April 8, 1969 S. L. HARGROVE 3,437,125

BI-FOLD DOOR CLOSER

Filed July 17, 1967 Sheet 1 of 2

FIG. 1

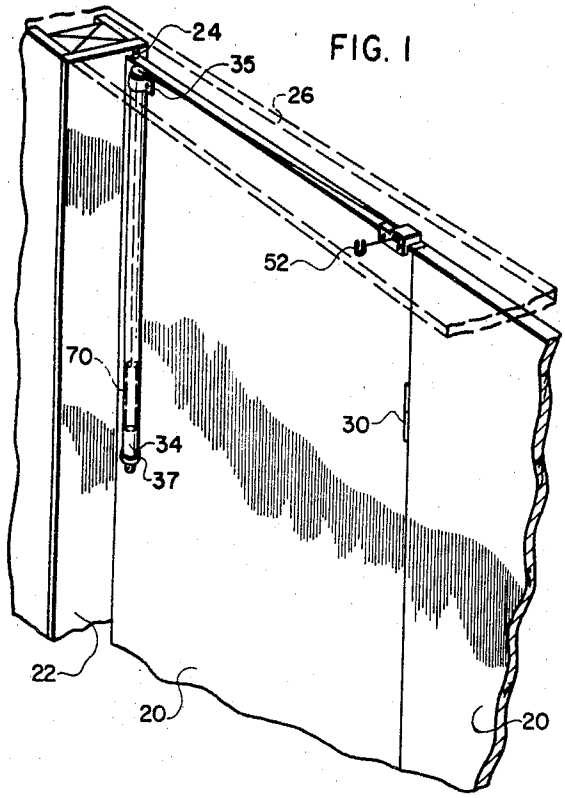


FIG. 2

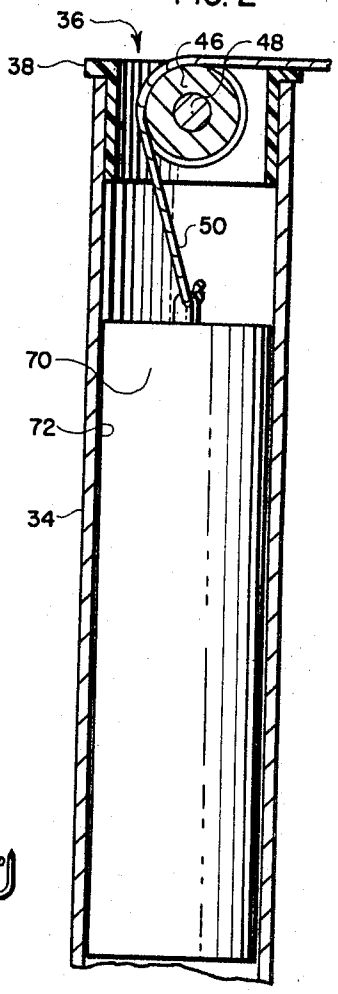


FIG. 3

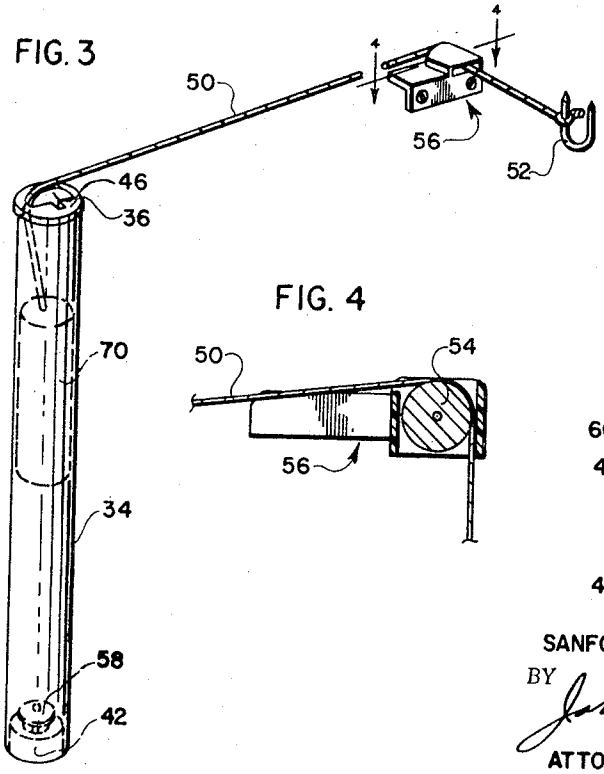
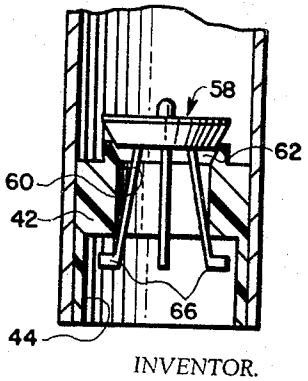


FIG. 4



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FIG. 5

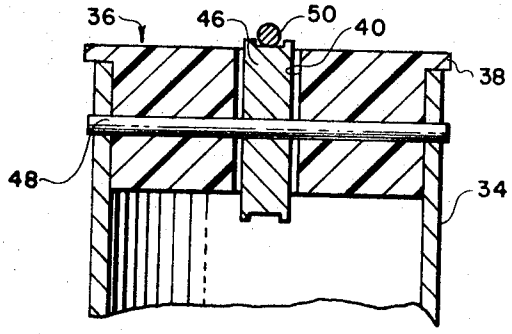


FIG. 8

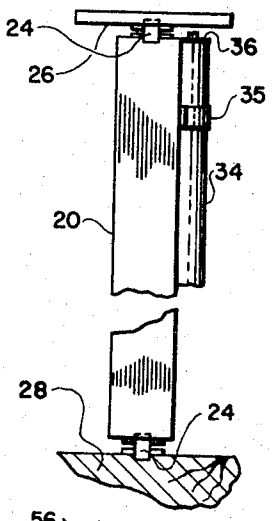


FIG. 6

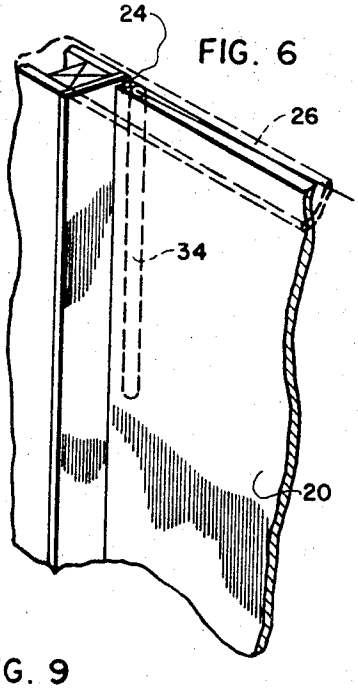


FIG. 7

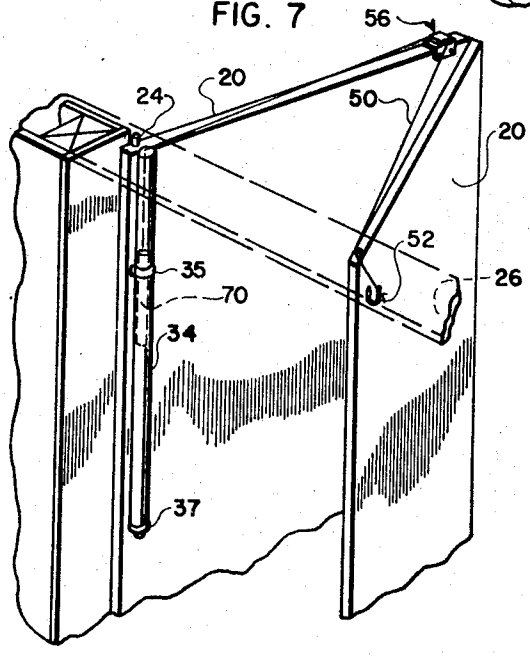
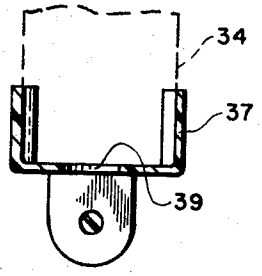


FIG. 9



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United States Patent Office 3,437,125
Patented Apr. 8, 1969

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BI-FOLD DOOR CLOSER

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Continuation-in-part of application Ser. No. 592,952, Nov. 8, 1966. This application July 17, 1967, Ser. No. 653,975

Int. Cl. E05f 1/02, 11/04

U.S. Cl. 160—193

2 Claims

ABSTRACT OF THE DISCLOSURE

The invention disclosed herein is an apparatus for automatically closing a so-called bi-fold door having at least two hingedly connected sections. These bi-fold doors are commonly used mounted in a door casing having a lintel or another overhead member. For example, bi-fold doors are widely used as closet doors. The apparatus of my invention for closing these doors automatically has a tubular housing which is mounted in vertical position on one of the sections of the bi-fold door, and I employ brackets to mount and maintain the tubular housing on the door section. The tubular housing has a guide for a line in the top. The apparatus also utilizes another guide which is mountable on the top edge of the door section mounting the tubular housing, and this guide is mounted in use relatively remote from the tubular housing. An attachment element is employed which in use is mounted on the lintel or another overhead member of the door casing. A line of cord or the like is used. One end of the line is fastened in use to the attachment element, the line when mounted passing over the guide means and down into the tubular housing where it is secured to a weight slidably mounted in the tubular housing. A check valve is mounted in the lower end of the tubular housing, this check valve providing fluid communication between the lower portion of the housing inside and the atmosphere therearound. The weight is an important element in the automatic closing of the doors under controlled conditions, and the weight has distances thereacross relative the corresponding inside distances across the tubular housing so that there is a relatively small annulus in cross section between the weight and the inside of the housing. Also, the weight is made of length and mass and the annulus of cross section through the operating length so that the air between the bottom of the weight and the bottom and walls of the housing is controllably released around the weight as it falls in the tubular housing with the check valve being closed, and this is the sole means of controllably releasing such air, that is, by the small annulus between the weight and the walls of the tubular housing. With my invention being employed, the bi-fold door is opened manually causing the weight to be raised in the tubular housing, and as this occurs air automatically enters the tubular housing at the bottom through the check valve. When released the bi-fold door is automatically closed, and relatively slowly, by the force exerted by the weight falling in the tubular housing. The speed of fall is controlled by compressed air below the weight in the housing, and the escape of the air around the weight through the annulus.

This is a continuation-in-part of application Ser. No. 592,952, filed Nov. 8, 1966, now Patent No. 3,334,444, issued on Aug. 8, 1967.

Several devices are known in the prior art for automatically closing doors which have been opened. Some of these employ a dropping weight. However, all suffer from the disadvantages that they give a "hard" closing, i.e., a door so closed closes with a loud noise and with considerable force. These prior art devices have no satisfactory way of checking or cushioning the speed of the door before it strikes the door post or casing because they all consist essentially of only a means for exerting a continuous force, the result of which is that the door mass continues to accelerate until the moment that it strikes the door post or casing. The closers of the prior art are suitable only for fairly rugged doors such as fire doors, barn doors, and other heavy duty doors, but would be annoying and dangerous if installed in the usual sliding doors of a home or office, or on cabinet doors, and the like.

The new sliding door closer means of my invention eliminates these disadvantages of the prior closing devices while retaining their usefulness with the aforesaid heavy duty doors as well as doors which are desirably closed quietly and easily. My invention has, in addition to a device for exerting closing force, a means for causing an opposing force to be applied whose strength is dependent on the speed at which the door is traveling, and whose strength increases exponentially with that speed.

More specifically, my invention comprises, in preferred specific embodiments, a means of exerting force, such as a falling weight made of a suitable material for example a heavy material, such as iron, lead, and the like. My invention also preferably has a vertical cylinder and a piston, the piston and the above mentioned weight being the same part serving two purposes. The weight-piston in use is suitably connected, preferably by means of a cord and pulleys, to a door casing, an overhead member or a lintel, so that when the door to be automatically closed is opened, the weight-piston is raised in the cylinder. The pulley is preferably mounted in a cap with a shoulder to prevent the pulley from being drawn into the cylinder, the top of said cap preferably being flush with the top of the door when mounted in the door between the forces thereof. The axis of the pulley preferably has two pointed ends which extend beyond the walls of the cap. These pointed ends are driven into the wood so that the orientation of the pulley cannot change during use, making the closer means long reliable in use. In a preferred embodiment the cylinder or housing is connected on the outside of the door by a slip and/or brackets. A check valve is provided, preferably such as a retained valve operator in a hole in a plug in the bottom of the cylinder extending from the bottom of the cylinder to the atmosphere with either the operator or the valve seat in the plug being preferably plastic or coated, as with plastic to prevent noise, and such valve is provided so that air can freely enter during opening. When the door is released, the weight falls, closing the door. The check valve is closed and the air is compressed as the weight falls, cushioning the fall of the weight.

The preferred embodiment of my invention controllably releases the air during the dropping of the weight. As the weight drops it is gently slowed and cushioned by the compressed air, causing the door to close gently. To perform the closing, either the cylinder is located in one section of the bi-fold dood and the cord anchored to the overhead member above the door, or the cylinder is located on the outside of the door section and the cord is anchored to the overhead member above the door, in each case, the cord passing over a pulley at the top of the cylinder. Thus, my invention has been found to be versatile as desired relative closing bi-fold doors.

Various types of common catches can be used to hold open the bi-fold doors employing my invention if desired.

It is an object of this invention to provide a new closing means.

It is another object of my invention to provide new means for automatically closing bi-fold doors.

It is still another object of this invention to provide a means to automatically close a bi-fold door which had

been previously opened, the closing taking place gently.

Still another object of this invention is to provide new means to close automatically and gently a bi-fold door hingedly mounted to a door post or casing, which had been previously opened.

Yet another object of my invention is to overcome the disadvantages of the prior art devices for closing doors, and to do so economically and efficiently.

Other objects and advantages of the new door closing means of my invention will be obvious or will become apparent to those skilled in the art upon reading this disclosure.

Drawings accompany and are a part of this disclosure. These drawings depict preferred specific embodiments of the new door closing means of my invention, and it is to be understood that such drawings are not to unduly limit the scope of my invention.

In the drawings,

FIG. 1 is an isometric view showing the new closer of my invention mounted on a bi-fold door which in turn is mounted in a door casing;

FIG. 2 is an enlarged longitudinal cross sectional view through a preferred specific embodiment of the operator portion of the closer means of my invention, such shown mounted on the door section of FIG. 1;

FIG. 3 is an isometric view of the preferred specific embodiment of the closer means of my invention.

FIG. 4 is a view taken on line 4—4 of FIG. 3;

FIG. 5 is an enlarged cross sectional view transverse the view of FIG. 2 of the top portion of the operator part of the means of my invention shown in FIG. 2.

FIG. 6 is an isometric view showing the operator portion of the closer means of my invention mounted in a door section between the faces thereof;

FIG. 7 is an isometric view of the bi-fold door and closer means of FIG. 1 in partial open position;

FIG. 8 is an end view of the bi-fold and closer means showing the hinged mounting in the door casing of the bi-fold door;

FIG. 9 is an enlarged longitudinal cross sectional view through the lower mounting means for mounting the operator portion of the closer means of my invention on the door.

Following is a discussion and description of the new bi-fold door closing structure of my invention, made with reference to the drawings whereupon the same reference numerals are used to indicate the same or similar parts and/or structure. The discussion and description are of preferred specific embodiments of the new door closer structure of my invention, and it is to be understood that such is not to unduly limit the scope of my invention.

FIGS. 1 through 9 illustrate a preferred specific embodiment of my pneumatic bi-fold door closer invention. This specific embodiment of my invention can conveniently be used on a hollow bi-fold door mounted on a door post or casing side. The new door closing means of my invention has been found suitable for closet doors, cabinet doors, entryway doors, inside doors in dwellings and other buildings, and the like. Typical closet doors **20** are equippe to provide my new invention, and **22** indicates the adjacent door post or side of the door casing in which doors **20** are hingedly mounted by hinges **24**. The hinge posts are pivotally mounted in lintel member **26** and sill **28**. The doors **20** are hinged at **30** to fold as shown in FIG. 7. A tube **34** is used, and it is preferably made of suitable non-permeable material, such as metal, for example, aluminum. At the top, tube **34** has a cap **36** with an overhanging flange or shoulder **38** to prevent it from slipping into the door when tube **34** is mounted in the door (FIG. 6). Clip **35** and rest **37** secured in any suitable manner to door **20** mount tube **34** on the door. Rest **37** has a hole **39** therethrough for passage of air into tube **34**. Cap **36** has a slot **40**. At the bottom, tube **34** has a plug **42** with a hole **44** therethrough. A pulley **46** is mounted in slot **40** with its axis **48** perpendicular to the plane of door **20**, the pulley being rotatably mounted in cap **36** and tube **34**. This pulley can be made of any convenient material such as wood, metal, plastic, and the like, preferably metal or nylon plastic. Cord **50** is fastened to attachment element **52** driven into lintel member **26** or secured in any other suitable manner, such as with an eye (not shown) and preferably near the point of hinging doors **20** together when closed. The cord **50** passes over a pulley **54** of guide means **56** which is mounted on the same door section as tube **34** at the top edge thereof remote from tube **34**. Then cord **50** passes over pulley **46** and into tube **24**. A suitable check valve is provided in the bottom of tube **34**, and operator **58** together with hole **60** in plug **42** and seat **62** forms a check valve, which allows passage of air into tube **34** through holes **39**, **44** and **60**, but not out. Either the valve seat **62** of plug **42** or operator **58** or both can be made of plastic, hard rubber, etc., or coated with same to provide for a noiseless valve. Leg ond feet members **66** prevent operator **58** from getting out of place. And, as those skilled in the art will know, the valve operator **58** is guided in plug **42** to seat in **62** to make certain the operator closes the hole **60** when it should.

Tube **34** can be mounted in doors **20** in any suitable manner such as drilling a hole therein slightly larger in diameter than tube **34** (FIG. 6). Cap **36** is preferably countersunk in door **20**, and with sharp pointed axle **48** for pulley **46** driven down into the door **20** to position pulley **46** stationarily to keep cord **50** aligned on the track.

A preferred specific embodiment of means for exerting downward force is illustrated in FIGS. 1 through 9. FIG. 1, FIG. 2, FIG. 3, and FIG. 7 show a large cylindrical weight **70**. FIG. 2 shows a relatively small clearance **72** between weight **70** and the walls of tube **34**. This clearance acts as a means of controllably releasing air as the weight drops. The diameter of weight **70** relative the diameter of tube **34** provides the relatively small annulus in cross section **72**. The weight **70** is of length and mass and the annulus **72** is of cross section throughout an operating length, thereby providing when weight **70** falls controlled release of air trapped thereunder through the annulus **72** to slowly close a door. As those skilled in the art will appreciate any of the embodiments of means for controllably releasing air from tube **34** disclosed in my prior patent application, supra, can be used in my invention to close bi-fold doors. And, any suitable catch means common in the art can be used to maintain the bi-fold doors in open position, until it is desired that the closer means of my invention act to automatically close the doors.

The door closer works as follows. When doors **20** are opened, weight **70** is raised, and air enters through hole **60** around operator **58**. When the door is released, weight **70** drops, compressing the air beneath it, which forces operator **58** to seat on **62** closing the valve. The compressed air cushions the fall of the weight and thus the closing of the doors. Air is slowly released through clearance **72** around the weight, and thus controls the rate of door closing.

As will be obvious to those skilled in the art, various changes and modifications of these preferred specific embodiments of the sliding door closer of my invention disclosed herein can be made or followed without departing from the spirit of the disclosure or from the scope of the claims.

I claim:

1. Automatic pneumatic closer means for a bi-fold door having two sections hingedly connected together, said bi-fold door hingedly mountable in a casing at one side thereof, said casing having a lintel or another overhead member,

(a) a tubular housing vertically mountable on one of said sections of said bi-fold door,

(b) mounting means to mount said tubular housing on the bi-fold door section,

(c) a guide means in the top portion of said tubular housing mountable on the door section,

(d) another guide means mountable on the top edge of said door section mounting said tubular housing, said another guide means mountable in use relatively remote from said tubular housing when mounted,

(e) attachment means mountable on said lintel or another overhead member adjacent the hinged connections of said door sections and positioned laterally of said another guide means,

(f) a line one end of which is fastenable to said attachment means, said line when mounted passing around said last-named guide means and said first-named guide means and with the other end of said line passing down into said tubular housing,

(g) a means for exerting downward force comprising, a weight slidably mounted in said tubular housing, said weight secured to said other end of said line, and

(h) a check valve mounted in a lower portion of said tubular housing providing when open communication between the lower portion of said tubular housing inside and the atmosphere therearound, said weight having distances thereacross relative the corresponding inside distances across said tubular housing providing a relatively small annulus in cross section therebetween, being of length and mass and said annulus being of cross section throughout and opearting length thereby providing sole means of controllably releasing air contained between the bottom of said means for exerting downward force and the walls of said tubular housing and said check valve, said means of controllably releasing air comprising a relatively small annulus between said weight and the walls of said tubular housing, said bi-fold door being openable manually causing when mounted said means for exerting downward force to be raised, said check valve allowing air to enter said tubular housing below said weight, and said bi-fold door being automatically closed when released by said means for exerting a downward force with such closing being controlled by compressed air inside said tubular housing below said weight, said compressed air being slowly released by said means of controllably releasing air and the offset position of said another guide means maintains a positive force to seat said door sections against said casing.

2. The automatic pneumatic closer means of claim **1**, wherein:

(a) the first-named guide means is a pulley having its plane generally parallel to the plane of the door section when mounted thereon, a portion of said pulley projecting out of the top of said tubular housing,

(b) said another guide means is a pulley mounted in a housing mountable on said door section with the plane of said pulley substantially parallel to the plane of the top edge of said door section, said another guide means movable laterally of said attachment means on pivotal opening of said door section to raise said weight through said line,

(c) said tubular housing being imperforate and round in cross section throughout its length, and

(d) said weight is elongated and cylindrical.

References Cited

UNITED STATES PATENTS

617,159	1/1899	Hogan et al.	49—387
1,272,160	7/1918	Weiss	49—359
1,860,333	5/1932	Dunn	16—49 X
2,014,591	9/1935	Sanders	160—206 X
3,274,733	9/1966	Bailey	16—81 X
3,334,444	8/1967	Hargrove	49—404

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U.S. Cl. X.R.

160—199, 206