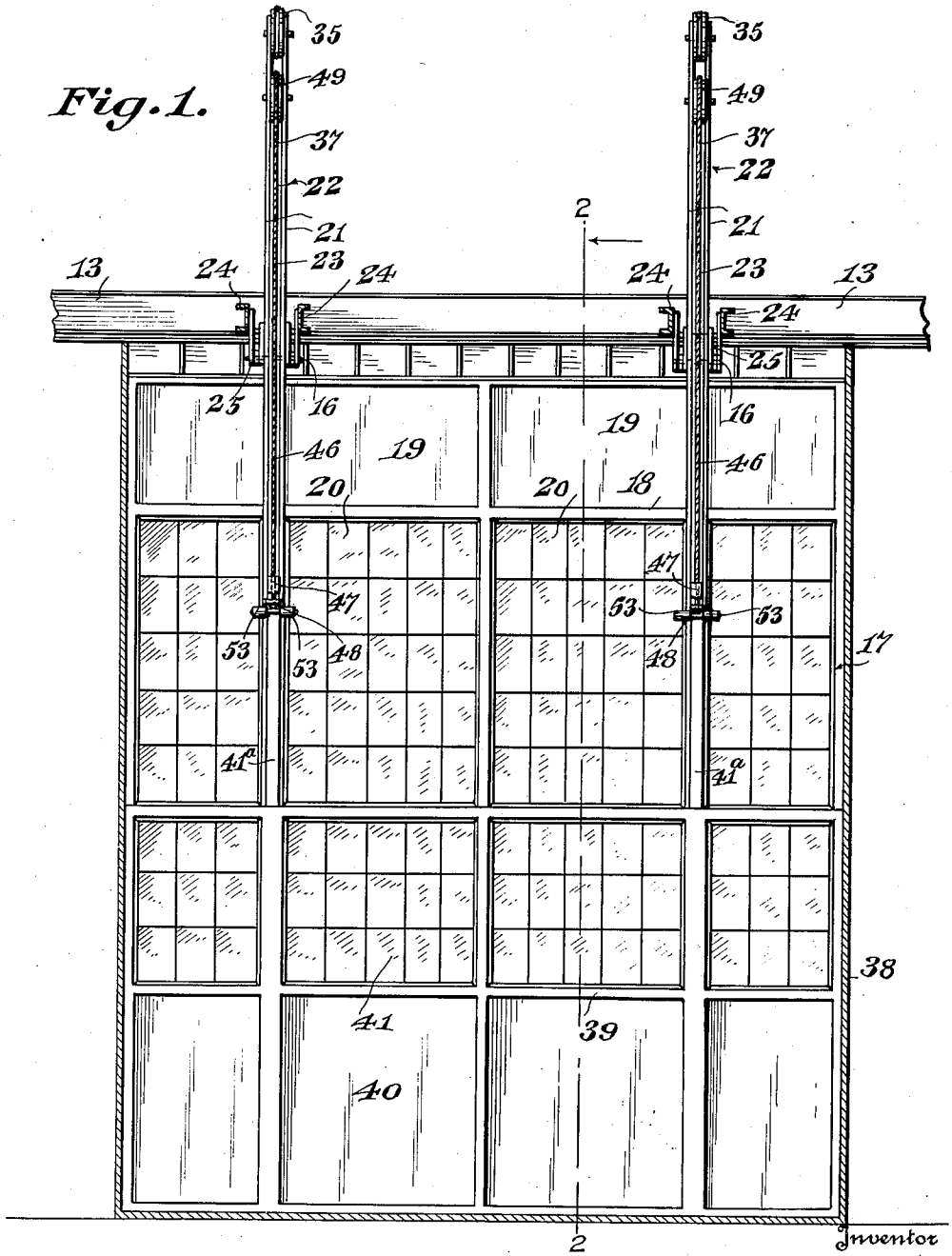
Feb. 13, 1934. D. H. MORGAN 1,947,422

DOOR STRUCTURE AND OPERATING MEANS THEREFOR

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Fig. 1.



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Fig. 2.

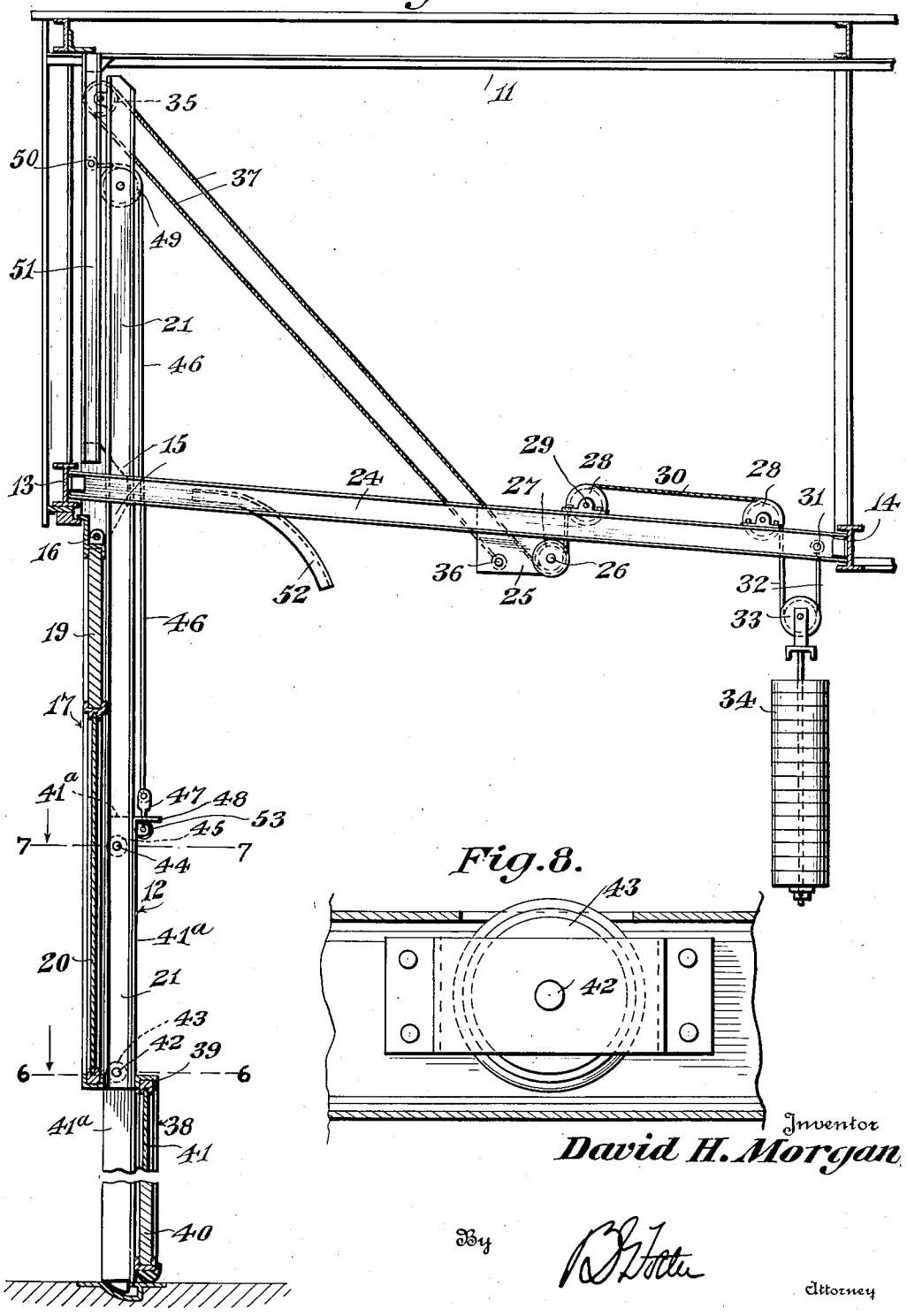


Fig. 8.

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DOOR STRUCTURE AND OPERATING MEANS THEREFOR

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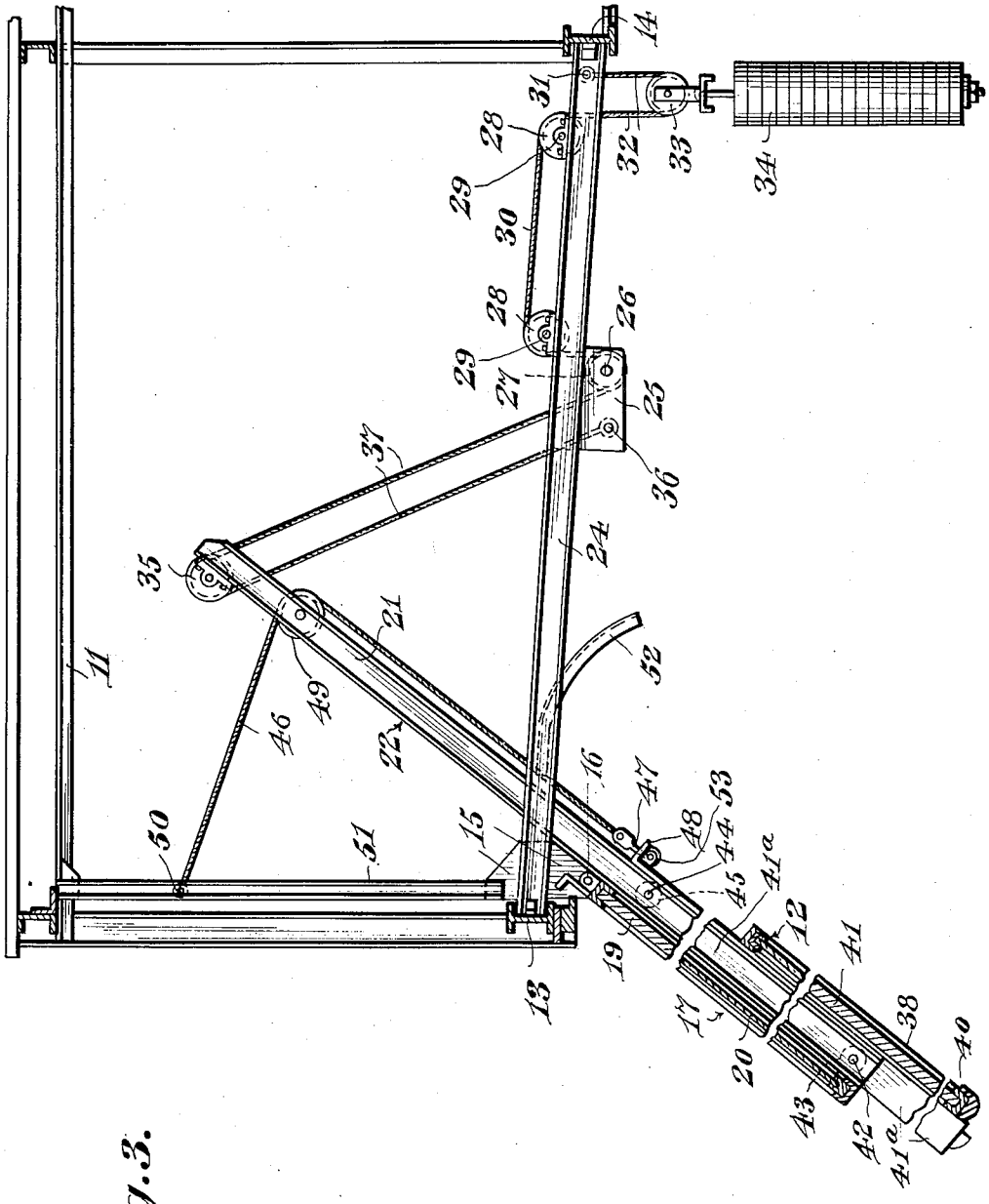


Fig. 3.

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DOOR STRUCTURE AND OPERATING MEANS THEREFOR

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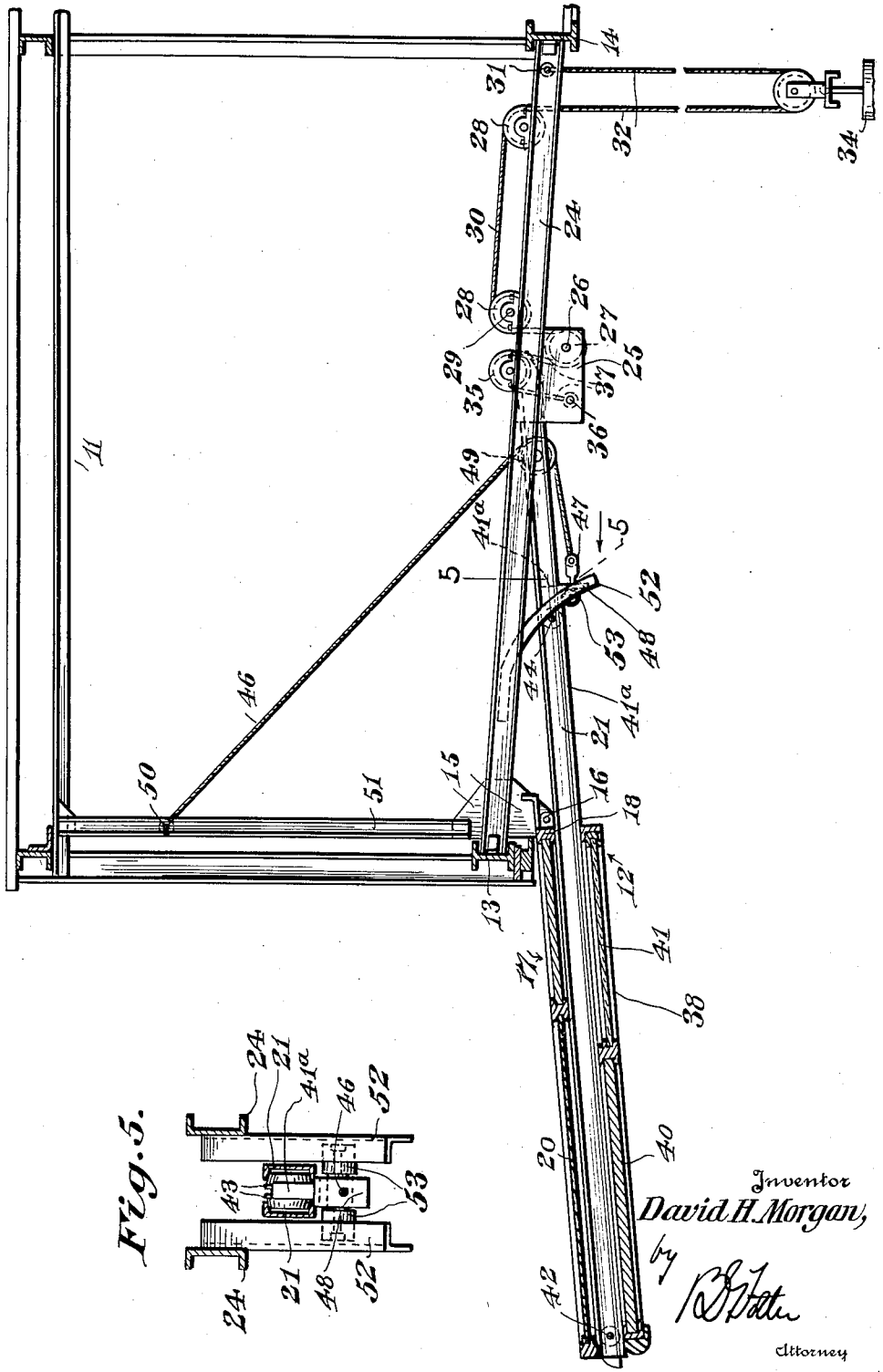


Fig. 4.

Fig. 5.

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DOOR STRUCTURE AND OPERATING MEANS THEREFOR

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Fig. 6.

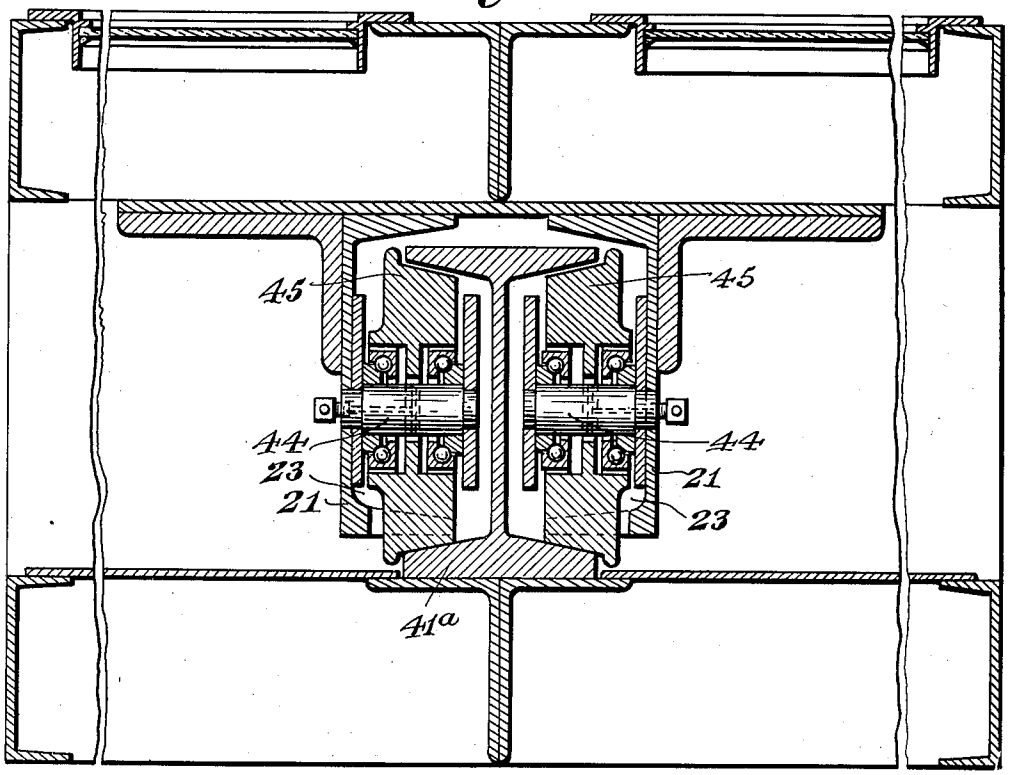
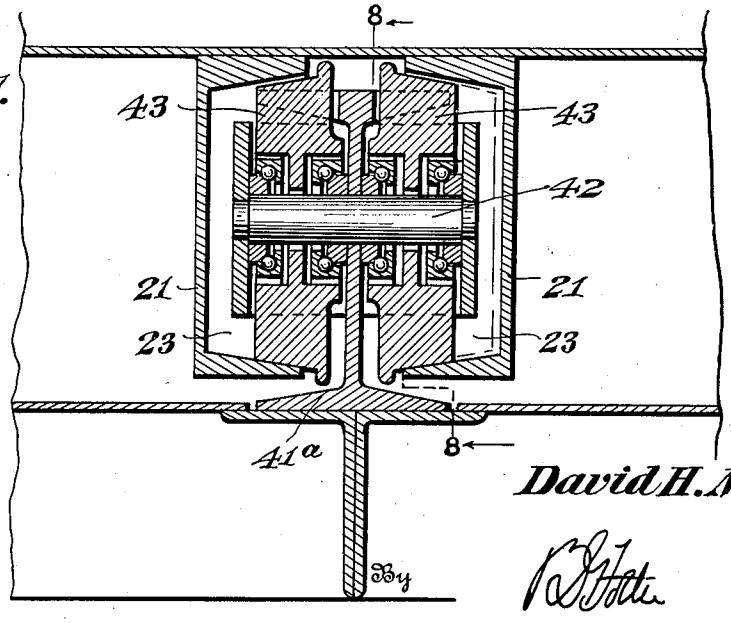


Fig. 7.



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Fig. 9.

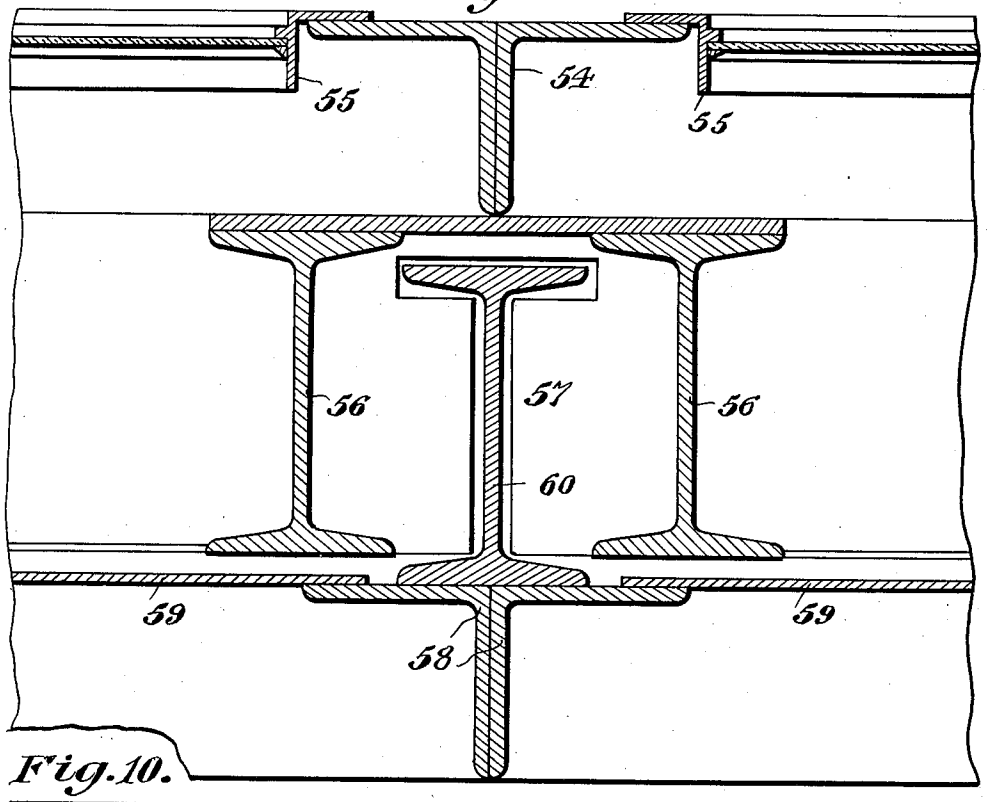
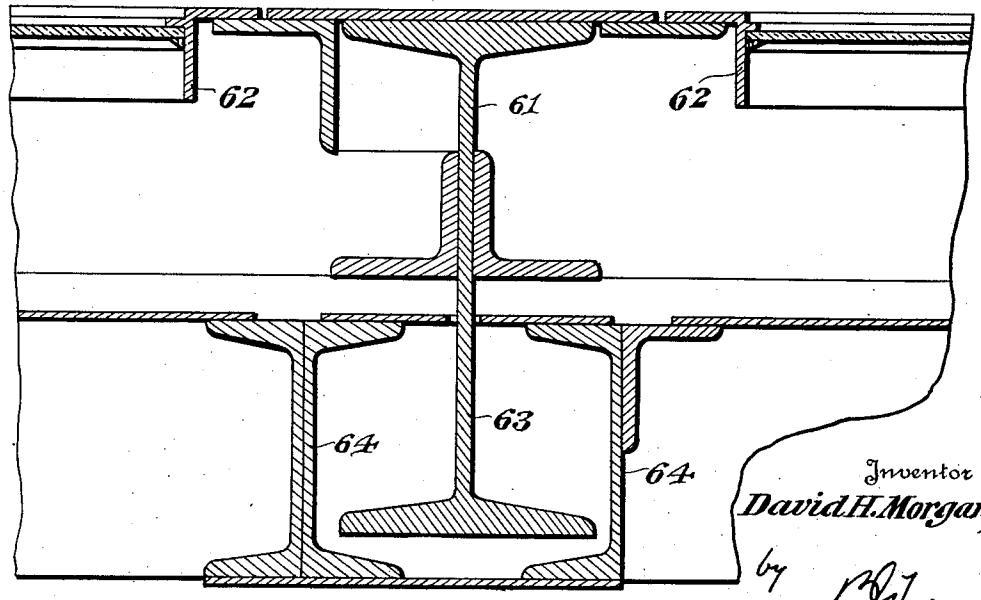


Fig. 10.



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UNITED STATES PATENT OFFICE

1,947,422

DOOR STRUCTURE AND OPERATING MEANS THEREFOR

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Application March 28, 1931. Serial No. 526,098

21 Claims. (Cl. 20—19)

In modern housing structures, as for example, hangars for aeroplanes, the size of the doorways has been rapidly increased due to the increase in the size of the aeroplanes and like apparatus that have to pass through the same, until it has become a serious problem to provide a door structure large enough to cover the doorway and yet readily movable to open position. This is due not only to the necessary size of the door, but to the necessity of providing adequate storage space when it is in open position, and which storage space does not materially encroach on the interior area of the hangar or other housing structure.

A "canopy" door is a desirable closure for the above type of doorway in that it swings upwardly and outwardly, but with the increased heights of the doorway, a correspondingly high door creates other problems, in that it must withstand wind pressure and wind loads so that in opening and closing these must be taken into account as well as the extended weight of the door when elevated. For example, it is now not uncommon to have doorways twenty-two feet high and one hundred and twenty feet wide and in fact there are structures requiring door twenty-six feet high and of equal width. The swinging upwardly and outwardly of a door of that height obviously is a difficult proposition, particularly if there is wind against it, and in any event considerable strain is brought upon the building and the operating mechanism for the door.

One of the objects of the present invention is to provide a door structure that is preferably of the "canopy" type and in which the overall length of the door is reduced when the door is raised, so that it provides an elevated canopy when open that is of materially less area than when closed.

A further and important object is to provide simple mechanism of a novel character for effecting the operation of a door of this type.

In the accompanying drawings:

Figure 1 is a side elevation of a preferred embodiment of the invention, with the door in its closed position.

Figure 2 is a vertical sectional view on the line 2—2 of Figure 1.

Figure 3 is a view similar to Figure 1, but showing the door partially raised.

Figure 4 is another sectional view, but showing the door completely opened.

Figure 5 is a detail sectional view on the line 5—5 of Figure 4.

Figures 6 and 7 are cross sectional views taken respectively on the lines 6—6 and 7—7 of Figure 2.

Figure 8 is a detail longitudinal sectional view on the line 8—8 of Figure 7.

Figure 9 is a detail cross sectional view of a modified form of construction.

Figure 10 is a cross sectional view of another embodiment of the same.

Portions of a hangar structure are illustrated, including a frame 11 providing a doorway 12 surmounted by a lintel 13 that constitutes a part of the frame. A fixed cross beam 14 is shown within the structure in rear of the lintel beam 13. Suitable brackets 15, mounted on the lintel of the doorway, have pivoted thereto, as shown at 16, an upper door member or section, designated generally by the reference numeral 17. It will be obvious that this door section may assume various forms, but in the embodiment herein disclosed, it comprises a frame 18 forming panels 19, and provided with suitable windows 20.

This door member is reenforced by vertical beam elements, two being shown, though a greater or less number may be employed, as desired. As illustrated, two sets of channel beams 21 are arranged vertically on the rear side of the upper door member, and extend well above the same to produce arms 22 that are located inside the building when the door section is in its vertical position. The beams 21 of each set are spaced apart, thereby providing between them, a guideway 23. It will be understood that the various frame bars and parts may be secured together in any suitable way, but preferably they are welded.

The arms 22 provide means, by which the door members 17 may be swung upwardly and outwardly. The operating means for the door has mountings on the upper ends of these arms 22. Each of the said arms 22 swings between a pair of channel beams 24 extending from the lintel 13 to the beam 14. Hangers 25, carried by the beams 24, have journaled therein a drive shaft 26 that may be operated by any suitable power. This shaft is provided with sprocket wheels or drive pulleys 27. Guide sheaves 28 are also journaled in bearings 29 on the beams 24. Cables 30, which may be sprocket chains, have their ends secured, as shown at 31, to and between the rear ends of the beams 24 and have downward loops 32, in which is a sheave 33 carrying a counterweight 34. These cables pass over the sheaves 28 and around the drive sheave or pulley 27, thence around sheaves or pulleys 35 journaled on the upper ends of the arms 22, these sheaves preferably being located between the channel bars 21. The cables

then extend downwardly and are secured, as shown at 36, to the hanger brackets 25. It will be observed that the stretches 37 of the cables which are looped about the sheaves 35, extend downwardly and rearwardly. Consequently when the shaft 26 is rotated in one direction, the arms 22 will be drawn rearwardly and downwardly, thereby swinging the upper door section 17 upwardly and outwardly. If the shaft 26 is turned in the opposite direction, the door member 17 will be permitted to swing downwardly and inwardly to its vertical or closed position. The weight 34 at all times takes up the slack of the cable and counterweights the door.

Associated with the door member 17 is a lower door member 38 slidable on the rear side of the door member 17 to and from a position alongside the same. The door member 38 is preferably formed of a suitable frame 39 having lower solid panels 40 and upper glassed panels 41. The structure of course may be varied as desired. Secured vertically to the front side of the door member 38 are vertical channel beams 41*a* that lie between the beams 21 and constitute guides operating in the vertical guideways 23. These beams 41*a* extend above the top of the lower door section. In order that they may ride easily in their guideways, the said beams have at their upper ends cross spindles 42 (see Figure 7), on which are journaled rollers 43 that run between the flanges of the channel bars 21. Similarly the channel bars 21 are provided adjacent the lower end of the upper door section with inwardly extending spindles 44 (see Figure 6), on which are journaled rollers 45 that operate between the flanges of the I-beams 41*a*.

The lower door member 38 is caused to slide up on the upper door member 17 when said upper door member swings upwardly and outwardly to open position. To secure this operation cables 46 are provided, the lower ends of which are secured, as shown at 47, to brackets 48 fixed upon the upper ends of the I-beams 41*a*. These cables pass about sheaves 49 journaled to and between the channel bars 21, and said cables thence extend forwardly and are secured, as shown at 50, to vertical bars 51 located within the building structure.

The operation of the door is as follows: When it is in vertical position, or as shown in Figures 1 and 2, the lower door member is extended with respect to the upper member 17 so that the door is closed. The door is opened as already explained by operating the shaft 26, thereby drawing the cable loops 37 downwardly, swinging the arms 22 downwardly, and consequently swinging upwardly and outwardly the upper door member or section 17. The slack in the cable 37, as already explained, is taken up by the downward movement of the counterweight 34. As soon as the arms 21 start to swing downwardly, they bear against and begin to bend the cables 46, thereby changing them from their vertical positions as shown in Figure 2 into angular formation, as illustrated in Figure 3. The consequence is that the lower door member 38 begins to slide upwardly behind and on the upper door member and this movement continues until the door is fully opened, as shown in Figure 4, when the lower door member is alongside the upper door member. When the drive shaft 26 is rotated in the opposite direction, the upper door member 17 of course swings downwardly and as the cable begins to straighten, the lower door member moves downwardly. However, inasmuch as the door members when raised quite nearly approach a horizontal position, as shown in Figure 4, it will be obvious that the lower door member may not immediately start to slide outwardly as the upper door swings downwardly. There therefore is some danger that after the upper door member reaches a relatively sharp inclination, the lower door member will begin to suddenly slide and acquire considerable momentum before the slack that is thus occasioned in the cable 46 is taken up. To overcome this tendency the beams 24 have fixed to them cam tracks 52 which are disposed eccentrically to the pivot axis 16 of the door, and the I-beams 41*a*, which it will be recalled are carried by the lower door member, are provided with rollers 53 adapted to ride against these cam tracks 52. Therefore as the door swings downwardly, the rollers 53, operating against the cam tracks 52, will push the lower door member outwardly so that its movement on the upper door member is thus continuously effected. The cam tracks 52, as shown more particularly in Figure 5, are preferably formed of angle iron to provide relatively rigid tracks for the rollers 53.

That the door structure may be built in various ways, will be clear from the modifications illustrated in Figures 9 and 10. In Figure 9 the upper door frame is shown as of angle iron 54 with the glass-holding frames shown at 55. Carried by the rear side of this upper door member are vertical guide beams 56 forming the arms and the guideway 57 for the lower door member. In this embodiment it will be noted that the doors 56 are I-beams. The lower door member frame is also of angle iron, as indicated at 58 and has the panel elements 59 welded thereto. A vertical guide bar for the lower member is shown at 60 and operates in the same manner as does the beam 41*a* of the structure first described.

A still further modification will be found in Figure 10. In this case, vertical main frame I-beams 61 are provided to which are secured the glass frames 62. The I-beam 61 is sufficiently broad to extend beyond the rear side of the upper door section, and in this case constitutes a guide 63 that is located between panel bars 64 carried by the lower door member. In other words, the guiding means in this structure is a reverse arrangement from that disclosed in Figures 6, 7 and 9.

From the foregoing, it is thought that the construction, operation and many advantages of the herein described invention will be apparent to those skilled in the art without further description, and it will be understood that various changes in the size, shape, proportion and minor details of construction may be resorted to without departing from the spirit or sacrificing any of the advantages of the invention.

What I claim, is:

1. In a door structure, the combination with a pivotally mounted upper section, of a lower section slidable upon the upper section in a path substantially parallel thereto, means for swinging the upper section, and means for causing the lower section to slide on the upper section as the latter swings.

2. In a door structure, the combination with an upper section pivotally mounted at its upper end, of operating means for swinging it upwardly and outwardly to provide a canopy over the doorway, a lower section that slides to and from an extended position in a path that is substantially parallel to the upper section, and means for caus-

ing said sliding movement when the upper section is swung.

3. In a door structure, the combination with an upper section pivotally mounted at its upper end, of operating means for swinging it upwardly and outwardly to provide a canopy over the doorway, a lower section that has a reciprocatory sliding movement to and from an extended position on and with respect to the upper section and in a path substantially parallel to the same, and means other than the operating means for the swinging door to cause the sliding movement of the lower section when the upper section is swung.

4. The combination with a structure having a doorway, of a door pivotally mounted adjacent the top of the doorway and swinging upwardly and outwardly with respect to the same to an unobstructive position, an arm carried by the door and extending above it substantially parallel thereto, and means engaged with the upper portion of the arm and located at a lower level for swinging said arm inwardly and downwardly, and thereby swinging the door outwardly and upwardly.

5. The combination with a structure having a doorway, of a door pivotally mounted adjacent the top of the doorway and swinging upwardly and outwardly with respect to the same to an unobstructive position, an arm carried by the door and upstanding above it and above the pivot axis of the door and located within the structure, a cable extending rearwardly and downwardly from the arm, a counterweight on the cable, and means coacting with the counterweight for swinging said arm inwardly and downwardly and thereby swinging the door outwardly and upwardly.

6. The combination with a structure having a doorway, of a door pivotally mounted adjacent the top of the doorway and swinging upwardly and outwardly with respect to the same to an unobstructive position, an arm carried by the door and upstanding above it and above the pivot axis of the door and located within the structure, a cable extending rearwardly and downwardly from the arm, a counterweight on the cable, and means engaged with the cable for swinging said arm inwardly and downwardly, and thereby swinging the door outwardly and upwardly.

7. The combination with a structure having a doorway, of a door pivotally mounted adjacent the top of the doorway and swinging upwardly and outwardly with respect to the same to an unobstructed position, an arm carried by the door and upstanding above it and above the pivot axis of the door and located within the structure, a pulley on the arm, a cable having one end fixed behind and lower than the pulley, said cable passing around the cable and having a counterweight hung therefrom, and an actuating device operating on the cable behind and below the pulley for drawing said cable rearwardly and downwardly.

8. The combination with a structure having a doorway, of a door section mounted to swing between a position across the doorway and an unobstructive elevated position, a second door section that slides on the first section, and a cable connected to the second door section and to the structure, said cable having a bearing on the swinging door section at one side of its axis of movement and being thereby operated as the first section is swung to effect the sliding of the second section.

9. The combination with a structure having a doorway, of a door section mounted to swing between a position across the doorway and an unobstructive elevated position, said door section having an upstanding arm portion, a second door section that slides on the first section, and a cable connected to the second door section and to the structure, said cable having a bearing on the arm above the axis of movement of the first section and being thereby operated as the first section is swung to effect the sliding of the second section.

10. The combination with a structure having a doorway, of a door section mounted to swing between a position across the doorway and an unobstructive elevated position, said door section having an upstanding arm portion, a pulley journaled on the arm, and a cable fixed to the sliding section and to the structure and passing about the pulley, said cable being bent by the arm on the swinging of the first door section, and thereby causing the sliding of the second door section.

11. The combination with a structure having a doorway, of a swinging door section pivotally mounted at the upper portion of the doorway and having an upstanding arm, means engaged with the upper portion of the arm for swinging it and thereby the upper door section, a lower door section slidable on the upper section, and a cable connected to the lower door section and to the structure and engaged with the arm to cause the cable to be bent and thereby cause the lower door section to slide when the upper section is swung to open position.

12. The combination with a structure having a doorway, of a swinging door section pivotally mounted at the upper portion of the doorway and having an upstanding arm, said upper door section swinging upwardly and outwardly and the arm swinging inwardly and downwardly, a cable for thus swinging the arm and door and connected to the arm, a lower door section slidable on the upper section, and a cable connected to the lower door section and to the structure and engaged with the upper portion of the arm to cause the cable to be bent and thereby cause the lower door section to slide when the upper section is swung upwardly to open position.

13. The combination with a structure having a doorway, of a swinging door section pivotally mounted at the upper portion of the doorway and having an upstanding arm, said upper door section swinging upwardly and outwardly and the arm swinging inwardly and downwardly, sheaves journaled on the upper portion of the arm, an actuating cable for the door including a rearwardly and downwardly inclined loop passing around one of the sheaves, and a cable connected to the lower door section, passing around the other sheave and fixed to the structure.

14. The combination with a swinging door section movable between a raised generally horizontal position and a generally vertical position, of a sliding door section slidably mounted on the swinging section and free to move thereon as the swinging door section moves from its horizontal position, and a cam member operating on the sliding section for causing it to slide on the swinging section as the latter moves from its generally horizontal position.

15. The combination with a swinging door section movable between a raised generally horizontal position and a generally vertical position, of means engaged with the swinging section to

swing it, a sliding door section slidably mounted on the swinging section and free to move thereon as the swinging door section moves from its horizontal position, means for causing the sliding section to slide to a position alongside the swinging door section as the latter is moved to its generally horizontal position, and means engaging the upper portion of the sliding section and being ridden against thereby to cause it to be slid from its said position to an extended position as the swinging section moves from its generally horizontal position.

16. The combination with a swinging door section having a fixed pivotal mounting and movable between a raised generally horizontal position and a generally vertical position, of a sliding door section slidably mounted on the swinging section, means for causing the sliding section to slide to a position alongside the swinging door section as the latter is moved to its generally horizontal position, and a cam track eccentric to the axis of movement of the swinging section and operating on the sliding section to cause it to be slid from its said position to an extended position as the swinging section moves from its generally horizontal position.

17. The combination with a structure having a doorway, of an upper door section having a fixed pivot mounting on the upper portion of the doorway and swinging outwardly and upwardly to provide a canopy above the doorway, means connected to the swinging section for swinging it, a lower section slidable on the upper section, means for sliding it to a position alongside the upper section when the latter is swung upwardly by said means, a cam track adjacent the lower section when in its latter position and disposed eccentrically to the axis of movement of the swinging section, and a device on the sliding section that rides the track to cause the sliding section to be slid from its said position to an extended position as the swinging section moves from its elevated position.

18. The combination with a swinging upper door section, of a reinforcing bar extending across and above the same, means engaged with the portion of the bar above the section to swing the upper portion, said bar forming a guideway, and a lower door section slidable on the upper section and having a portion slidable on the guideway.

19. The combination with a swinging upper door section, of spaced channel bars extending vertically across the upper section and forming a guideway between them, said bars projecting above the same to form an upstanding arm, means engaged with the arm for swinging it and thereby swinging the upper section, a lower door section slidable to and from a position alongside the upper section, and a reinforcing bar extending across the lower section and slidable in the guideway formed by the bars of the upper section.

20. The combination with a swinging upper door section, of a lower door section slidable to and from a position alongside the upper section, a pair of spaced channel bars on one section reinforcing the same and forming a guideway between them, and a reinforcing bar on the other section that is slidably received between the first bars.

21. The combination with a structure having a doorway, of a door pivotally mounted on the structure at the top of the doorway and swinging outwardly and upwardly from a position across the doorway to an open position at the top of the same, said door including a reenforcing bar that extends across the same and projects above the door and doorway within the structure, and means engaged with the upper projecting portion of the bar for drawing the same inwardly and downwardly to swing the door outwardly and upwardly as aforesaid.

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