Sept. 27, 1966 L. N. HANSEN 3,275,064

FOLDING DOOR

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Fig. 1

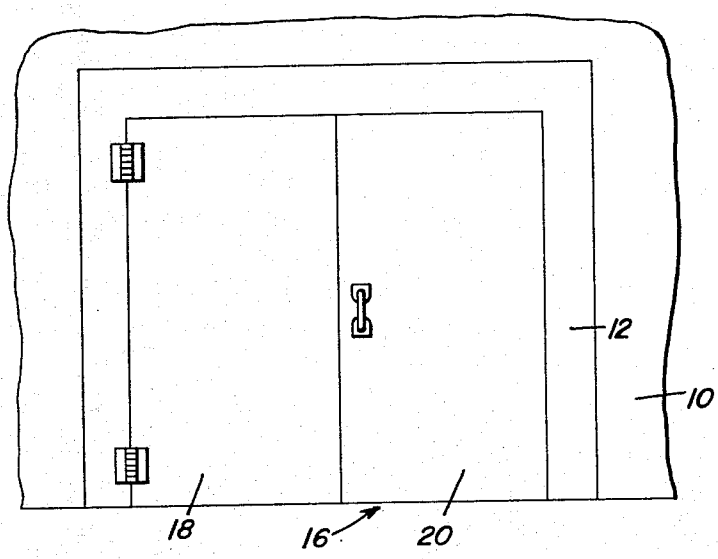


Fig. 3

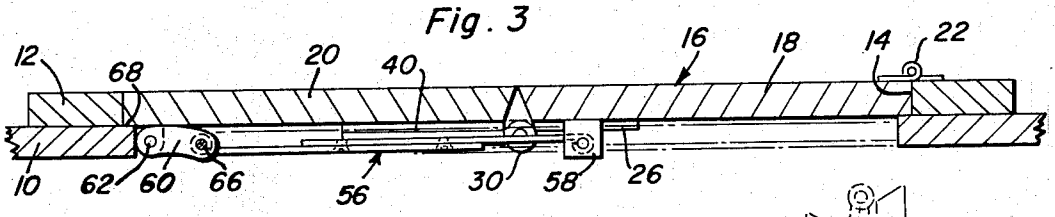


Fig. 6

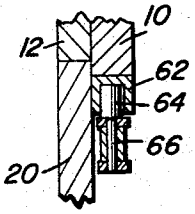
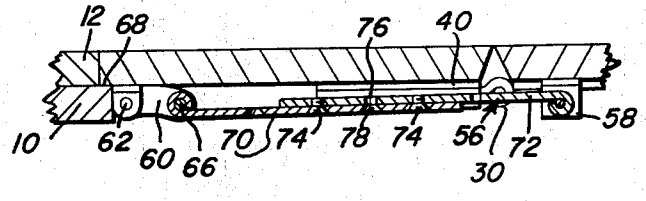


Fig. 4

Fig. 5



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Fig. 2

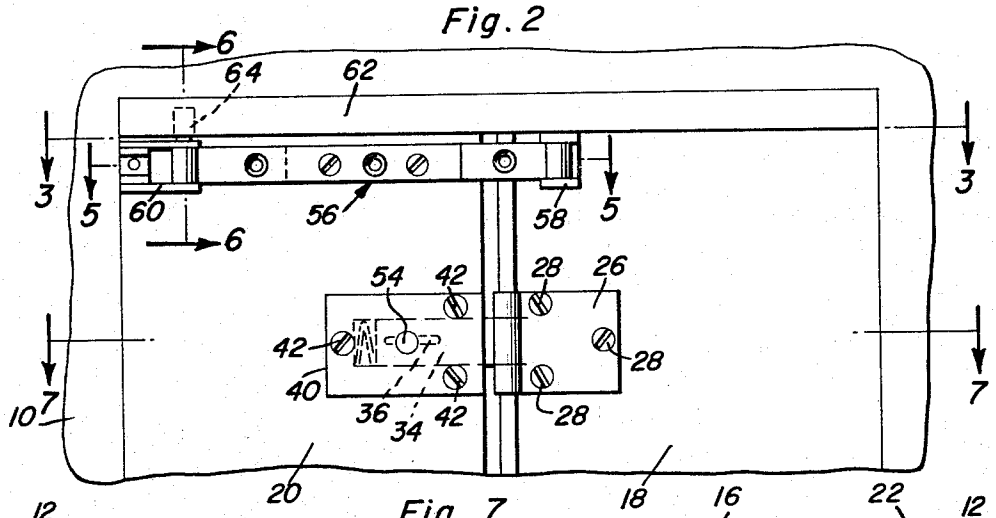


Fig. 7

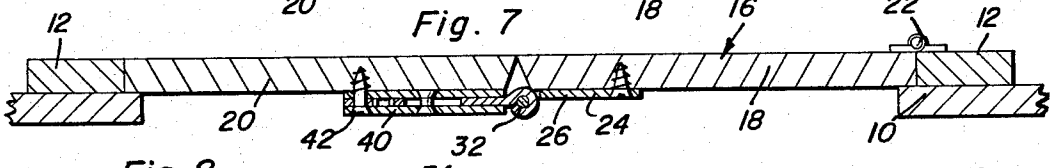


Fig. 8

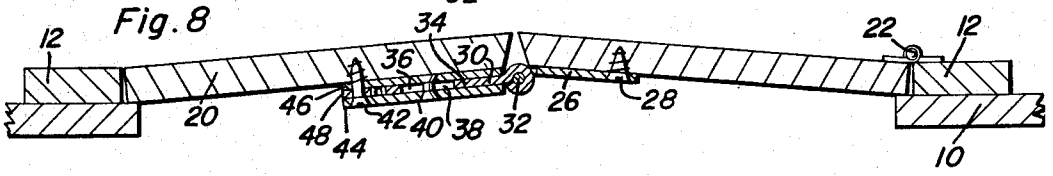


Fig. 9

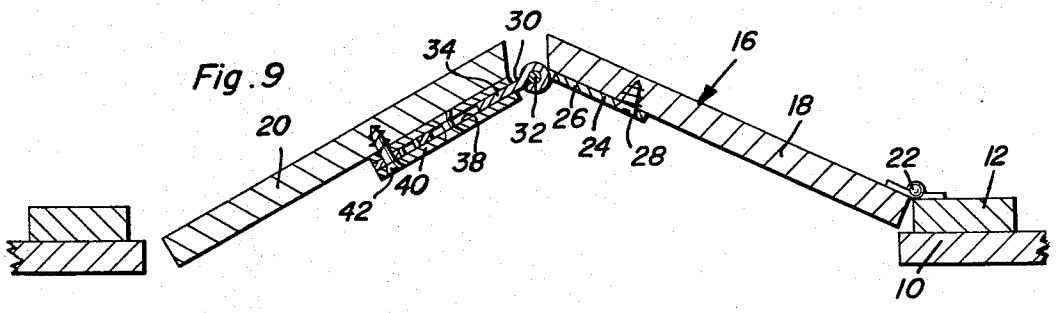
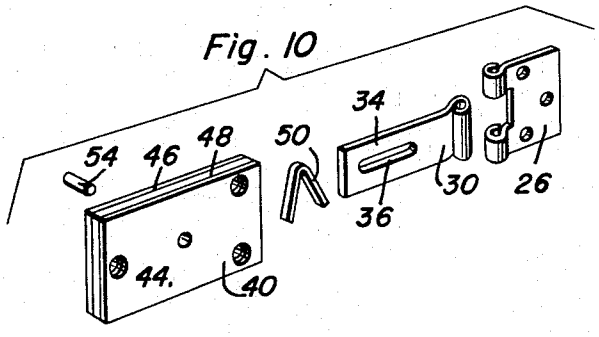


Fig. 10



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3,275,064
FOLDING DOOR

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4 Claims. (Cl. 160—206)

This invention relates to a novel and useful folding door construction and more specifically to a bi-fold door construction which can be quickly installed in a standard door frame or door opening with a hidden upper track assembly and without requiring a floor guide. The folding door construction or assembly of the instant invention includes a pair of doors which are disposed in edgewise adjacent relation and which are pivotally secured together for relative rotation about an axis generally paralleling and adjacent the adjacent edge portions of the two doors. Novel hinge assemblies are utilized to pivotally secure the two doors together and each hinge assembly includes a pair of hinge leaves which are pivotally secured together in a conventional manner, one of the leaves of each assembly being fixedly secured to one of the doors and the other leaf of each hinge assembly being mounted on the other door for reciprocation in a plane generally paralleling the medial plane of the other door and allowing for movement of the other door toward and away from the axis of rotation of the doors relative to each other. With this type of construction the door assembly, when in the fully extended position, can have a width greater than the width of the door frame on which the door assembly is mounted. One of the doors may be mounted from the door frame in the conventional manner by means of conventional hinge assemblies with the axes of rotation of the door assembly relative to the door frame and the doors relative to each other disposed on opposite sides of the medial plane of the door assembly when the latter is in its fully extended or closed position.

With this type of construction the free edge of the door assembly may engage the side of the door frame remote from the side of the frame to which the door assembly is secured before the door assembly is moved toward its fully closed position with the two doors paralleling each other. Inasmuch as the free door is yieldably supported from the door pivotally secured to the door assembly as the door assembly is moved to the fully closed position, lost motion will occur between the two doors and insure that the free edge of the door assembly is urged into tight frictional engagement with the corresponding side of the door opening or frame. Further, inasmuch as the axes of rotation of the door assembly relative to the frame and the doors relative to each other are disposed on opposite sides of the door assembly when the latter is in its fully closed position, the fully closed position of the door assembly defines an overcenter position and spring means operatively connected between the free door and the corresponding hinge leaves may be utilized to yieldably retain the door assembly in its fully closed postion in lieu of additional latch means.

The main object of this invention is to provide an improved bi-fold door construction including structural features which will be capable of insuring a tight fit between the free edge of the door assembly and the corresponding portion of the door frame.

Still another object of this invention, in accordance with the immediately preceding object, is to provide a bi-fold door assembly including structural features which will inherently resiliently retain the door assembly in a fully closed overcenter position.

Yet another object of this invention is to provide a bi-fold door construction including structural features that will enable the door construction to be quickly installed in a standard door frame or opening with only an upper guide for the free door of the assembly and without requiring undesirable floor guides for the free door.

A final object of this invention to be specifically enumerated herein is to provide a novel bi-fold door construction in accordance with the preceding objects which will conform to conventional forms of manufacture, be of simple construction and easy to install so as to provide a device that will be economically feasible, long-lasting and relatively troublefree in operation.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

FIGURE 1 is a side elevational view of a building structure including a door frame defining a door opening and with the bi-fold door construction of the instant invention operatively mounted in the door opening;

FIGURE 2 is an enlarged fragmentary side elevational view of the embodiment illustrated in FIGURE 1 as seen from the reverse side thereof;

FIGURE 3 is a horizontal sectional view taken substantially upon the plane indicated by the section line 3—3 of FIGURE 2;

FIGURE 4 is a horizontal sectional view similar to FIGURE 3 but showing the door assembly in a partially open position in solid lines and in a fully opened position in phantom lines;

FIGURE 5 is a fragmentary horizontal sectional view taken substantially upon the plane indicated by the section line 5—5 of FIGURE 2;

FIGURE 6 is a fragmentary vertical sectional view taken substantially upon the plane indicated by the section line 6—6 of FIGURE 2;

FIGURE 7 is a horizontal sectional view taken substantially upon the plane indicated by the section line 7—7 of FIGURE 2;

FIGURE 8 is a horizontal sectional view similar to that of FIGURE 7 shown with the doors of the door assembly in a slightly over-center and substantially fully closed but slightly open position;

FIGURE 9 is a horizontal sectional view similar to FIGURES 7 and 8 but showing the doors of the door assembly in still another open position; and

FIGURE 10 is an exploded perspective view of one of the hinge assemblies by which the doors of the door assembly are pivotally secured together.

Referring now more specifically to the drawings the numeral **10** generally designates a wall in which a door frame **12** is formed. The door frame **12** defines a door opening **14** and the door assembly of the instant invention is generally referred to by the reference numeral **16** and includes a pair of doors **18** and **20**. As can best be seen from FIGURES 1 and 7–9 of the drawings the door **18** is pivotally supported from the door frame **12** by means of a pair of conventional hinge assemblies **22**. The door **20** is pivotally supported from the free edge portion of the door **18** by means of a pair of special hinge assemblies **24**.

Each of the special hinge assemblies **24** includes a first hinge leaf **26** which is fixedly secured to the door **18** by means of suitable fasteners **28**. A second hinge leaf **30** is also provided and is pivotally secured to the corresponding hinge leaf **26** by means of a hinge pin **32**. However, the tongue portion **34** of the second hinge leaf **30** is longitudinally slotted as at **36** and slidingly received within a complementary blind recess **38** formed in a mounting housing **40** provided therefor and fixedly secured to the door **20** by means of suitable fasteners **42**. The housing **40** comprises a pair of opposite side plates **44** and **46** which sandwich therebetween a center spacing plate **48**. The spacing plate **48** has a notch formed therein defining the blind recess **38** and in which the tongue portion **34** is

slidingly received. A V-shaped resilient spring member **50** is seated in the recess **38** and yieldingly urges the corresponding tongue portion **34** outwardly of the recess **38**.

From FIGURES 7–9 of the drawings it will be noted that the axis of rotation of the door **18** relative to the door frame **12** is defined by the pivot pins **22** and disposed on one side of the medial plane of the door assembly **16**. On the other hand, the axis of rotation of the doors **18** and **20** relative to each other is defined by the pivot pins **32** and disposed on the opposite side of the medial plane of the door assembly **16** when the latter is in its fully closed position illustrated in FIGURE 7 of the drawings. Accordingly, as the door assembly **16** is moved from the partially open position illustrated in FIGURE 9 of the drawings to the position illustrated in FIGURE 8 of the drawings the free edge portion of the door **20** engages the corresponding edge portion of the frame **12** and subsequent movement of the door assembly **16** to the fully closed position illustrated in FIGURE 7 of the drawings causes the springs **50** to be compressed. As the axis of rotation of the doors **18** and **20** relative to each other and defined by the pivot pins **32** passes through a plane containing the pivot pins **22** and the points of contact of the free edge portion of the door **20** with the frame **12**, the door assembly **16** is urged toward a fully closed over-center position by the springs **50**, the latter having been slightly compressed during movement of the door assembly **16** toward a center position with the pivot pins **32** disposed in the aforementioned plane after initial contact of the free edge portion of the door **20** with the frame **12**.

From FIGURES 7–10 of the drawings it may be seen that a limit pin **54** is secured through the plates **44** and **46** and passes through the slot **36** and thereby establishes limit positions of movement of the tongue portion **34** relative to the housing **40**.

Although not required for satisfactory operation of the door assembly **16**, a connecting rod assembly generally referred to by the reference numeral **56** is provided and has one end pivotally supported from a bracket **58** supported on the free edge portion of the door **18**. The other end portion of the connecting rod **56** is pivotally connected to one end of an arm **60** whose other end is pivotally supported from the free edge portion of the door **20** by means of a pivot pin **62** stationarily positioned relative to the door **20**. Further, the connecting rod **56** is disposed adjacent the upper edge portion of the door assembly **16** and the frame **12** includes an upper horizontal downwardly opening guide channel **62** which slidingly receives a follower **64** mounted on an extended end portion of the pivot pin **66** by which the connecting rod **56** is pivotally secured to the arm **60**.

Inasmuch as final movement of the door assembly **16** to the fully closed position illustrated in FIGURE 3 of the drawings from the slightly open position illustrated in FIGURE 4 of the drawings will cause the arm **60** to be pivoted from the position illustrated in FIGURE 4 of the drawing to the position illustrated in FIGURE 3 of the drawings, movement of the door assembly **16** to the fully closed position will not only frictionally engage the free edge portion of the door **20** with the corresponding portion of the frame **12** but will also cam the free edge portion of the door **20** against the stop flange portion **68** of the wall structure **10**. Still further, it may be seen from FIGURE 5 of the drawings that the connecting rod **56** is constructed of two arm sections **70** and **72** which are overlapped at adjacent ends and secured together by means of fasteners **74** secured through registered apertures formed in the arm sections **70** and **72**. Accordingly, it may be seen that the effective length of the connecting rod **56** may be adjusted merely by causing different sets of the apertures **76** and **78** formed in the arm sections or members **72** and **74**, respectively, to be registered with each other.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention as claimed.

What is claimed as new is as follows:

1. In combination, a door frame including first and second opposite edge portions and a third edge portion extending between corresponding ends of said first and second edge portions and defining a door opening between said first and second edge portions, a door assembly including first and second doors, said first door being pivotally secured along one edge portion to said first edge portion, means pivotally securing the corresponding edge portion of said second door to the free edge portion of said first door, means slidably securing the free edge portion of said second door to said third edge portion for movement therealong, the adjacent edge portions of said doors being spaced apart, arm means pivotally connected at its opposite ends to the free edge portion of said first door and to the remote edge portion of said second door, said door assembly when fully extended, being of slightly greater width than said opening, the first-mentioned means including first and second hinge component means pivotally secured together, said first hinge component means being fixedly secured to one of said doors and the second hinge component means being mounted on the other of said doors for reciprocal movement between two limit positions toward and away from the adjacent edge portion of said second door, means connected between said second hinge component means and the other door yieldingly urging said second hinge component means toward said one door, said second edge portion of said frame including abutment surface means disposed in a plane generally paralleling the medial plane of said opening and projecting into the latter from said second edge portion, said means slidably securing said free edge portion of said second door to said third edge portion of said frame and said arm means including means operative to force said free edge portion of said second door laterally into tight abutting engagement with said abutment surface means upon final movement of said doors to the fully closed planar positions.

2. The combination of claim **1** wherein the axis of rotation of said first door relative to said frame is laterally spaced to the side of the medial plane of said first door which is advanced when opening said doors and the axis of rotation of said second door relative to said first door is laterally spaced to the other side of said plane.

3. The combination of claim **12** wherein said abutment surface means faces toward the first mentioned side of said medial plane.

4. For use in connection with a door frame including first and second opposite edge portions defining a door opening therebetween and including a third edge portion extending between the first and second edge portions and also abutment surface means disposed in a plane generally paralleling the medial plane of said opening and projecting in the latter from said second edge portion, a door assembly including first and second doors, said first door including means adapted to be pivotally secured along one edge portion to said first edge portion, means pivotally securing the corresponding edge portion of said second door to the free edge portion of said first door, the free edge portion of said second door including means adapted to slidingly engage said third edge portion of said frame for guided movement therealong, the adjacent edge portions of said doors being spaced apart, arm means pivotally connected at opposite ends to the free edge portion of said first door and the remote edge portion of said second door, said door assembly, when fully extended, being of a width adapted to exceed the width of

said opening, said means pivotally securing said free edge portion of said first door to said second door including first and second hinge component means pivotally secured together, said first hinge component means being fixedly secured to one of said doors, and the second hinge component means being mounted on the other of said doors for reciprocal movement between two limit positions with respect to the adjacent edge portion of said second door, means connected between said second hinge component means and the other door yieldingly urging said second hinge component means toward said one door, said means adapted to slidingly secure the free edge portion of said second door to said third edge portion of said frame and said arm means connecting the free edge portion of said first door to the remote edge portion of said second door including means adapted to force the free edge portion of said second door laterally into tight abutting engagement with said abutment surface means upon final

movement of said doors to the fully closed planar positions closing said opening.

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