Jan. 14, 1969 W. R. YOUNGS 3,421,568

FLEXIBLE DOOR CLOSURE

Filed June 29, 1966

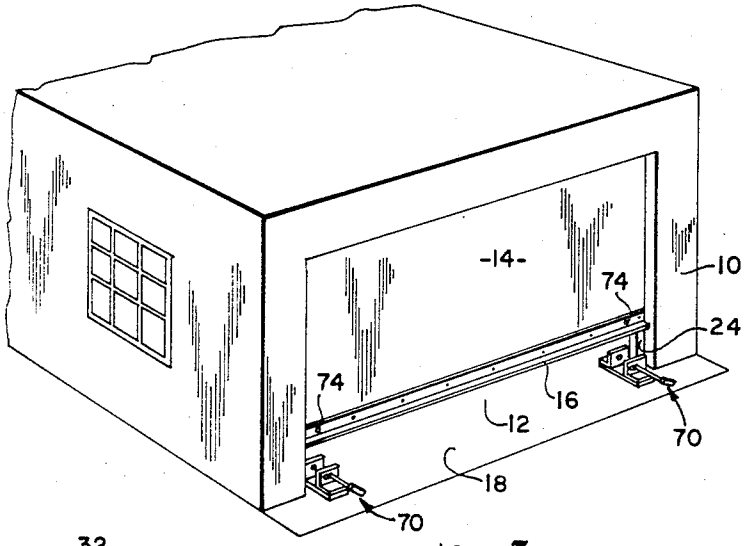

Fig. 1

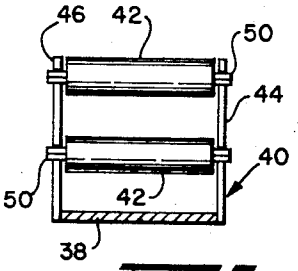

Fig. 5

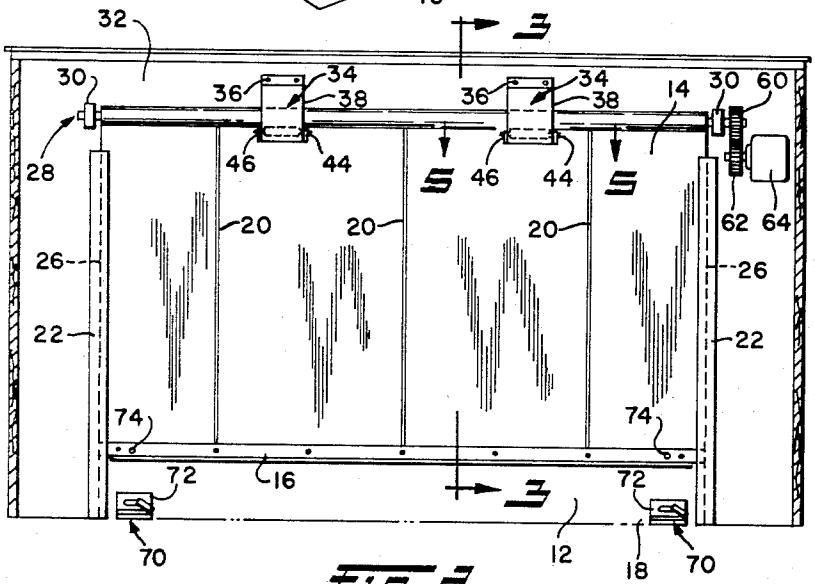

Fig. 2

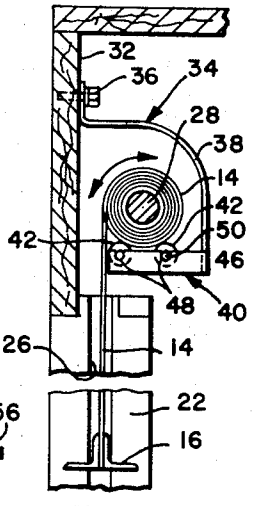

Fig. 3

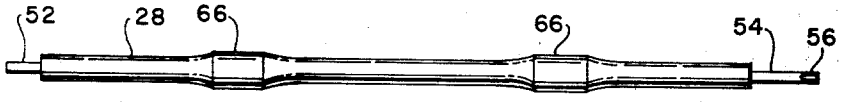

Fig. 4

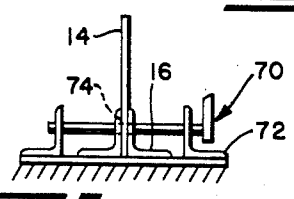

Fig. 6

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FLEXIBLE DOOR CLOSURE

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ABSTRACT OF THE DISCLOSURE

There is provided a flexible closure means for structural openings characterized by a main curtain roller supported by a header member or lintle, to which roller a flexible membrane dimensioned to cover the opening is secured, and means for supporting the roller intermediate its extremities, and characterized by the interposition between the main curtain roller and the roller support means of diameter-increasing means.

Although this invention has applicability to many uses including, for example, gymnasium or meeting room dividers, it will be described in reference to a closure for an airplane hangar. The structures commonly employed as closures for the openings of airplane hangars are necessarily large, and because of the necessity for ability to withstand heavy wind loading, are also of quite substantial and heavy construction. These closures are normally of the laterally sliding or folding type, or they move as a single unit from a vertical position to an elevated position which approaches the horizontal. A principal problem with closures of such conventional types for airplane hangars is in the heat loss during cold weather each time the doors must be opened. This heat loss is substantially the same regardless of the size of the airplane, because for each opening, the closure is removed substantially completely, and to its maximum height, i.e., the height of the header above the ground. Heat which accumulates in the upper portion of the hanger is then allowed to escape. On a larger hangar having, for example, a 90-foot opening, this loss is considerable.

Flexible curtains or closures for hangar door openings have been previously disclosed, and reference may be had to my Patent 3,211,211 dated Oct. 12, 1965. This latter structure overcomes the problem of heat loss for the reason that the flexible curtain is removed from and returned to closing position by means of a traveling roller supported entirely by the flexible panel or curtain. By applying force to the end of the roll to cause it to roll upwardly or downwardly, it will roll itself into the curtain or unroll itself from the curtain, as the case may be. Thus, where a small aircraft is being removed from the hangar, for example, the curtain need by raised only halfway thereby saving a substantial portion of the heat which would otherwise be lost.

The present invention embodies an entirely different principle from the invention of my prior patent. Instead of a movable roller, I employ a fixed roller secured across the top of the opening which is to be closed and mounted there for rotation. In order that the flexible curtain may be a continuous sheet across the entire opening, it is possible only to support the roller, onto which the flexible curtain is wrapped or wound during opening, at the extremities of the roller. To span a great distance with a roller without encountering sagging would require an unduly expensive structure. Accordingly, in carrying out the present invention, one or more support members is or are disposed intermediate the extremities of the roller, and secured adjacent the roller to the adjacent structure, for example, the lintle, or header member. The supporting means are conveniently embodied in the form of one

or more rollers preferably defining a cradle for supporting the main curtain roller and accommodating a variable amount of curtain material which is wound about the main curtain roller.

Such a structure contemplates that the curtain material shall in virtually all positions of the curtain relative to the ground level be interposed between the main curtain roller and the support roll or rollers.

It has been found that the plastic materials from which the flexible membranes or curtains are made, when submitted to the forces arising when portions thereof are interposed between the main curtain roller and the support means, undergo a moderate amount of elongation or stretching. If this elongation or stretching of the curtain material in the region of the support means is not compensated for, the curtain will undergo folding and wrinkling in the region of the support means resulting in excessive build-up of material on the roller, excessive wear, and unsightly appearance. To overcome this, it has been found that the diameter of the main flexible curtain roller should be increased a predetermined amount in the region where it will be in indirect contact with the intermediate supporting means through the flexible curtain material. This invention, then, makes possible the provision of a wide span, flexible curtain operated from a fixed overhead roller of relatively small diameter and simple construction, and avoids the problems attendant a long span roller supported by the curtain and moving towards and away from the header member. Not only does it take considerable power to elevate such a roller, but the structure encounters problems when dirt, tools, foreign matter, ice, etc. are caught in the bight between the moving roller and the curtain. The structures of the present invention are much simpler, more economical to operate, avoid all of the difficulties attendant a moving roller structure, and are made possible by the invention hereof.

This invention may be better understood by having reference to the annexed drawings wherein:

FIG. 1 is a fragmentary perspective view of the front portion of an airplane hanger showing the exterior appearance of a flexible closure in accordance with the present invention in a partially open position;

FIG. 2 is a rear view on a somewhat larger scale of the closure structure and showing the fixed main roller rotatably supported on the lintle of the opening, the support means, the flexible curtain, and means for driving the roller to raise and lower the curtain;

FIG. 3 is a fragmentary cross-sectional view taken in the plane indicated by the line 3—3 in FIG. 2, and showing the details of a preferred form of support means for the roller to prevent sagging;

FIG. 4 is a plan view of a roller adapted for use with a flexible curtain and supported at two intermediate points, and showing the enlarged diameter of the roll to accommodate stretched material at these points;

FIG. 5 is a section showing the details of a roller support carriage with a pair of support rolls defining a cradle;

FIG. 6 is a detail view of a curtain locking device useful with the closures hereof.

Referring more particularly to FIG. 1, there is here shown in diagrammatic form a fragmentary perspective view of an airplane hangar **10** having an opening **12** partially closed by flexible curtain **14**. Flexible curtain **14** is dimensioned to cover the opening **12** when in its fully extended position, and is provided along its lower marginal edge with a bead **16** suitably secured thereto and adapted to coact with the ground level or sill **18** to effect a closure therewith. Means coacting between the beads **16** and the sill **18** may be provided to lock the door in the closed position, as will be hereinafter more particularly exemplified and described.

Referring more particularly to FIG. 2, there is here shown the closure of FIG. 1 from the reverse side in somewhat more detail and on an enlarged scale. Curtain **14** is shown in a partly open position with bead **16** secured along the lower marginal edge. It will be understood that any suitable means for securing the bead **16** or an equivalent structure along the lower marginal edge may be employed. Bead **16** is desirably of substantial weight in order to exert a tensioning effect on the curtain.

Curtain **14** is conveniently formed of a very tough, thin-section plastic material, for example, a nylon fiber reenforced vinyl sheet, a neoprene sheet, polyester fiber reenforced nylon sheet, or the like. Usually, the large section panels of sufficient dimension to cover the opening of an airplane hangar are formed from a plurality of strips of the tough plastic sheeting material which are heat sealed along overlapped marginal edges to provide a continuous sheet of the proper dimension. The heat seals of panel **14** are shown in FIG. 2 and indicated by the numeral **20**. Such heat seals should be vertically disposed relative to the opening covered by the flexible closure. For most purposes, a heat seal in width to about 1" in width is most satisfactory, best results being secured with the wider heat seal.

Along the marginal edges of the opening **12** there are provided a pair of parallel vertically disposed guides suitably secured to the vertical margins defining the opening **12** and forming a channel or way **24** in which the lateral marginal edges **26** of the curtain **14** are free to move. Roller **28** spans the entire length of the opening **12** and is mounted and journaled for rotation in bearings **30** at each end of the roller, which bearings **30** are in turn secured to the lintle **32** across the top of opening **12**. Roller **28** is better shown in cross-section in FIG. 3, it being obscured from view by convolutions of the flexible curtain **14** in FIG. 2. Roller **28** is, however, conveniently a steel tube, preferably about 4.5" in diameter and dimensioned to span the opening. As indicated above, these openings may vary, depending upon the ultimate use of the closure from 10 to as much as 100 feet or more. To accommodate the largest airliners in current use, openings of as much as 200 feet may be required. Depending upon the overall span, the basic tube diameter may range from about 2.5" to about 12" for most purposes. The diameter of the basic roller is not critical.

As shown in FIG. 2, support means are provided intermediate the extremities of the roller to prevent the roller **28** from sagging. If the roller **28** were allowed to sag, it would be impossible to raise and lower the curtain without encountering extreme wrinkling, distortion, and possible destruction of the flexible membrane. In the embodiment shown in FIG. 2, two such support means are provided, although it will be understood that one or more roller support means may be provided. It is a relatively simple matter to calculate how many such supports are required for a roller of given physical properties, diameter, and length in order to eliminate sag. Usually, for a six inch steel tube having walls about 0.3" thick, about 8 to 10 feet can be tolerated without intermediate support. Of course, the more flexible the tube, the shorter the span that can be tolerated without support.

Accordingly, in FIG. 2, there are provided supports **34**, desirably about uniformly spaced from the extremities of the roller **28** and from each other, and secured by any suitable means such as bolts **36** to the header or lintle **32**. As best shown in FIG. 3, the supports **34** include a bracket **38** which is contoured to extend from the lintle **32** rearwardly and downwardly to support in turn a carriage **40** for disposition below and in supporting relation with respect to the roller **28**. Carriage **40** is provided in the embodiment shown in the annexed drawings with a pair of parallel rollers **42** journaled for rotation in the carriage **40** with their axes parallel to the axis of roller **28**. The bracket **38** of support **34** may desirably be somewhat flexible to accommodate relative movement between the main curtain roller **28** and the support rolls **42** due to build-up of the flexible curtain material **14** in convolutions about the roller **28**. Alternatively and conveniently, the rollers **42** are provided with a resilient rubber coating able to accommodate the relatively slight build-up in the relatively few revolutions required to fully raise the curtain. The carriage **40** is of very simple structure and is composed of a pair of parallel side rails **44** and **46**, each having a pair of spaced notches **48** adapted to receive axial pins **50** in the rollers **42**. The side rails **44** and **46** of carriage **40** are conveniently welded to the support bracket **38** at its lower extremity as shown in FIG. 3. The forward portion of the carriage **40** adjacent to curtain **14** may be open or closed by a suitable header or cross-member if desired. As shown in FIGS. 2 and 3, no such cross-member is provided.

The rollers **42** may be of conventional design of the type used in roller type conveyors, such conveyors being commonly used for conveying boxes of material from one point to another in a packaging plant, and preferably provided with a skin of resilient rubber.

FIG. 4 shows in greater detail a main roller **28**. The terminal portions of the roller are provided with shaft extensions **52** and **54** adapted to be journaled for rotation in bearings **30** (FIG. 2). Shaft extension **54** is also provided with a splined end portion **56** to accept a gear **60** for meshing coaction with drive gear **62** operating from a motor-gear reduction apparatus of conventional design generally indicated at **64** in FIG. 2. While electric drive means have been shown in the preferred embodiment illustrated in FIG. 2, it will be understood that any suitable driving means, manual, pneumatic, hydraulic, electric, or any combination of these may be employed to rotate roller **28** about its own axis in a relatively fixed position to raise and lower curtain **14**.

The curtain roller **28** is provided with diametral enlargements **66**, the centers being located at approximately the 25% of the length of the rod **28** and the 75% marks of the rod **28** calculated from the left-hand end, respectively, and are designed to be located for coaction with the supports **34**. The amount of increase in the diameter will depend to some extent upon the plastic which is used. In the preferred case, the curtain is formed of a nylon thread reenforced vinyl sheeting material which has a thickness of about 0.025", and is characterized by a remarkable property of "memory." Once the material is stretched out of shape in any region, it gradually reassumes the original dimension and contour which it possessed prior to the stressing. This is a very desirable attribute from the standpoint of appearance of the door. With such a curtain of 0.025" thickness, it has been determined that a build-up **66** is formed by wrapping around the roller **28** approximately 3.0 times a strip of the same curtain material having a width preferably slightly greater than the width of the roller **42**. More specifically for a 4.5" diameter roller **28**, the length of the strip wrapped about the exterior of the roller **28** is 43" of the same curtain material. This will provide a build-up of sufficient increase in diameter to compensate for the stretch which will occur in the curtain at the supporting rollers or support means when operating the curtain from the fully closed position to the fully open position. For best results, the built-up portion **66** is fared out smoothly to the diameter of the adjacent sections with the cement material. With the other heat sealable plastic materials, the extent of stretching may not be precisely the same as with the aforesaid nylon-vinyl material which is preferred for use in airplane hanger door applications and gymnasium applications. However, it is a simple matter to calculate the amount of build-up which will be required to accommodate the stretch imposed by the rollers **42** on which the main roller **28** rests and rotates. The nylon-vinyl plastic is preferred because of its excellent weatherability and extreme toughness. It can be obtained in a variety of colors and in white from commercial sources.

The closures of the present invention are also desirably provided with locking means which may be of very simple structure. As shown in FIG. 6, a locking pin **70** of very simple design may be extended through an angle plate **72** secured through a sill plate **73** to the sill **18**, through an aperture **74** in the bead **16** and through a second angle plate **75**, also secured to sill plate **73**. When the pins **70** are inserted through the angle plates **72** and **75** and through the cooperating aperture **74** in the beam **16**, the door is locked in the down position, and the application of a slight amount of tension by attempting to raise the door while the pins are restraining it against upward movement applies a tension to the curtain **14** which increases the wind resistance of the curtain **14** and also serves to obliterate quickly any wrinkles which may have formed in the curtain.

There has thus been provided a flexible closure for an opening which is particularly adapted for use as a closure for an opening in an airplane hangar, but is equally adaptable for use as a garage door, a room divider, a gymnasium divider, or any other opening where a substantial span for the fixed roller for the flexible curtain is encountered. Under such circumstances, unless supporting means are provided for the roller, the roller will sag. In most cases, where a steel roller is contemplated having a diameter of about 2.5" up to about 12", a span in excess of about 10 feet is contemplated. For smaller diameter rollers, shorter spans, of course, are contemplated. In any event, when such supports are provided and result in rolling action against the surface of the flexible membrane dimensioned to cover the opening, there results a stretching of the material in the area where the support means bears against the curtain. In the absence of a roller including an enlarged diameter in the region of such support means, the wear is so excessive and the build-up of such a nature that the device is soon rendered inoperable, unsightly, or the curtain itself is destroyed. This invention overcomes these difficulties and makes possible the fabrication of flexible membrane closures which span very large distances and which but for the present invention have not heretofore been possible in this simplified form. Moreover, because of the enlargement of the roll diameter at the point of support, the effect it is distribute the load more evenly to all portions of the curtain.

What I claim is:

1. A flexible closure for an opening defined by a head member, a pair of spaced parallel side members or jambs, and a base or sill comprising in combination:

(a) a flexible curtain dimensioned to cover the opening and having top and bottom marginal edges;

(b) a fixed roller spanning said opening and to which roller the top marginal edge of said curtain is secured, said roller being mounted for rotation on an axis adjacent said head member whereby said curtain is wrapped on or unwrapped from said roller to raise and lower said curtain, respectively;

(c) means for supporting the roller and curtain to limit sagging of said roller intermediate the extremities of the roller, convolutions of said curtain being disposed between said support means and said roller;

(d) diameter increasing means coacting between said roller intermediate its extremities and said support means in the region of said support means, and dimensioned to compensate for any stretching of said curtain between said support means and said roller; and

(e) driving means mechanically coupled to and coacting directly with said roller at, at least, one extremity for directly applying a rotational force thereto to wrap said curtain on or unwrap said curtain from said roller.

2. A flexible closure in accordance with claim **1** which is further characterized by the provision of a bead along the bottom marginal edge of said flexible curtain.

3. A flexible closure in accordance with claim **2** wherein the bead includes a pair of rigid angle members secured together and gripping the lower marginal edge of said flexible curtain on opposite sides thereof.

4. A flexible closure in accordance with claim **1** wherein the means for supporting the roller and curtain includes a roller positioned for rolling and supporting contact with the surface of the curtain wrapped around said fixed roller.

5. A flexible closure in accordance with claim **4** wherein said at least one supporting roller is provided with a resilient rubber surface for contact with said flexible curtain on said fixed roller.

6. A flexible closure in accordance with claim **1** wherein said support means includes a bracket secured to the head member at one extremity, and having a carriage secured to its lower extremity, said carriage including a pair of spaced support rollers disposed with their axes parallel to the axis of said fixed roller and defining a cradle for supporting said fixed roller at a point intermediate its extremities.

7. A flexible closure in accordance with claim **1** wherein the diameter increasing means on said fixed roller comprises a wrapping of flexible material about said roller and secured thereto.

8. A flexible closure in accordance with claim **7** wherein the flexible material is of the same composition as the flexible curtain.

9. A flexible closure in accordance with claim **1** in which the flexible curtain is a fiber reenforced plastic sheet.

10. A flexible closure in accordance with claim **9** in which the fiber reenforced elements in said flexible curtain are nylon fibers.

References Cited

UNITED STATES PATENTS

705,214	7/1902	Daus	242—73.5
869,447	10/1907	McCloud	160—267
1,164,385	12/1915	Neupauer	160—264 X
1,243,923	10/1917	Dargo	160—273
1,377,784	5/1921	Nodland	242—73.5
1,655,260	1/1928	Dixson	160—264
1,776,119	9/1930	Johnson	160—23 X
2,894,578	7/1959	Caesar et al.	160—308
3,292,685	12/1966	Clark	160—26

FOREIGN PATENTS

584,631	10/1959	Canada.

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U.S. Cl. X.R.

160—267