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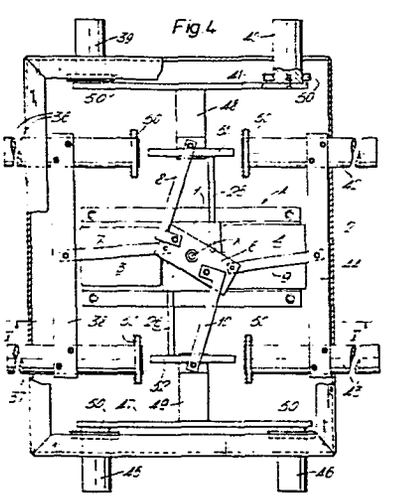
(54) Door-locking mechanisms for security enclosures.

(57) The locking mechanism for the door of a safe or the like has sets of bolts (36, 37) and (42, 43) thrown from the side edges of the door and sets of bolts (39, 40) and (45, 46) thrown from the top and bottom edges. The four bolt sets are thrown and withdrawn together by a central thrower (6) to which they are linked by respective drive rods (7-10). The side bolts are arranged in opposed pairs (36, 42) and (37,43) and the top and bottom bolt structures carry abutment bars (51, 52) which, when thrown, are placed between the inner ends of the side bolts in the opposed pairs so that each side bolt in a pair is effective in resisting forced retraction of the other. Two locks (3,4) are provided to lock up the thrower (6) when thrown and to block the retraction of rods (25, 26) carried together with the top and bottom bolt structures.



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DOOR-LOCKING MECHANISMS FOR SECURITY ENCLOSURES

The present invention relates to locking mechanisms for the doors of safes, vaults, strongrooms and the like security enclosures.

It is customary for the door of a safe or the like enclosure to be locked by means of bolts thrown from the door into engagement with the surrounding frame, for which purpose there may be provided an externally-accessible handle or the like control member which drives the boltwork through a mechanical transmission mounted within the door, the same mechanism, of course, being used to withdraw the bolts when the door is to be opened. This boltwork is in turn locked in its thrown condition by the operation of one or more locks which may, for example, throw bolts into engagement with portions of the main boltwork to resist the subsequent withdrawal of the main bolts. It is usual for the bolts which are thrown from the vertical (side) door edges to be arranged in opposed pairs - that is to say the bolts which are thrown from one

vertical door edge are at similar heights and spacings to the bolts which are thrown from the opposite vertical door edge. It is of course vital to the security of the enclosure that the door bolts have a high degree of resistance to forced retraction, and in one aspect the present invention seeks to provide an improved locking mechanism for a security enclosure door in which bolts thrown from opposite sides of the door are in effect interlocked to provide mutual resistance to forced retraction.

Accordingly the invention resides in a locking mechanism for the door of a security enclosure which includes: boltwork comprising pairs of opposed bolts arranged to be thrown from opposite vertical edges of the door; means for throwing and withdrawing the boltwork; one or more locks for selectively locking the boltwork in its thrown condition; and mechanism arranged to move a respective abutment into place between the inner ends of the two bolts in respective said pairs when thrown, whereby forced retraction of either bolt in a said pair can be resisted bythe engagement of that bolt with the opposed bolt through the respective said abutment.

Preferably the aforesaid abutments are carried by structure which moves together with further bolts which are arranged to be thrown from the top and bottom edges of the door, in so-called four-way boltwork.

It is also of advantage, in maximising the supported length of the vertical-edge bolts and in order to place the abutments closely between them, to stagger the movement the vertical-edge bolts and of the abutments so

that, upon throwing, those bolts commence movement before or at a faster rate than the abutments and, upon withdrawal, the abutments commence movement before or at a faster rate than the bolts.

In a preferred embodiment, where there is a handle or other control member accessible from outside the door and a mechanical transmission for coupling said control member to the boltwork for throwing and withdrawing the same, the mechanism according to the invention also comprises means for selectively disengaging the coupling of said control member to the boltwork when in its thrown condition. By this means, in the event of burglarious attack on the enclosure it is impossible to use the control member to put force on the boltwork or to withdraw the bolts even if the locking action of the lock(s) can be overcome. Preferably such disengaging means are operatively associated with a said lock whereby operation of the lock to lock the boltwork acts also to disengage the coupling of the control member as aforesaid. Alternatively, however, the disengaging means could be embodied eg as an independent key or combination operated mechanism, separate from any such lock, if desired.

It is highly desirable that the bolts which are thrown from the door edges are well supported over an appreciable axial length within the door, in order to resist attempts at twisting the bolts in their mountings, by use of explosives or jacks for example; this is particularly so in the case of bolts thrown from the door edges which are parallel to the hinge line - ie from the vertical (side) door edges. If such support for the bolts is to be achieved it follows that the bolts will occupy at least

a substantial proportion of the width of the door, if not the entire width when withdrawn. With known doors it has proved difficult to provide such bolt support and at the same time accommodate the locks and other necessary components in the available space within the door. In a mechanism according to a preferred feature of the invention, however, a dispostion of parts can readily be achieved such that it is practical to locate both the aforesaid lock(s) and any said disengaging means in a space which lies entirely between the lines of action of successive said pairs of opposed bolts, thus leaving the entire width of the door free for accommodating the bolts if desired.

These and other features of the present invention will now be more particularly described, by way of example, with reference to the accompanying drawings illustrating portions of a preferred embodiment of a safe door equipped with a locking mechanism according to the invention, including also a handle/bolt isolating mechanism, in which:

Figure 1 is a section, taken on the line I-I of Figure 2, through the locks and handle/boltwork-isolating mechanism of the safe;

Figure 2 is a section taken on the line II-II of Figure 1;

Figure 3 is an elevation, partly in section, of the boltwork incorporated in the safe, shown in its withdrawn condition;

Figure 4 is a view similar to Figure 3 but showing the boltwork in its thrown condition; and

Figure 5 is a section on the line V-V of Figure 4.

Referring to Figures 1 and 2, the illustrated locking and isolating unit A includes a mounting block 1 which is secured within a steel pan 2 on the inside face of the safe door. Two locks 3 and 4 are mounted to the block 1, in the illustrated example lock 3 being a combination lock and lock 4 being a keylock, although other permutations of lock type are possible. The boltwork of the door is operated by turning an external handle (not shown) mounted on the end of a shaft 5, it being necessary to establish a driving connection between the shaft 5 and a coaxial thrower 6 borne by the block 1 if the turning of the handle is to be effective to throw or withdraw the boltwork. Movement of the thrower 6 is transmitted to the boltwork through four drive rods 7-10 pinned to the thrower (of which three are seen in Figure 1), as will be more fully described hereafter.

As will be seen from Figures 1 and 2, the thrower 6 has a longitudinal slot 11 within which is borne a drive element 12 of rectangular cross-section. This drive element is capable of axial movement relative to the thrower within limits set by a cross-pin 13 held by the thrower and extending through a slot 14 in the element 12. The drive element is biased towards one of its limiting positions by means of a compression spring 15 captive in the thrower, and when the element 12 is free to move under the bias of the spring it can project from the thrower to engage in a rectangular recess 16 in the adjacent end of the shaft 5;

(in Figure 1 the shaft 5 is shown rotated through 90° from the position in which it can engage with the element 12). When these components are engaged rotation of the shaft is transmitted into rotation of the thrower for throwing or withdrawing the boltwork as appropriate.

Normally, however, when the safe door is closed and locked, the drive element 12 is maintained in the position in which it is shown in Figure 1, ie out of engagement with the shaft 5 which latter can accordingly turn without putting any force on the boltwork. This disengagement is achieved by operation of the locks 3 and 4.

To this end, each lock has a bolt 17,18 with a tapaered nose which, when the bolt is thrown, extends through the block 2 and into a respective radial aperture 19,20 in the thrower 6, where the nose engages a respective inclined surface 21,22 on the drive element 12 to withdraw that element from the shaft 5 by a camming action, against the bias of the spring 15. As will be appreciated, throwing either of the lock bolts 17 or 18 will achieve this disengagement, although in point of fact the inclined surface 21 of the element 12 which cooperates with the combination lock bolt 17 is undercut slightly as compared with the other inclined surface 22, so that when both lock bolts have been thrown the force of the spring 15 is met by the keylock bolt 18 only and the combination lock bolt 17 is not loaded. By their entry into the apertures 19 and 20 the bolts 17 and 18 also, of course, interlock the thrower 6 to resist any subsequent attempt at forced retraction of the boltwork. Furthermore, the lock bolts have lateral extensions 23,24 which in this position block withdrawing movement of rods 25 and 26 carried with the

top and bottom boltstraps of the main boltwork, as will be more fully described hereafter. Arranging the locks as shown in the Figures, with their bolts facing each other across the thrower, assists not only in the provision of a very compact unit but also in resisting attempts to overcome the locking mechanism by knocking in the lock bolts.

In the illustrated embodiment there is also a mechanism, operated by the combination lock 3, for blocking access to the keyhole 27 of the keylock 4 in all conditions except when the combination lock is released. This mechanism comprises a plate 28 which can be slid relative to the keylock between two positions, in one of which an aperture 29 in the plate (Figure 2) registers with the keyhole 27 to provide access for the key and in the other of which (as illustrated) the aperture 29 is withdrawn from registry with the keyhole. The plate 28 is connected via a toggle lever 30 and slide 31 to a bar 32 which moves together wth the bolt assembly of the combination lock 3 to effect the required movement of the plate. It is also preferred to block the whole of the key-entrance 33 (Figure 1) which extends through the safe door, whenever the door is closed and locked. To this end, after the keylock 4 has been thrown and the key removed, but before the combination lock is thrown, a profiled steel section (not shown) is inserted into the entrance 33 and through the plate aperture 29 into the keyhole, and the combination lock 5 is then thrown to slide the plate 28 so that a narrow extension 34 of theplate aperture 29 moves over a waisted portion at the end of the steel section to retain it in place.

It will also be seen from Figure 2 that the thrower 6 has a third radial aperture 35. The purpose of this is to enable the keylock 4 to be re-thrown after the main boltwork has been withdrawn and the door has been opened, in withrdawing the main boltwork the thrower 6 having been rotated into the position in which the aperture 35 aligns with the lock bolt 18. This is of value both in enabling the key to be removed from the lock 4 (if the lock is of a key-retaining kind) and in re-locking the thrower to prevent tampering with the throwing mechanism. The presence of the rod 25, which in this condition will have been withrdawn with the main boltwork to extend through the whole of its guideway in theblock 1, does not block this re-throwing of the keylock as the rod 25 is provided with an appropriately positioned notch (not shown) which permits the bolt extension 24 to pass. Throwing of the combination lock 3 is, however, precluded in this condition as there is no corresponding additional aperture for the bolt 17 in the thrower 6.

Turning now to Figures 3 and 4, these show the general arrangement of the boltwork within the door. This is a four-way boltwork comprising a pair of bolts 36 and 37 interconnected by a strap 38, thrown from the hinge side of the door; a pair of bolts 39 and 40 interconnected by a strap 41, thrown from the top of the door; a pair of bolts 42 and 43 interconnected by a strap 44, thrown from the opening side of the door; and a pair of bolts 45 and 46 interconnected by a strap 47, thrown from the bottom of the door. The side bolt straps 38 and 44 are linked to the thrower 6 by respective pinned drive rods 7 and 9, and thetop and bottom boltstraps 41 and 47 are secured to bars 48 and 49 which in turn are linked to the thrower 6 by

respective pinned drive rods 8 and 10. Each one of the bolts is journalled at two positions along its length, one position provided by the side wall of the pan 2 and the other by a respective bearing block 50 welded to the face of the pan.

The hinge-side and opening-side bolts are arranged in opposed pairs 36, 42 and 37, 43 and it will be seen from Figure 3 that in the withdrawn condition these bolt pairs extend across virtually the entire width of the door. It will be appreciated from Figures 3 and 4, together with Figure 5, that this is made possible by mounting the locking and isolating unit A completely within the space between the lines of action of the successive vertically-spaced bolt pairs 36/42 and 37/43. Movement of the bolts from the Figure 3 to Figure 4 position is achieved by appropriate rotation (in the clockwise sense as viewed) of the thrower 6, and it will be further appreciated from Figure 4 that the arrangement maximises the length over which the side bolts 36,37,42 and 43 are supported within the door and at the same time permits the bolts to be thrown through a relatively long distance. Typically with the illustrated arrangement the hinge-side, top and bottom bolts are thrown a distance of 50mm while the opening-side bolts 42 and 43 opposite the hinge line are thrown through 80mm, the increased throw for the latter being achieved by linking the drive rod 9 to the thrower 6 at a greater radius from the axis of rotation X of the thrower than the other drive rods 7,8 and 10.

As previously indicated, when the boltwork is thrown and the locks 3 and 4 operated, the external handle is disengaged from the thrower and forced retraction of the

boltwork is resisted by the lock bolts engaging the thrower 6. Retraction of the top and bottom bolts 39,40 45 and 46 will also be resisted by the lock bolts blocking the paths of movement of rods 25 and 26 carried with the boltstraps 41 and 47 and extending into the central section of the mounting block 1. In addition, forced retraction of the side bolts will be resisted by the positioning of respective abutment bars 51 and 52, which are carried by the bars 48,49 together with the top and bottom boltstraps 41,47, between the inner ends of the bolts in each opposed pair 36/42 and 37/43. For example, if an attempt were made to knock the bolt 42 inwards when thrown it would engage the bar 51 and eventually through it the bolt 36 which latter is received in a detention in the opposite side of the door frame. The bolt 36 therefore is prevented from being knocked further outwards from the door and thus prevents the bolt 42 from being knocked inwards sufficiently far to disengage from its own detention; in effect, the bolts react against each other to resist retraction of either one.

In order to permit the bars 51 and 52 to be placed closely between the side bolts without fouling the bolts in their movement the relative angular positions at which the drive rods 7-10 are linked to the thrower 6 are so selected that during the initial stage of throwing movement the boltstraps 38 and 44 move at a higher linear rate than the boltstraps 41 and 47 to make way for the bars 51 and 52, and conversely during the initial stage of withdrawing movement of the boltstraps 41 and 47 move at a higher linear rate than do the straps 38 and 44.

Although described and illustrated in terms of its application to boltwork having only two bolts thrown from each vertical door edge, this locking mechanism can readily be adapted for doors of sizes and proportions which require a greater number of vertical-edge bolts. In such a case the boltstraps 38 and 44 are extended in length (upwards and/or downwards relative to the position of the locking/isolating unit A) to carry the required number of bolts, and the bars 48,49 are correspondingly extended between their points of connection to the drive rods 8,10 and boltstraps 41,47, to carry the requisite number of abutment bars 51,52 for each opposed pair of side bolts.

CLAIMS

1. A locking mechanism for the door of a security enclosure which includes: boltwork comprising pairs of bolts (36/42,37/43) arranged to be thrown from opposite vertical edges of the door; means (5,12,6,7-10) for throwing and withdrawing the boltwork; one or more locks (3,4) for selectively locking the boltwork in its thrown condition; characterised by mechanism (8,48,10,49) arranged to move a respective abutment (51,52) into place between the inner ends of the two bolts (36/42, 37/43) in respective said pairs when thrown, whereby forced retraction of either bolt in a said pair can be resisted by the engagement of that bolt with the opposed bolt through the respective said abutment.

2. A locking mechanism according to claim 1 characterised in that the boltwork further comprises bolts (39,40,45,46) arranged to be thrown from the top and bottom edges of the door and said abutments (51,52) are carried by structure (48,49) which moves together with such further bolts when thrown and withdrawn.

3. A locking mechanism according to claim 1 or claim 2 characterised in that the movement of said vertical-edge bolts (36/42, 37/43) and of said abutments (51,52) is staggered such that, upon throwing, the vertical-edge bolts commence movement before or at a faster rate than the abutments and, upon withdrawal, the abutments commence movement before or at a faster rate than the vertical-edge bolts.

4. A locking mechanism according to any preceding claim characterised in that the bolts (42,43) which are arranged to be thrown from the vertical edge of the door

remote from the hinge line are thrown through a greater distance than the bolts (36,37,39,40,45,46) which are arranged to be thrown from any other door edge.

5. A locking mechanism according to any preceding claim characterised in that said throwing and withdrawing means comprise a thrower (6) rotatable in either sense, which thrower is connected by radiating drive rods (7-10) to respective structures (38,44) interconnecting the bolts (36,37,42,43) arranged to be thrown from respective vertical edges of the door and to respective structures (48,49) carrying the said abutments (51,52).

6. A locking mechanism according to claim 5 characterised in that a said lock (3,4) has a bolt (17,18) engageable with said thrower (6) for locking the boltwork in its thrown condition.

7. A locking mechanism according to any preceding claim characterised in that there are carried with said abutments (51,52) rods (25,26) which translate as the abutments are thrown and withdrawn, and one or more said locks (3,4) have bolts (17,18) which block forced retraction of said rods when thrown.

8. A locking member according to any preceding claim comprising a control member accessible from outside the door and a mechanical transmission (5,12,6,7-10) for coupling said control member to the boltwork for throwing and withdrawing the same; characterised by means (17,18) for selectively disengaging the coupling of said control member to the boltwork when in its thrown condition.

9. A locking mechanism according to claim 8 characterised in that said disengaging means (17,18) are operatively associated with a said lock (3,4), whereby operation of the lock to lock the boltwork acts also to disengage the coupling of said control member as aforesaid.

10. A locking mechanism according to any preceding claim characterised in thatthe or each said lock (3,4) and any said disengaging means (17,18) are located in a space which lies entirely between the lines of action of successive said pairs of opposed bolts (36/42, 37/43).

11. A locking mechanism according to any preceding claim characterised in that the bolts (36/42, 37/43) in respective said pairs are of such length that when withdrawn they collectively occupy substantially the entire width of the door.

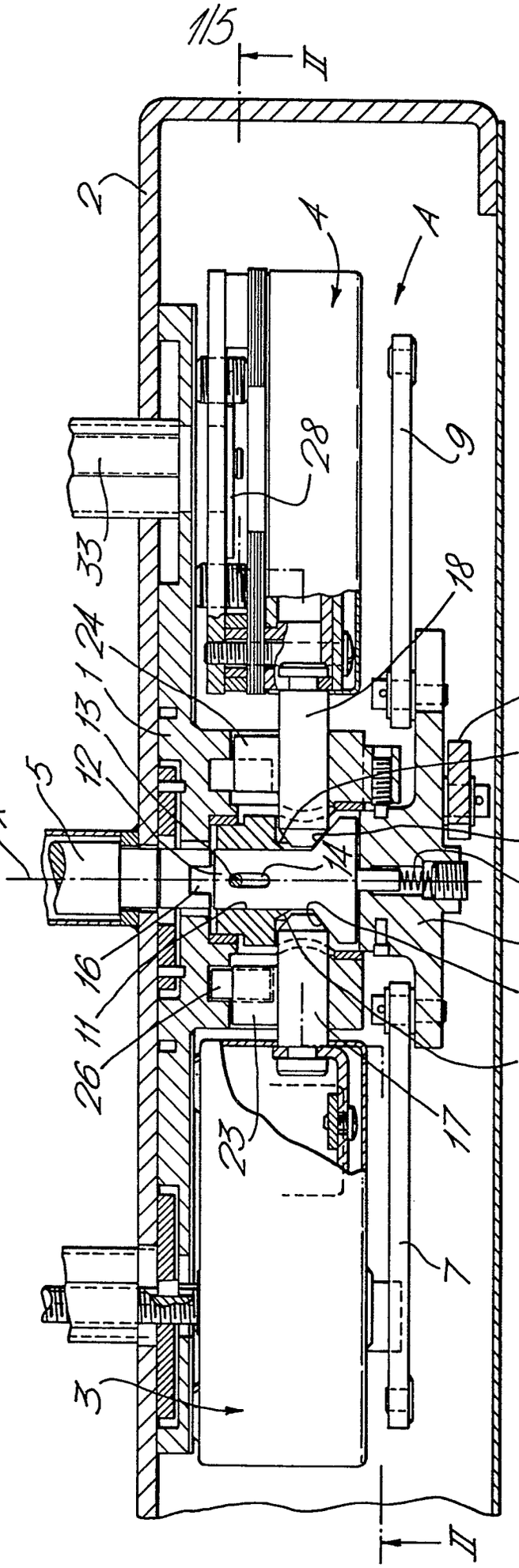
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Fig.1.

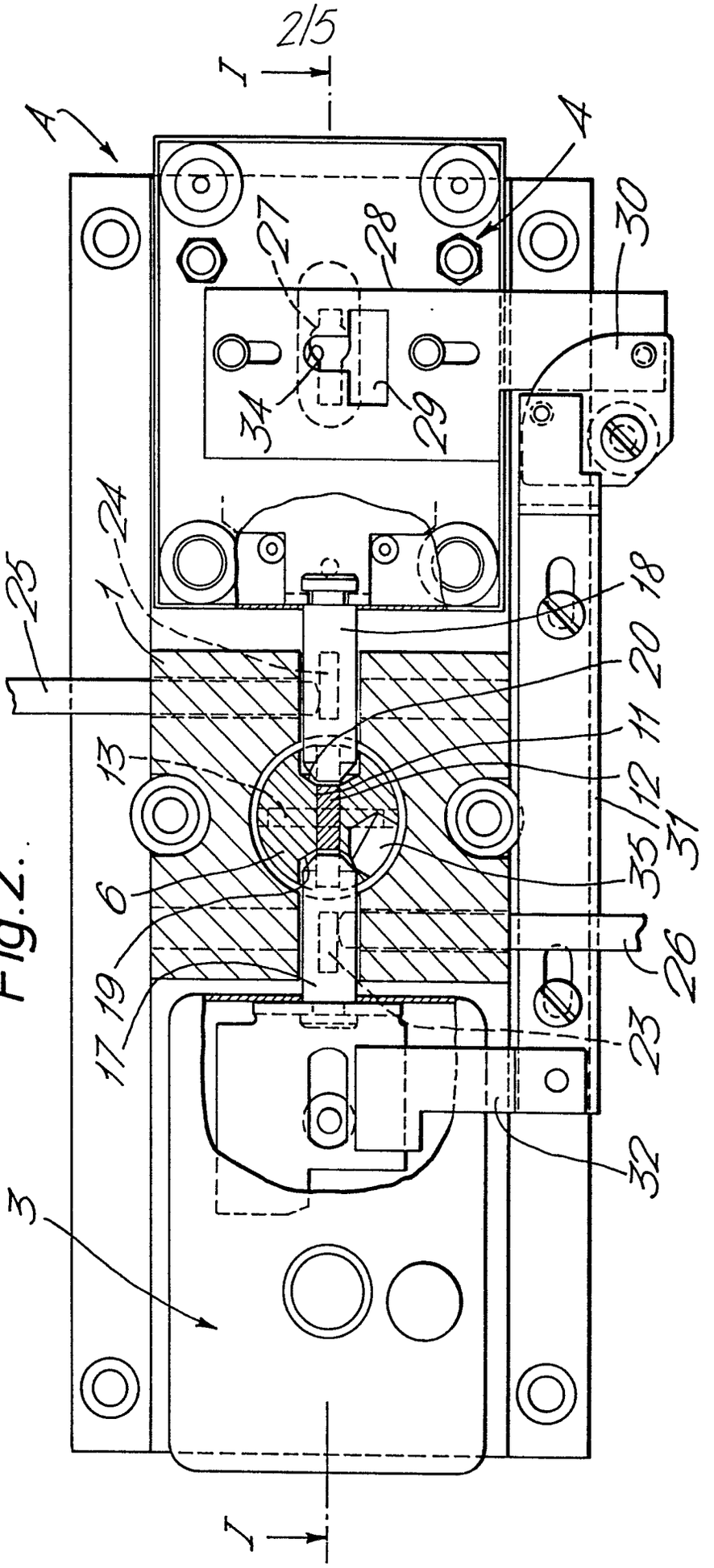

Fig.2.

Fig.3.

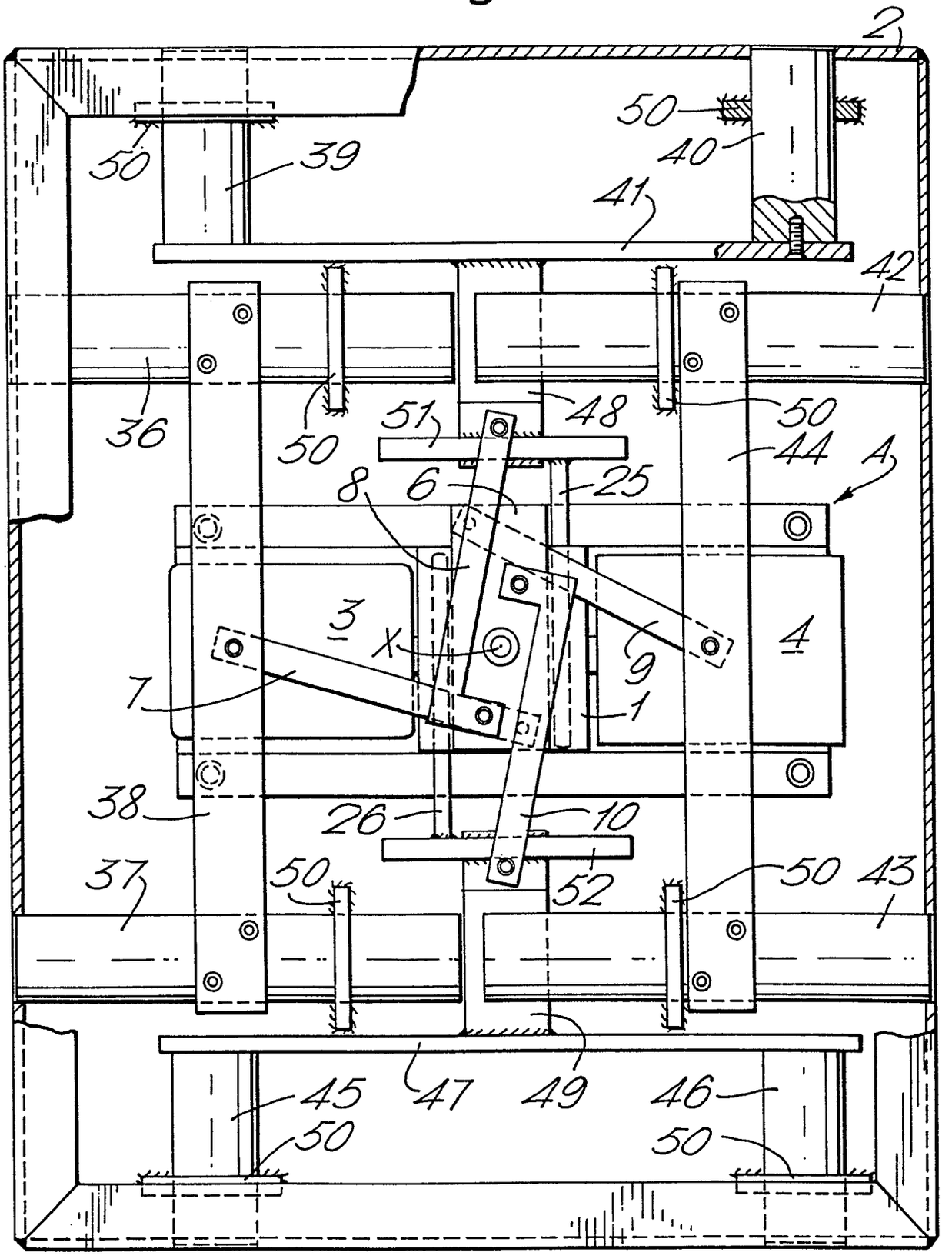
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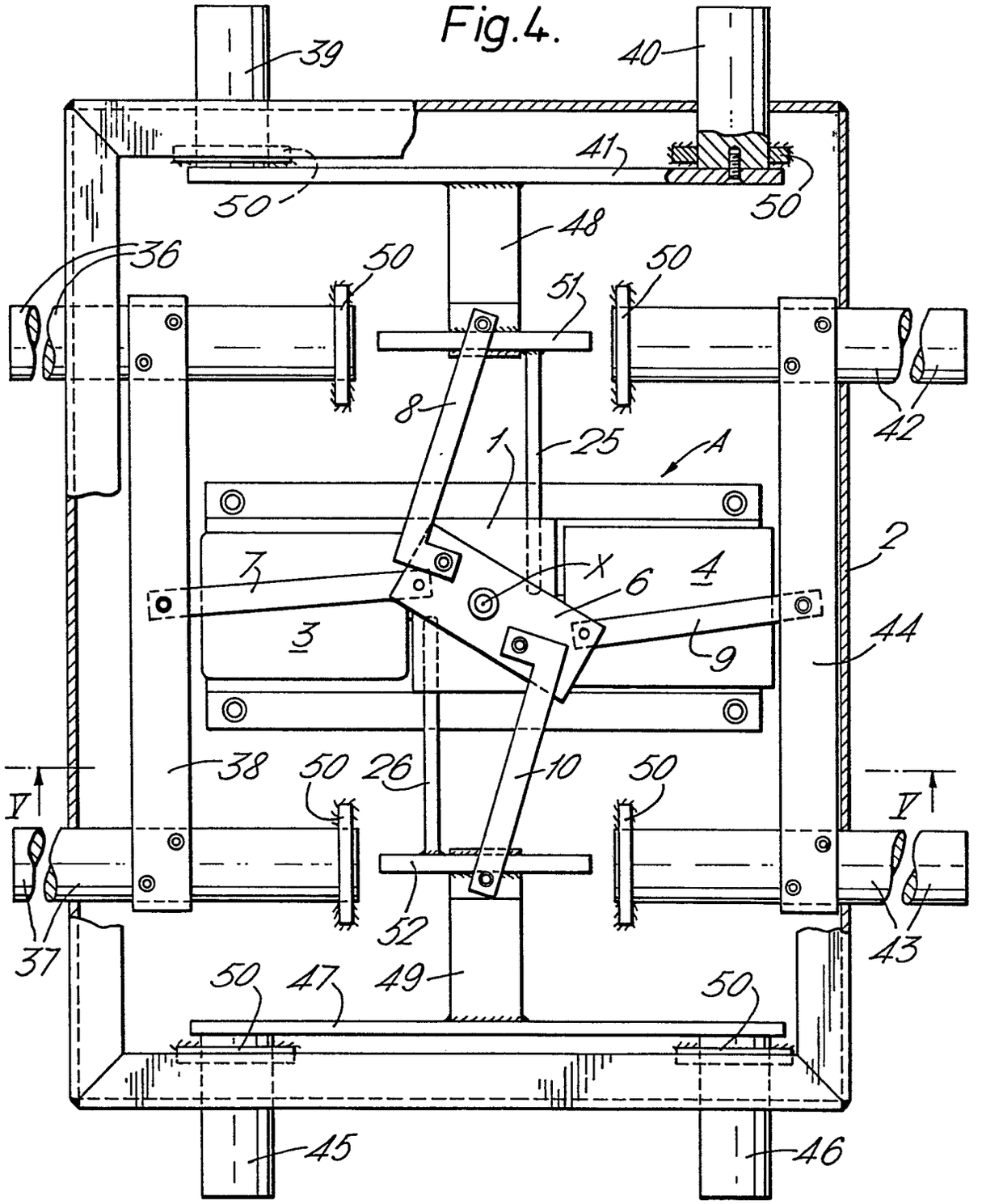
Fig.4.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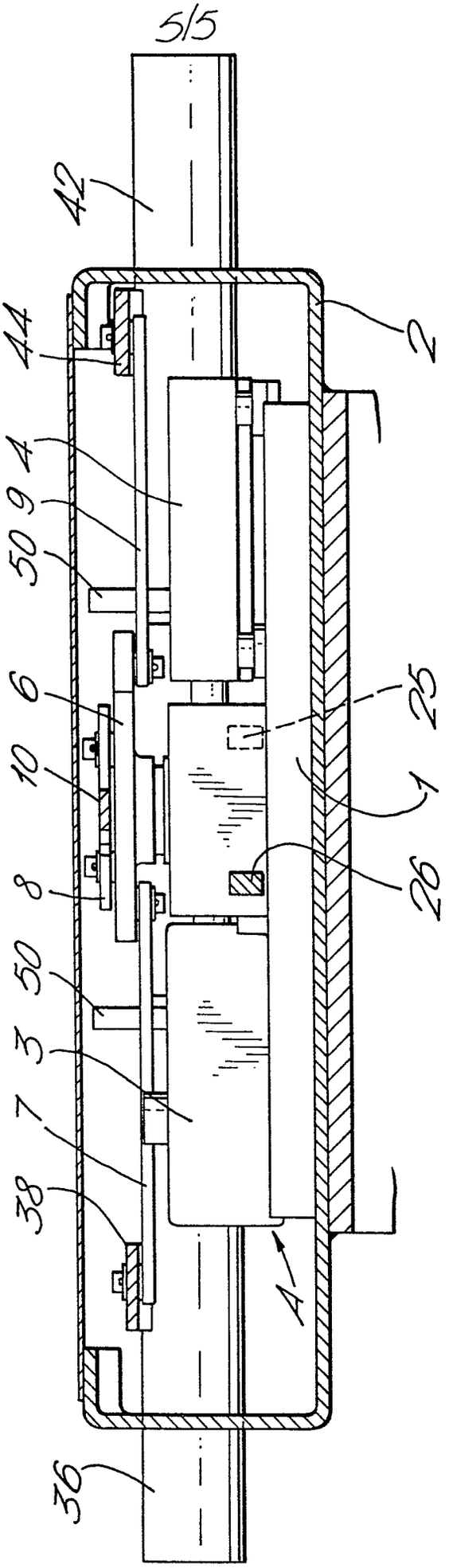

Fig.5.