ABSTRACT OF THE DISCLOSURE

A fire damper or other closure device includes an imperforate sheet folded back and forth to form blade sections. The sheet is mounted within a frame and normally held in a retracted position, adjacent one of the frame members when the device is open. The sheet extends across and completely blocks the opening of the frame when the device is closed. The blade sections formed by the folded sheet are substantially parallel when the sheet is in the retracted position. When the sheet is extended, the blade sections form a zigzag pattern across the frame. The closure device is particularly effective for fire dampers where there are no joints or hinges between adjacent blades which are subject to leaking and subject to possible binding and thus being inoperative. The construction also minimizes the number of parts required and thereby reduces labor costs in fabricating the device.

This invention relates to a closure device and particularly to a fire damper which employs an imperforate sheet of metal in place of conventional inter-connected blades.

The new closure device includes a frame and a sheet of metal which is folded in opposite directions at predetermined, spaced intervals to form blade sections which correspond to conventional blades in a damper or shutter, for example. One edge of the folded sheet is attached to a frame member of the frame and the sheet can be held in a retracted position adjacent the frame member by suitable retaining means. The sheet can be in a stressed condition when in its retracted position so that it will tend to expand and extend across the frame by itself when the retaining means is released. It can also be extended with the aid of gravity and by a weight attached to the edge of the sheet opposite the edge attached to the frame, or with the aid of springs, motors, etc. The closure device has relatively few parts so that the assembly thereof is held to a minimum. Further, the forming of the sheet into the blade sections requires fewer operations and less time than required to form a plurality of individual blades. The thickness of the metal used in the sheet can be less than that required for individual blades. In addition, the lack of any hinges between blade sections means that there is no possibility of the hinges binding and being inoperable because of dirt contamination, rust, corrosion, etc. The lack of joints also means that there is absolutely no fluid leakage between the blade sections which can and does occur with hinged joints or overlapping edges of conventional blades. Further, the integral blade sections provide utmost strength, thereby affording maximum protection against explosions, too. In addition, the blade sections with the resulting certainty of operation, and lack of joints between blades, thereby substantially eliminating leak possibilities, make the closure device particularly effective for use as a fire damper. Further, fire dampers are opened and closed relatively little so that any possibility of metal fatigue is of little consideration. Even where the closure device is opened and closed frequently, however, the sheet forming the blade sections can be selected, and the folds can be shaped, so that the device can be opened and closed almost any number of times without encountering metal fatigue and possible cracking at the folds.

It is, therefore, a principal object of the invention to provide an improved closure device having lower labor costs, greater reliability in operation, and minimum possible fluid leakage.

Another object of the invention is to provide a fire damper having a folded imperforate sheet of metal forming integral blade sections constituting the structure which blocks the progress of a fire, and which has the advantages discussed above.

Numerous other objects and advantages of the invention will be apparent from the following detailed description of preferred embodiments thereof, reference being made to the accompanying drawings, in which:

FIG. 1 is a view in perspective of a closure device or fire damper embodying the invention and shown in an open position;

FIG. 2 is a view similar to FIG. 1 of the fire damper in a closed position;

FIG. 3 is an enlarged view in transverse cross section taken along the line 3—3 of FIG. 1;

FIG. 4 is a view similar to FIG. 3 showing the sheet forming the blade sections in the extended or closed position; and

FIG. 5 is a view in transverse cross section of a sheet forming modified blade sections.

Referring to FIG. 1, a fire damper embodying the invention is indicated at 10 and includes a frame 12 which is designed to fit in a particular duct or a wall opening where fire might be encountered, in order to block the duct or opening should fire occur. The frame 12 includes first and second or, in this case upper and lower, frame members 14 and 16 and side frame members 18 and 20, which are suitably fabricated and joined at their ends by welding or fastening means. Each of the side frame members has a pair of parallel flanges 22 which extend into the opening formed by the frame a predetermined amount and are spaced apart a predetermined distance. The flanges 22 also are preferably located on the bottom frame member 16 and can be on the upper member 14, if desired.

In place of the usual separate, hinged blades, the fire damper 10 employs an imperforate, unbroken sheet 24 of metal. The sheet 24 is folded or curved back in opposite directions at spaced, predetermined intervals, as along folds or fold lines 26 in FIG. 3, to form adjacent integral blade sections 28 which conform generally to conventional blades but which are integrally connected at the ends by the folds 26. The fold lines 26 are parallel to one another and also preferably are parallel to the upper and lower edges of the sheet 24. For higher dampers, two or more sheets may be employed, being suitably affixed along edge portions, as by spot welding.

The upper or first edge of the sheet 24 is affixed to the first frame member 14 by suitable fasteners 30, such as rivets or bolts. With the sheet 24 in the retracted position, as shown in FIGS. 1 and 3, it can be retained by means or other suitable members 32 and 34 connected by a fusible link 36 with the blade sections 28 then being substantially parallel and substantially parallel with the first frame member 14, extending downwardly at small angles.

The blade sections 28 of the sheet will usually be in a stressed position when the sheet is retracted, as shown in FIGS. 1 and 3, so that when the fusible link 36 is parted, the sections 28 will tend to spring outwardly and thus move the sheet 24 toward the closed position, as shown in FIGS. 2 and 4. When the blade sections are made, the sheet is preferably bent to form about 30° angles between the blade sections when in a free, un-stressed position. To assure that the sheet will extend...
fully across the frame opening to the second frame member 16, the free, unstressed length of the blade sections 28 can be longer than the distance between the frame members 14 and 16, or a weight 38 can be attached to the last one of the blade sections 28 near the edge thereof opposite the edge attached to the frame member 14. When the fire damper is used in a horizontal position, closure of the sheet 24 can be aided by springs, by weights connected to the lower blade section by cables extending around pulleys, by a motor, etc. When the sheet 24 is in the closed position, it will remain so in most instances without the need for any catch or other locking arrangement. Should the blade sections 28 be hit by water from a fire hose, the force of the water will generally act both upwardly and downwardly to be counterbalanced so as not to urge the blade sections toward the open position. However, if desired, a pair of leaf spring catches 40, as shown in FIG. 1, can be affixed by fasteners 42 to the side frame members 18 and 20 between the flanges 22 and near the second frame member 16. As the blade sections 28 move downwardly, with their edges near the side frame members 18 and 20, they will depress the spring catches 40 when passing thereover but cannot then move upwardly past the catches again. Hence, the catches 40 provide a simple, yet efficient and reliable, locking device for the blade sections, although other locking devices can be employed.

The sheet 24 can be effective even if provided in a number of different metals and in a number of different thicknesses. The metal and the thickness will depend on a variety of factors such as the purpose for which the closure device is to be used, the cross-sectional shape, the angle of the blade sections, the type of environment it will be in, e.g., indoors, outdoors, damp, dusty, near salt water, etc., the size of the opening of the frame 12, and the width of the blade sections 28. The length of the sheet can vary according to the number of blade sections used and their widths. Where fewer wider blade sections are employed, the height of the retracted blade sections will be less than where many narrower sections are used. On the other hand, with more, narrow sections, the distance between the adjacent blade sections will be less when the damper is closed. Also, with the wider blade sections, the frame 12 must be wider and this is often a disadvantage in many installations, with an overall frame width of about six inches being usually about the maximum desirable.

The material used also will depend upon the number of times it is desired that the device be opened and closed without metal fatigue or failure at the folds 26. Even when the device is used as a fire damper, however, in many installations the fire damper will be tested by an inspector at least once a year. Consequently, even though the fire damper may be in actual use only once, it is still desired that it be capable of withstanding a number of opening and closing operations without metal fatigue. Where an increased number of opening and closing operations is desired for a given damper, the radii of the folds 26 can be increased to accomplish this, for example, the angle between blade sections can be decreased, or the blade section width increased, or the thickness of the sheet material can be decreased.

In a specific example of a suitable fire damper, by way of further illustration and not limitation, the frame 12 but are of the width of a height of four feet. The sheet 24 is of 28-gauge galvanized steel and has a length approximately three times the height of the opening or ninety-six inches when flat, the length preferably being from about two to eight times the height, depending on the number and width of the blade sections. The sheet 24 is uniformly divided to provide twenty-four blade sections, the folds having radii of approximately 3/8 inch. A damper employing a sheet of this type withstood a total of 250 complete cycles of opening and closing and no fatigue occurred in the metal at the folds.

With the fire damper closed, there are no blade hinges or joints whatsoever to leak and through which flames or hot gases can pass. At the bottom and side frame members 16, 18, and 20, the flanges 32 extend inwardly beyond the blade sections 28 and the frame members with any possibility for leakage at these positions being at least no greater than that for conventional fire dampers. Further, there are no interlocking joints which might bind, particularly when the fire damper remains in the retracted, unused position for a number of years. The relatively few parts also reduce labor costs in assembling the damper and even though the area of the sheet 24 would exceed the area of individual blades used in the damper, the metal of which the sheet is made can be thinner than the metal required for individual damper blades.

The folds between the blade sections can be of a variety of designs. By way of further example, another fold which has been found to be effective is shown in FIG. 5. Here a sheet 44 is bent to form a plurality of blade sections 46 between which are folds 48. The folds in this instance each include a fold short of 50 adjacent which is a pair of inwardly-extending shallow grooves 52. The bulbous portion 50 enables the sheet 44 to be folded and unfolded with a minimum of metal stress. When the sheet is folded, it is in a stressed condition with the inner surfaces of the shallow grooves 52 in engagement, which provides a "springboard" for causing the sheet to extend and at least partially close the fire damper when the restraining means is released. By way of example, the bulbous portion 50 can have an inner radius of 3/16 inch with the shallow grooves 52 having a radius of 1/4 inch. The facing grooves are spaced apart a distance of about 3/8 inch when the sheet is in the unfolded condition and alternate folds are spaced apart approximately three inches with the blade sections 46 having widths of four inches.

Numerous modifications of the above-described embodiments of the invention will undoubtedly be suggested to those skilled in the art, and it is to be understood that such modifications can be made without departing from the scope of the invention, if they are within the spirit and the tenor of the accompanying claims.

We claim:

1. A fire damper comprising a frame including first and second frame members and two side frame members, an imperforate, unbroken sheet having generally parallel first and second edges and parallel side edges, said sheet being folded along substantially equally-spaced parallel lines which are also generally parallel to the first and second edges of said sheet and forming blade sections between the fold lines, the adjacent blade sections being structurally integral with one another, the first edge of said sheet being fixed relative to said first frame member with the fold lines generally parallel to said first and second frame members, sensing means for holding said sheet in a retracted position near the first frame member and for releasing said sheet if a fire is sensed, said sheet being internally stressed when in the retracted position, whereby the adjacent blade sections of said sheet will work to cause said sheet to extend rapidly substantially across the opening formed by the frame members when the sensing means releases said sheet.

2. A fire damper according to claim 1 characterized by the length of said sheet between the first and second edges when flat is from one and one half to two and one half times the distance between said first and second frame members.

3. A fire damper according to claim 1 wherein said side frame members have inwardly-extending parallel flanges spaced apart a distance exceeding the width of said blade sections.

4. A fire damper according to claim 1 wherein said frame has means engageable with said sheet when in the extended position to hold the sheet in the extended position.

5. A fire damper according to claim 1 wherein said
side frame members have means engageable with edges of at least one of said blade sections to prevent the blade sections, when extended, from moving toward the retracted position and thereby hold the sheet in the extended position.

6. A fire damper comprising a frame including a plurality of frame members forming an opening, an integral unbroken, imperforate metal sheet of a size to fully close the opening formed by the frame members when said sheet is in an extended position, one edge of said sheet being affixed to an adjacent frame member, said sheet being folded back and forth in opposite directions along parallel lines to form structurally integral blade sections which are internally stressed when the sheet is in a retracted position, sensing means holding said sheet in the retracted position and in the internally stressed condition near said adjacent frame member, whereby the blade sections tend to spread and cause said sheet to move to the extended position across the opening and close the opening, whether the frame is mounted vertically, horizontally, or at any angle therebetween, when said sensing releases said sheet.

References Cited

UNITED STATES PATENTS

231,817 8/1880 Kerr ------------------ 160—84
451,068 4/1891 Park ------------------ 160—84
790,632 5/1905 Hall ------------------ 160—1
2,202,358 5/1940 Stone ------------------ 160—84
2,221,059 11/1940 Persson ------------------ 160—84
2,922,226 2/1960 Wasserman et al. -------- 98—86
2,940,377 6/1960 Darnell et al. -------- 98—86
3,273,632 9/1966 McCabe ------------------ 160—1

FOREIGN PATENTS

365,529 9/1937 Italy.

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