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FLEXIBLE CLOSURE TENSIONING DEVICE

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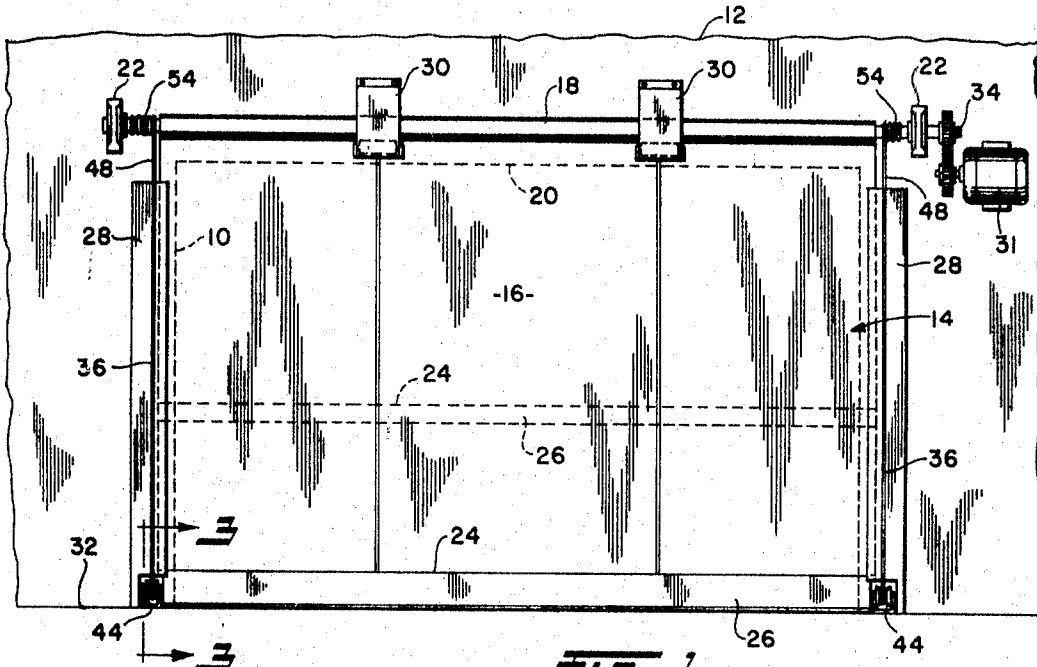


FIG. 1

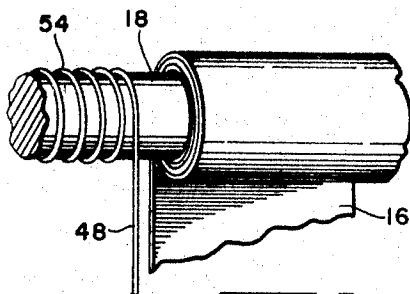


FIG. 2

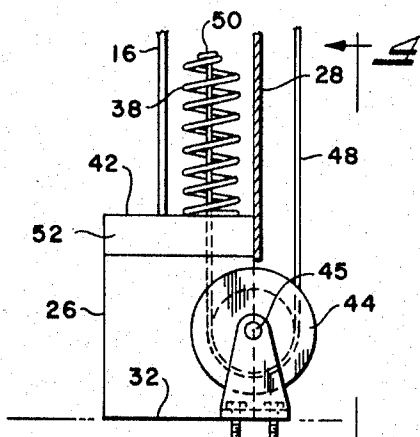


FIG. 3

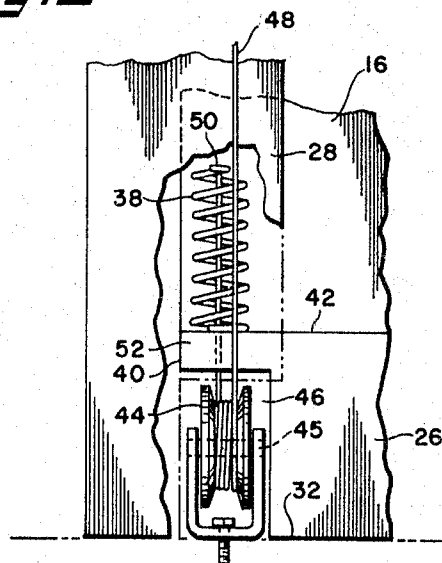


FIG. 4

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FLEXIBLE CLOSURE TENSIONING DEVICE

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1 Claim

ABSTRACT OF THE DISCLOSURE

A device for tensioning the membrane of a closure employing a flexible membrane fastened to a bottom rail which is movable towards and away from an upper roller on which the membrane wraps and unwraps itself as the closure opens and closes. This device includes a spring and cable system coacting together with the upper roller and the bottom rail for biasing the bottom rail away from the roller, whereby tension is applied to the flexible membrane in all positions of the lower marginal edge of the latter.

BACKGROUND OF THE INVENTION

This invention is particularly well suited for, and will be described in relation to the flexible closures described in application Ser. No. 561,627, filed June 29, 1966, now Patent No. 3,381,916. Such closures resemble window shades, in that both employ rollers on which a flexible membrane wraps and unwraps itself as the shade or closure is opened and closed.

An advantage of these flexible closures is that they can be locked in a closed position, and tension applied to the membrane to enable it to withstand greater wind loads. However, the membrane cannot be properly tensioned when the closure is unlocked or in a partially opened position, and when subjected to high winds, will literally flap in the breeze in much the same manner as a window shade. It would be extremely beneficial to the operation of the closure, therefore, if the membrane could always be properly tensioned independently of its position in the opening. This invention provides such a means for tensioning the flexible membrane to eliminate this particular problem.

The following description of the invention will be better understood by having reference to the annexed drawing, wherein:

FIG. 1 is a front view of a closure for an opening, including a flexible membrane and embodying the present invention;

FIG. 2 is an enlarged, detailed perspective view of one end of the top roller on which the flexible membrane is wrapped;

FIG. 3 is an enlarged, fragmentary, detailed view of one end of the bottom rail of the closure; and

FIG. 4 is an enlarged, fragmentary view of one end of the bottom rail as it appears in the plane indicated by the line 4—4 of FIG. 3.

ENVIRONMENT OF THE INVENTION

Referring more particularly to the drawing, there is shown an opening 10 in an aircraft hangar 12. A flexible closure or overhead-type hangar door for covering the hangar door opening 10, is generally indicated at 14.

The hangar door 14 comprises a flexible membrane or curtain 16, dimensioned to cover at least a portion of the opening and preferably the entire opening, plus that required to secure it to the roller, and secured along its top marginal edge to a roller 18, which is mounted adjacent the head or top margin 20 of the hangar door opening 10 on bracket supports 22. The flexible membrane 16 has a free bottom marginal edge 24 extending from the roller 18.

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A rigid bottom rail or bead 26 is secured to the free marginal edge 24 of the membrane 16, and is movable in and along similar trackways 28, which are disposed adjacent each side of the hangar door opening 10. A plurality of roller supports 30 are generally provided as intermediate supports for the usually long roller 18.

A motor 31 is coupled to one end 34 of the roller 18, for driving or rotating the roller 18, whereby the flexible membrane 16 is wrapped and unwrapped from the rotating roller to open and close the hangar door 14. In some cases, particularly with very wide doors, drive means may be provided at both ends of the roller.

The bottom rail 26 can be locked or secured to the floor 32 by any suitable means (not shown) when the hangar door 14 is in a normally closed position, where the bottom rail 26 is adjacent the floor 32 and in farthest spaced relation from the roller 18. The roller 18 can be partially turned or rotated to tension the flexible membrane 16 to withstand greater wind pressures when the roller 18 is in this locked position adjacent the floor 32. The following is a description of a device for tensioning the membrane 16 when the hangar door 14 is unlocked or in a partially raised position, i.e. the closure 14 is not fixedly secured relative to the roller 18.

THE INVENTION

Briefly stated, the present invention is an improvement for a closure for a structural opening, which opening has horizontal top and bottom margins, and usually has parallel side margins. Such closures include a roller mounted for rotation along the top margin of the opening and a flexible membrane dimensioned to cover at least a portion of the opening, said membrane having top and bottom marginal edges. The flexible curtain is secured along its top marginal edge to the roller, and has a bottom rail or beam secured to and lying along the bottom marginal edge of the membrane. Driving means, such as an electric motor coacting through gear reduction means with the roller, are controlled to selectively cause the membrane to become wound upon and unwound from the roller whereby the closure is opened and closed, respectively. The improvement is in the provision of the combination of a flexible cable, or rope, having one end secured to an end of the roller for winding about the roller reversely to the direction of winding of the flexible membrane so that when one is wound on the roller, the other is unwound from the roller. A pulley is secured at the bottom margin of the opening and is adapted to receive the cable, and change the direction of force applied to the cable. Resilient tensioning means are provided which coact between the other end of the cable and the point of change of direction of force by the pulley. The other free end of the cable is then secured to the bottom rail. Usually, both ends of the roller are provided with tensioning means in accordance herewith.

A preferred embodiment for tensioning the flexible membrane 16 when the hangar door 14 is unlocked or partially open, preferably comprises means 36 for biasing each end of the bottom rail 26 in a direction away from the top roller 18 thereby placing the flexible membrane under the desired tension. The bottom rail biasing means 36 is illustrated in FIGS. 2-4 in relation to one end of the bottom rail 26. As the means for biasing both ends are similar, reference will be had to but one side, it being understood that like means are in the preferred embodiments applied to each side of the flexible curtain. The bottom rail biasing means 36 preferably comprises a coil spring 38 mounted adjacent each end 40 of the bottom rail 26. Coacting with a cable 48 which changes its length in substantial unison with the flexible curtain, but is so connected through a floor mounted pulley to the bottom rail 26 as to exert a force on the

rail in an opposite direction to that exerted by the curtain. The axis along which each spring 38 flexes extends towards the roller 18, and is preferably normal to the longitudinal axis of the bottom rail 26. The coil springs 38 are secured, as by welding, to and extend freely in unsupported relation from the top 42 of the bottom rail 26. Any resilient means may, however, be used. For example, the cable may be anchored directly to the bottom rail 28, and the sheave pin 45 spring loaded to regulate tension on the membrane and allow for effective roll diameter changes as the curtain rolls and unrolls.

To reverse the direction of the force applied by the cable-spring assembly to the bottom rail 26, a rotatable pulley 44 is fixedly mounted on the floor 32 adjacent each bottom rail end 40 for rotation in a plane which desirably includes the longitudinal axis of the coil spring 38. Thus, the pulley 44 is spaced farther from the roller 18 than the spring 38 when the bottom rail 26 is in all positions of the flexible curtain.

A portion 46 adjacent each end 40 of the bottom rail 26, is removed to permit seating of the bottommost marginal edge of bottom rail 26 against the floor 32, without interfering with the operation of the pulleys 44.

One end of a cable 48 is secured to the free end 50 of spring 38, one of which is located at each end of the bottom rail 26. The cable 48 is secured to spring end 50 farthest from the bottom rail 26, and extend downwardly along the axis of the coil spring 38 and bottom rail portion 52 for reeving about pulley 44. The cable 48 is then extended and secured to the corresponding free end 54 of the roller 18, and wound thereon in a direction opposite to the wrapping of the flexible membrane 16 on the roller 18. Thus, as the bottom rail 26 is raised and lowered, and the membrane 16 wraps and unwraps itself on the roller 18, the cable 48 is correspondingly payed out and in to keep the biasing force exerted by the springs 38 against the bottom rail 26, generally constant. As the exposed curtain length is decreased, the exposed cable length is increased due to the opposite mode of winding on roller 18 of the respective elements. The biasing force exerted by the spring 38 will tend to increase slightly as the hangar door 14 is raised, since the diameter of the roller 18 at the free ends 54 is slightly less than the overall diameter of the roller 18 including the convolutions of the flexible membrane 16. Thus, it can be appreciated that for each revolution of the roller 18, slightly more of the flexible membrane 16 will be taken up than cable 48 payed out, consequently increasing the spring tension. However, the difference is normally so slight as to be inconsequential to the operation of the hangar door 14. In fact, when the hangar door 14 is in a partially opened position as represented by the dotted position of the bottom rail 26 in FIG. 1, it is preferable that the membrane 16 be under slightly greater tension as the bottom rail 26 will not now be aided by engaging the floor 32, as would be the case if the hangar door were closed. The ends 54 may be tapered, if desired, to compensate for the variance of membrane thus reducing the spring compression travel.

The pulleys 44 are preferably mounted in parallel planes which can be normal to, or parallel to the longitudinal axis of the bottom rail 26 without altering their operability for the purposes of the invention.

Thus, there has been provided a device for keeping the flexible membrane of a closure under constant tension, whereby the closure can withstand greater wind loads in the partially open position. In most installations, adjusting the membrane to withstand wind pressures of 20 pounds per square foot, will be sufficient. The tension in the membrane may be adjusted by regulating the number of convolutions of the cable on the roller, the nature of the spring, or other suitable bias adjusting means co-acting with the cable, or the spring. In areas where higher winds are generally expected, the membrane tension can be increased accordingly.

In addition to the advantages previously mentioned the membrane tensioning device also acts to counteract torsional forces applied against the driving mechanism as winds load and bow the flexible membrane. This bowing effect created by the wind naturally tends to rotate the roller and bowing in either direction inwardly or outwardly causes a torsional force which is opposed by the motor or driving mechanism. However, the cables for operating the tensioning mechanism are reeved on the roller oppositely wound to the wrapping of the membrane on the roller and act to counter the forces exerted by the bowed membrane.

Although this invention has been described in relation to hangar doors for aircraft hangars, it will be understood that such devices are readily adopted to other uses including, for example, room divider curtains, e.g., in school gymnasiums.

What I claim is:

1. A closure for an opening having horizontal top and bottom margins and parallel side margins and including:
 - (a) a roller mounted for rotation along the top margin of said opening;
 - (b) a flexible membrane dimensioned to cover at least a portion of the opening and having top and bottom marginal edges, and parallel side marginal edges, said flexible membrane being secured along its top marginal edge to said roller;
 - (c) a bottom rail secured to and lying along the bottom marginal edge of said membrane;
 - (d) a membrane tensioning means comprising:
 - (1) at each end of said roller, a flexible cable having one end secured to said roller for winding in a direction opposite to said flexible membrane so that when the membrane is wound onto the roller to open the opening, the cables are unwound from the ends of said roller, and when the membrane is unwound from the roller to close the opening, the cables are wound upon the ends of the roller;
 - (2) a pulley fixedly mounted adjacent the bottom margin of said opening and at the lower extremity of each of said parallel side margins, and adapted to receive one of said cables and reverse the direction of force applied to said cable;
 - (3) elongated spring means mounted at each end of said bottom rail with its longitudinal axis parallel to the adjacent side marginal edges of said flexible membrane and extending toward said roller;
 - (4) the other end of each cable being secured to the free upstanding end of said spring means;
 - (5) the intermediate portion of each of said cables being reeved downwardly and around said fixed pulley and upwardly toward said roller;
 - (e) said driving means and said membrane tensioning means together opposing wind forces on said membrane by exerting torsional forces on said shaft which are opposite to torsional forces applied to said shaft by wind forces acting through said membrane.

References Cited

UNITED STATES PATENTS

262,398	8/1882	Gerard	160—265
783,587	2/1905	Nicewaner	160—265
1,121,898	12/1914	Davis	160—322 X
2,774,421	12/1956	Lion	160—238
3,180,401	4/1965	Gambon et al.	160—265

FOREIGN PATENTS

667,613 11/1938 Germany.

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U.S. Cl. X.R.