means mounted on said frame to be engaged by both sides and the unsecured end of said curtain when unrolled and contacting the curtain to seal against the passage of air through said duct around the curtain, said stop means along both sides being formed by elongated substantially straight stop members which are inclined from a plane perpendicular to the axis of flow through said frame enclosure such that in its unrolled condition the curtain is held against said stop members by the force of its own weight.

2. In a damper according to claim **1**, the further improvement in which said curtain slats each have a flat web portion and upstanding hinge flanges at opposite longitudinal edges thereof, one flange of each slat being formed with a female hook and the other flange of each slat being formed with a male hook, said female hook receiving the male hook of the flange of the adjacent slat to connectively join said slats, said hinge flanges each extending from a common side of said web so that the reverse sides of said webs form a substantially flat surface which bears at the sides of the curtain against said stop members when said curtain is in an unrolled duct closing position.

3. A damper according to claim **2** in which said frame enclosure has panels carrying said stop means, and said side stop members are disposed at an angle of between 15° and 75° from said plane perpendicular to the axis of flow; the combination of the curtain slat and hinge construction, and the downward incline of the stop members enabling the kinetic energy due to the weight of the curtain to unroll and fully extend the curtain into flattened position against the stops.

4. In a damper according to claim **2**, the further improvement in which gasket material is mounted on the surface of said stop members contacting the flat surface of the curtain at its sides.

5. In a damper according to claim **4**, the further improvement in which gasket strips are secured to one hinge flange of each adjacent interconnected pair of hinge flanges, said gasket strip being squeezed between said adjacent hinge flanges when said curtain is unrolled to a duct closing position, the gasket material at the sides of the curtain and the gasket strips between the slats of the curtain combining to provide a substantially air-tight seal through and around the curtain.

6. In a damper according to claim **1**, the further improvement comprising a power actuator for unrolling said curtain after it is released by said holding means.

7. A damper according to claim **6** in which said power actuator is a spring steel tape secured to said curtain to be coiled up inside the rolled curtain.

8. A damper according to claim **1** wherein said frame enclosure has side panels carrying said stop means, and said side stop members are disposed at an angle of between about 15° and 30° from said plane perpendicular to the axis of flow.

9. In a damper according to claim **1**, the further improvement wherein said holding means comprise a line with a releasable link.

10. A damper according to claim **1** including a spring latch means mounted on said frame enclosure for positively engaging said curtain in an unrolled duct closing position and securing said curtain in its fully extended position against said stop members.

11. A damper according to claim **1** in which a fireproof gasket material is secured to an upper surface of said stop members and said curtain slats together define in the fully unrolled condition of the curtain a substantially flat surface which engages said gasket material.

12. A damper according to claim **11** in which said curtain slats are hingedly interconnected in a series, gasket material is interposed in the hinge connection of each pair of slats and the connection is formed with elements which close and squeeze the gasket material between the elements of the hinge as said curtain is unrolled to a duct closing position to prevent the passage of air between the slats of the unrolled curtain.

13. In a fire, smoke, and blast damper having a frame enclosure for mounting in a duct, a damper curtain including a plurality of slats secured at one end to said frame enclosure and being adapted to be rolled upon itself from the other end so as to permit the flow or air through said duct, and means holding said curtain in said rolled condition and operable to release said rolled curtain, said curtain upon release by said holding means being unrollable to a duct closing position, the combination comprising: stop means mounted on said

frame inclined at an angle with respect to a plane perpendicular to the axis of flow through said frame enclosure for supporting at least a portion of the weight of said curtain when in said unrolled duct closing position, a spring steel strip secured to said curtain so as to be coiled inside the rolled curtain and provide force for unrolling the curtain after it is released, and latch means mounted on said frame enclosure for engagement by said curtain as it is unrolled and positively securing said curtain against said stops.

14. In a fire, smoke, and blast damper having a frame enclosure for mounting in a duct, the combination comprising: a damper curtain including a plurality of metal slats secured at one end to said frame enclosure and being adapted to be rolled inwardly upon itself from the other end and held in the rolled condition so as not to significantly obstruct the flow through said duct, said curtain slats each having a flat web portion and upstanding hinge flanges at opposite longitudinal edges thereof, one flange of each slat being formed with a female hook and the other flange of each slat being formed with a male hook, said female hook receiving the male hook of the flange of the adjacent slat to connectively join said slats, said hinge flanges each extending from a common side of said web so that the reverse sides of said webs form a substantially flat surface when said curtain is unrolled to a duct closing position; and curtain sealing means including stop means mounted on said frame to be engaged by both sides and the unsecured end of said curtain when unrolled, said stop means along both sides being formed by elongated substantially straight stop members positioned so as to be inclined at an angle with respect to a plane perpendicular ro the axis of flow through said frame enclosure such that the curtain is held in its unrolled condition against said stop members by the by the force of its own weight, gasket material mounted on the surface of said stop members contacting the flat surface of the curtain at its sides, and gasket strips secured to one hinge flange of each adjacent interconnected pair of hinge flanges, said gasket strips being squeezed between said adjacent hinge flanges when said curtain is unrolled to a duct closing position, the gasket material at the sides of the curtain and the gasket strips between the slats of the curtain combining to provide a substantially airtight seal through and around the curtain.

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