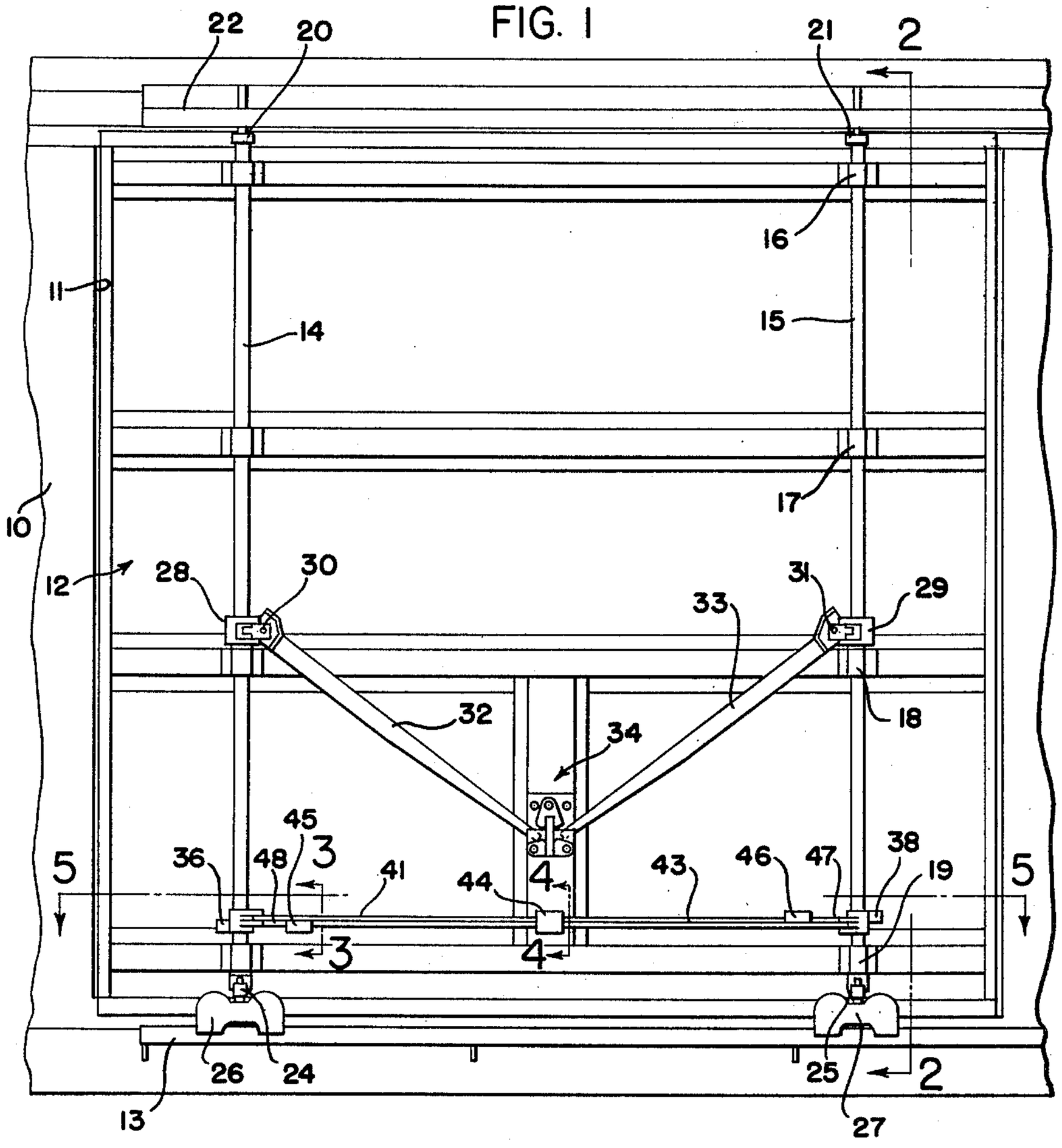
April 27, 1965 T. Z. HERR 3,179,985

SEQUENTIAL AND PROPORTIONAL CONTROL DEVICE

Filed May 31, 1963 4 Sheets-Sheet 1

FIG. 1



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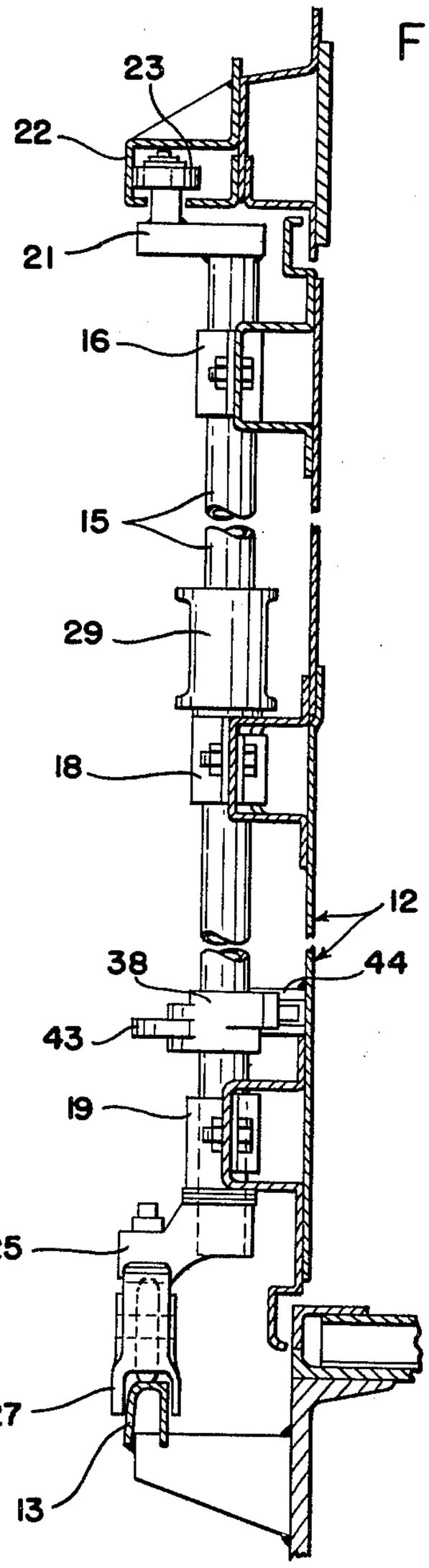
SEQUENTIAL AND PROPORTIONAL CONTROL DEVICE

Filed May 31, 1963 4 Sheets-Sheet 2

FIG. 2



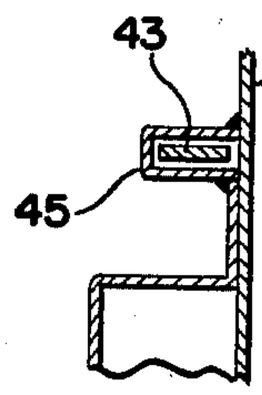


FIG. 3

FIG. 4

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April 27, 1965 T. Z. HERR 3,179,985

SEQUENTIAL AND PROPORTIONAL CONTROL DEVICE

Filed May 31, 1963 4 Sheets-Sheet 3

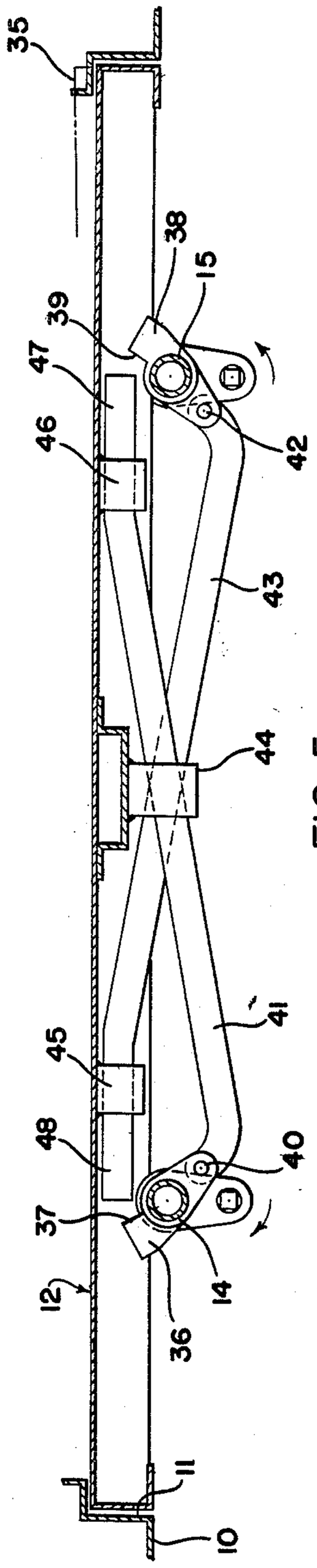

FIG. 5

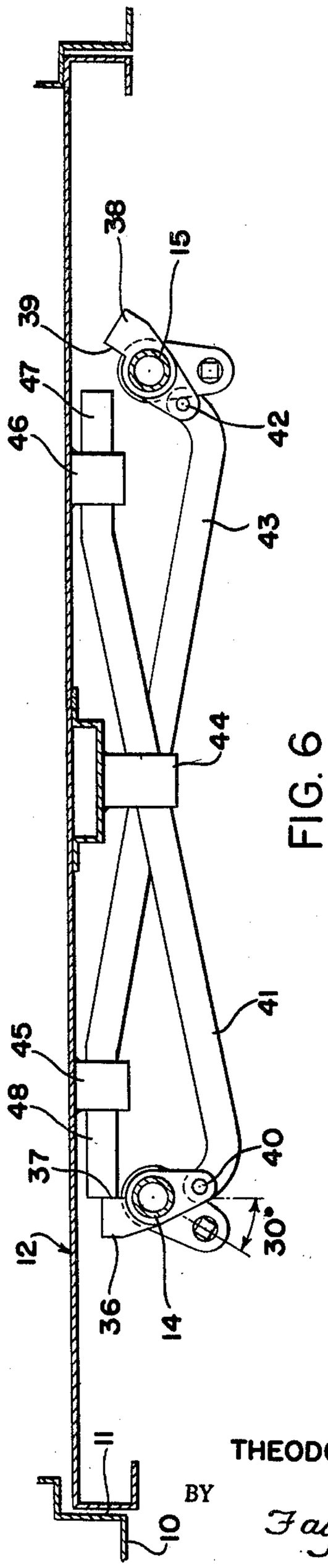

FIG. 6

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April 27, 1965 T. Z. HERR 3,179,985

SEQUENTIAL AND PROPORTIONAL CONTROL DEVICE

Filed May 31, 1963 4 Sheets-Sheet 4

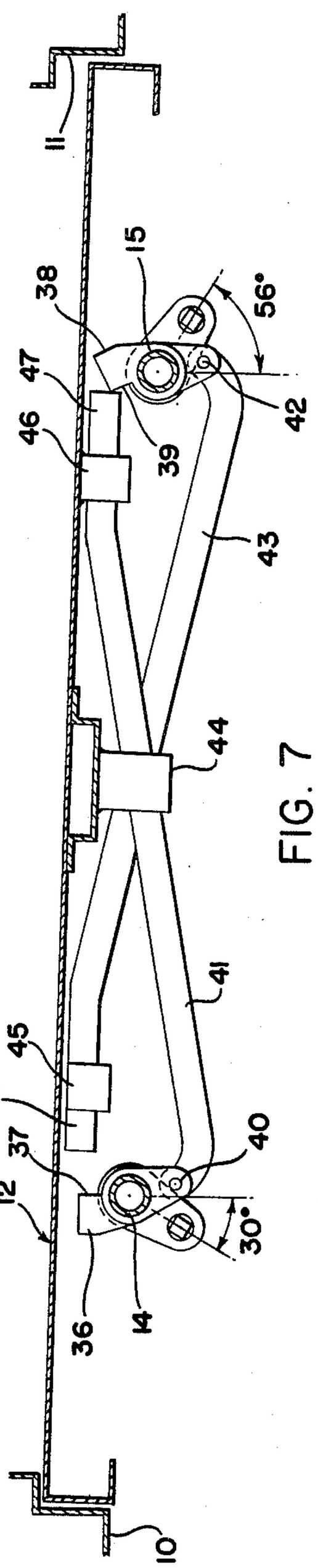

FIG. 7

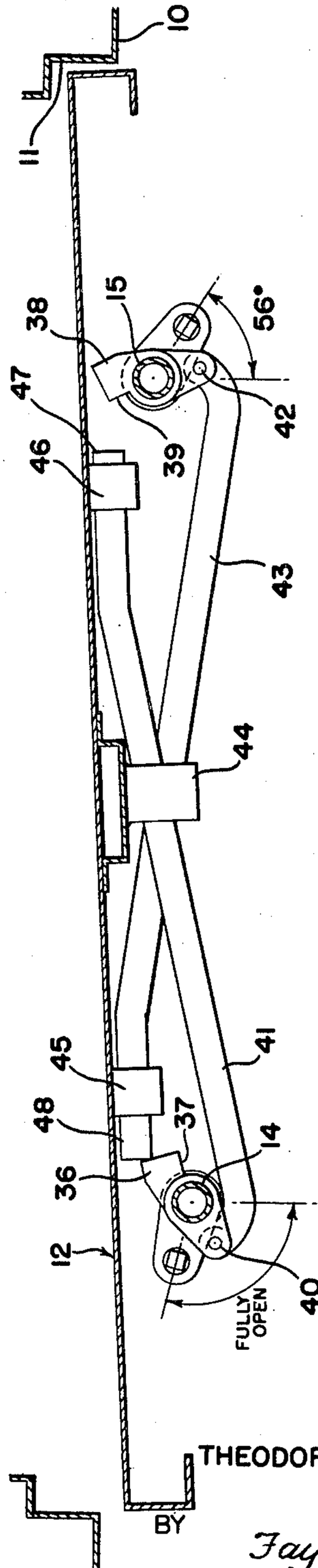

FIG. 8

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United States Patent Office

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SEQUENTIAL AND PROPORTIONAL CONTROL DEVICE

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Filed May 31, 1963, Ser. No. 284,536
8 Claims. (Cl. 20—23)

This invention relates to a device whereby the operating sequence and angular relationship of two or more rotating members may be controlled.

In its broadest aspect, the invention is directed to a mechanism whereby two separately operable rotatable members are interconnected so that the permissible rotation of one of the members is determined by the amount of rotation of the other of the members.

More specifically, the invention relates to a linkage system interconnecting two or more rotatable cranks. The linkage system is such that any one of the cranks may be rotated only a predetermined amount independently of the rotation of the other of the cranks.

In its most specific aspect, the invention relates to a mechanism controlling the opening operation of railroad car doors.

In the field of railroad cars, a well known type of door is the so-called flush or plug door in which the door fits in a rabbeted frame so as to present a surface flush with the external surface of the railroad car. Such doors are designed to be moved outwardly from the side of the railroad car and then moved along a track parallel to the side of the car so as to expose the door opening.

In order to accomplish the lateral movement of the door toward and away from the door opening and to support the door for longitudinal movement along the track, the door is normally provided with a pair of parallel pipes having cranks at each end. To operate the door, the pipes are rotated thereby causing the cranks to displace the door laterally relative to the side of the car. With the door in the closed position, the cranks either may be disposed substantially parallel to the surface of the door or the system may be designed in such a manner that the cranks are normal to the plane of the door.

With either of the above designs, it usually is necessary to operate the two pipes and thereby the cranks somewhat simultaneously. Failure to operate the pipes together will cause either the mechanism to bind or the door to be wedged in the door opening. This is particularly true with the cranks normal to the plane of the door. In such case should one of the pipes be rotated to the exclusion of the other, the door would tend to pivot about the other of the cranks as a fulcrum, causing the mechanism effectively to be wedged in the door opening.

It is an object of this invention to provide a mechanism whereby two separately operable rotatable members are interconnected so that the rotation of one of the members is dependent upon a corresponding rotation of the other of the members.

It is a further object of this invention to provide a control mechanism whereby the operation of one crank in a system having a plurality of cranks is dependent upon the operation of the other of the cranks.

It is a still further object of this invention to provide a control mechanism which provides a sequential control over a plurality of rotatable members.

It is another object of this invention to provide a mechanism which controls the sequential and proportional rotation of a plurality of rotatable members.

It is a more specific object of this invention to provide a device to control the opening movements of a plug type door.

2

It is a still more specific object of this invention to provide a device secured to a plug door on a railroad car with said device interconnecting the usual crank operating mechanism, thereby to control the opening operation of the door.

The control mechanism of the instant invention comprises a pair of rotatable rods mounted on the usual plug door on a railroad car with operating means secured to each of the rods for rotating the same. Extending transversely to the rods but interconnected therewith are interconnecting means which serve to restrain the independent movement of any one of the rods relative to the other of the rods. These interconnecting means consist of a pair of bars with appropriate stop means secured to each of the rotating rods and designed to cooperate with the interconnecting bars so that upon rotation of one of the rods there is a proportional rotation of the interconnecting bar which causes the bar to engage the stop means secured to the other of the rods, and thereby restrain the rotating movement.

To the accomplishment of the foregoing and related ends, said invention then consists of the means hereinafter fully described and particularly pointed out in the claims, the following description setting forth in detail one approved means of carrying out the invention, such disclosed means, however, constituting but one of the various ways in which the principles of the invention may be used.

In the drawings:

FIG. 1 is a front elevation view showing the plug door in the closed position in the railroad car.

FIG. 2 is a side elevation, partly in section, showing the operating mechanism for the plug door taken along line 2—2 of FIG. 1;

FIG. 3 is a view taken along line 3—3 of FIG. 1.

FIG. 4 is a view taken along line 4—4 of FIG. 1.

FIG. 5 is a view taken along line 5—5 of FIG. 1 showing the invention mounted on a plug door with the door in the closed position.

FIG. 6 is a view similar to FIG. 5 showing the mechanism as the opening operation of the door is begun.

FIGS. 7 and 8 are views similar to FIG. 5 further illustrating the opening operation of the door.

Referring now to the drawings which illustrate one preferred embodiment of the invention, the numeral 10 designates one sidewall of a conventional railroad car. A door opening 11 is formed in the sidewall and is adapted to be closed by a laterally moveable door 12. In closed position, the door 12 is seated in the door opening and is flush with the external surface of the sidewall 10.

To move the door laterally out of the door opening 11 for longitudinal movement along the sidewall 10 upon a track 13, there are provided spaced apart parallel vertical pipes or rods 14, 15. The pipes 14, 15 are rotatably secured upon the door 12 by means of brackets 16, 17, 18, 19.

Secured to the upper end of the pipes 14, 15 are cranks 20, 21 respectively. The cranks 20, 21 extend upwardly behind a retainer 22 and are provided with rollers 23 which guide the door in its longitudinal movement and retain the top of the door in the proper position relative to the car.

Secured to the lower end of each of the pipes 14, 15 are cranks 24, 25 respectively. The cranks 24, 25 are journalled in roller hangers 26, 27 mounted upon the track 13 thereby to facilitate sliding movement of the door.

Clevises 28, 29 are secured upon the pipes 14, 15 respectively and adjacent to the bracket 18. Secured by pins 30, 31 to the clevises 28, 29 are operating levers 32, 33. The operating levers 32, 33 are mounted for

vertical swinging movement and, as shown in FIG. 1, are pivoted downwardly to a position where they are retained by a locking mechanism generally indicated by the reference numeral **34**.

It is believed apparent that upon release of the levers **32, 33** from the locking mechanism **34** each lever may be pivoted to a position away from the locking mechanism. Thereupon, each lever **32, 33** may be rotated outwardly away from the door and through the pins **30, 21** and clevises **28, 29** cause rotation of the pipes **14, 15**. As the pipes **14, 15** are rotated, the upper cranks **20, 21** and lower cranks **24, 25** are caused to be rotated. As it is apparent from an inspection of FIG. 1 and FIG. 2, all of the cranks **20, 21, 24, 25** are normal to the plane of the door when the door is in a closed position. Upon rotation of the pipes **14, 15** the cranks are pivoted to a position approximating a parallel relationship with the plane of the door thus causing the door to be displaced laterally outward from the plane of the car's siding. After this has been accomplished, the door is then free to be displaced longitudinally along the track **13** thereby exposing the door opening.

Turning to FIG. 5, there is illustrated the problem which arises with doors of this type. In FIG. 5, there is a schematic diagram of the plug door **12** received in the railroad car **10**. Assuming the door to be in the closed position as illustrated in FIG. 5 with the cranks normal to the plane of the door, should the operator then rotate pipe **14** without a corresponding rotation of pipe **15**, the left end of the door in FIG. 5 would tend to assume the position shown in FIG. 6. The opposite end of the door, however, would tend to assume the position **35** shown in dotted lines in FIG. 5. Such a position obviously is impossible so the result is that the mechanism either binds or the door bends about a plane through the pipe **15**. It is the purpose of this invention to provide a mechanism which limits the operation of one crank independently of the other thereby to prevent binding or bending of the door.

Secured to the pipe **14** for rotation therewith is a stop lever **36** having an abutment surface **37**. A similar stop lever **38** is secured to the pipe **15** and has a stop surface **39**. At the end of the lever **36** opposite to the stop surface **37** there is secured by a pin **40** a rod or bar **41**. Similarly, secured to the end of the lever **38** opposite to the surface **39** by a pin **42** is a rod or bar **43**. The rods **41, 43** are crossed as shown in FIG. 5 and are supported at the point of crossing by a bracket **44** on the frame of the door. Brackets **45, 46** support the free ends **47, 48** of the rods **41, 43**.

The operation of the mechanism shown in FIG. 5 is initiated by manipulation of either of the operating levers **32, 33**. Assuming initial operation of the lever **32** the pipe **14** may be rotated through an angle of approximately 30°. Since the lever **36** is secured to the pipe **14**, it too is rotated through the same angle whereupon the surface **37** abuts the end **48** of the rod **43**. Upon abutment of the lever **36** with the rod **43** the lever **32** cannot be moved further until the lever **33** has been operated. This condition limits the inward movement of the heel of the door and thereby prevents damage to the structure.

Rotation of the operating lever **33** through an angle of approximately 56° causes the surface **39** to abut the end **47** of the rod **41** thereby restraining further operation of the lever **33**. The lever **33** was moved through a greater angle than the initial operation of the lever **32** since operation of the lever **32** retracted the rod **41** from its initial position. In the same manner, operation of the lever **33** retracts the rod **43** to a position where the end **48** of the rod **43** is now spaced from the surface **37** of the lever **36**. With the rod **43** retracted, the operating lever **32** may be rotated to the fully opened position which in turn frees operating lever **33** to complete its rotation. Thereafter, the door is free for longitudinal movement along track **13** to expose the door opening **11**.

With the arrangement as immediately disclosed above, it is apparent that neither of the operating levers may be rotated independently to a full angular displacement, but rather, the angular displacement of any lever depends upon a corresponding rotation of the other lever. This is particularly advantageous where the contents of the railroad car are exerting an outward pressure on the door and tend to wedge or bind the door in the opening unless the opening movements of the cranks are substantially the same. It should be noted, however, that with the door under internal pressure acting outward, this pressure may be utilized to cause the initially operated crank to continue the opening operation without external input to the other of the levers. That is, assuming the door to be in the position shown in FIG. 6 and a pressure exerted on the inner surface of the door, only operating lever **32** would need be operated thereafter. The internal pressure acting against the door would tend to continue the rotation of pipe **14** despite the blocking effect of lever **38**. If the internal pressure is sufficiently great, the force exerted on the door would be transmitted through the lever **36** and rod **43** to cause pipe **15** to be rotated. In this circumstance, only a single input lever would be needed.

It is believed obvious that either of the levers **32, 33** might be used to initiate the opening movements of the door. If for any reason, sequential control is desired so that one of the levers **32, 33** must be actuated first, this could be accomplished merely by making one of the rods **41, 43** longer than the other of the rods in which case the crank associated with the longer rod would have to be operated first. Thus, assuming rod **41** to be of a greater longitudinal extent than rod **43**, any initial attempt to rotate pipe **15** would cause surface **39** on lever **38** to abut the end **47** and restrain further movement. Therefore, with such an arrangement, it would be necessary first to operate pipe **14** which would withdraw end **47** from surface **39** and free the pipe **15** for limited rotation.

The illustrated embodiment is directly applicable to all types of plug doors where operating cranks on the door in the closed position are normal or nearly normal to the door and where improper operation would cause damage without the use of such a mechanism. Although the invention has been illustrated as being secured to the lower ends of the pipes **14, 15** the precise location of the mechanism is not critical and it might be located at any position along the length of the parallel pipes. Nor is this invention limited to railroad car doors, but may be used as a machine element wherever angular relationships or operating sequences in moving elements is required.

It will be apparent that numerous changes and modifications in the invention may be made by those having ordinary skill in the art and therefore the embodiments illustrated are not meant to be restrictive with all modifications and changes apparent to those having skill in the art comprehended within this invention which is to be limited only by the scope of the claims.

I claim:

1. A control for operating elements comprising;
a parallel pair of rotatable rods mounted on a common support;
operating means on each of said rods for rotating the same;
each of said operating means being movable independently of the other;
means associated with said operating means limiting the independent movement of any one of the operating means relative to the other of the operating means to a predetermined range of movement.

2. A control for operating elements comprising;
a plurality of rotatable rods mounted on a common support;
operating means on each of said rods for rotating the same;

each of said operating means being movable independently of the other;
control means operatively associated with said operating means, said control means being operative to limit the independent movement of any one of the operating means relative to the other operating means to a predetermined range of movement.

3. A control for operating elements comprising;
a plurality of rotatable rods mounted on a common support;
operating means secured to each of said rods for rotating the same;
means independent of said operating means interconnecting said rods thereby restraining the independent movement of any one of the rods relative to the other of the rods.

4. In combination;
a railroad car having a door opening;
a door adapted to close the opening in said railroad car;
a plurality of rotatable rods mounted on said door for moving said door out of the door opening;
each of said rods having an operating means for rotating the same;
means operatively associated with said operating means; said latter-mentioned means being operative to limit the independent movement of any one of the operating means relative to the other of the operating means to a predetermined range of movement.

5. A control mechanism comprising;
first and second rotatable members;
operating means secured to each of the members for rotating the same;
a first lever secured intermediate its ends to the first of said members;
a second lever secured intermediate its ends to the second of said members;
one end of each of said levers having an abutment surface;
a first bar secured at one of its ends to the other end of said first lever with the other end of said bar adjacent the abutment surface on said second lever;
a second bar being secured at one of its ends to said second lever and having its other end adjacent to the abutment surface on said first lever;
whereby upon rotation of one of said members relative to the other of said members, the abutment surface on the lever secured thereto will abut the adjacent end of the associated bar thereby limiting the rotation of said one of said members.

6. In combination;
a plug door;
a pair of rotatable rods mounted on said door;
operating means secured to at least one of said rods for rotating the same;
each of said rods having a lever secured intermediate its ends for rotation therewith;
a first bar secured at one of its ends to said lever on one of said rods;
a second bar secured at one of its ends to said lever on the other of said rods;

the free end of each of said bars being operatively associated with an abutment surface on the lever on the opposite one of said rods whereby rotation of one of said rods is restrained by the free end of the bar secured to the other of said rods.

7. A control for operating elements comprising;
first and second rotatable rods mounted on a common support;
operating means secured to at least one of said rods for rotating the same;
stop means secured to each of said rods for rotation therewith;
a first bar secured at one end thereof for rotation with said first rod;
a second bar secured at one end thereof for rotation with said second rod;
the free end of said first bar being operatively associated with said stop means on said second rod and the free end of said second bar being associated with said stop means on said first rod;
whereby rotation imparted by said operating means to said one of said rods causes said stop means secured thereto to abut the free end of the associated bar thereby limiting the permissible independent rotation of said rods.

8. In combination with a door adapted to close an opening in the side of a railroad car comprising;
first and second rotatable rods secured to the door;
crank means at either end of each of said rods with said crank means being adapted to move said door laterally out of the door opening upon rotation of the rods;
operating means secured to each of the rods for rotating the same;
a first lever secured intermediate its ends to the first of said rods;
a second lever secured intermediate its ends to the second of said rods;
one end of each of said levers having an abutment surface;
a first bar secured at one of its ends to the other end of said first lever, with the other end of said bar adjacent the abutment surface on said second lever;
a second bar secured at one of its ends to said second lever and having its other end adjacent to the abutment surface on said first lever whereby upon rotation of one of said rods relative to the other of said rods, the abutment surface on the lever secured thereto will abut the adjacent end of the associated bar thereby limiting the rotation of said one of said rods.

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