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(54) Die cutters.

(57) A die cutting press and a method of die cutting include two opposing and oppositely driven clamping bars (22,24) which move together to clamp the die board (14) and accurately position the clamped die board (14) at a predetermined location within the press. The press is operated to determine the adequacy of the cut produced by the die (15) in sheet material fed into the press. If the cut is unsatisfactory, the opposing clamp bars (22,24) are quickly driven apart thereby releasing the die board (14). The die board (14) can be removed from the press and then manipulated or modified to cure any imperfection in the cut. The modified die board (14) is then reinserted into the press and accurately repositioned at the predetermined location within the press by driving the opposing clamping bars (22,24) towards each other against the die board (14). The drive mechanism (21,23) of the clamping bars (22,24) ensures that when the die board (14) is securely clamped, the die board (14) will always be accurately repositioned in the same press at exactly the location assumed by the die board (14) when it was inserted. The opposing moving clamps (22,24) automatically move the die board (14) to the predetermined position without the need for measurement, registration or concern for variations in tolerances within a jig.

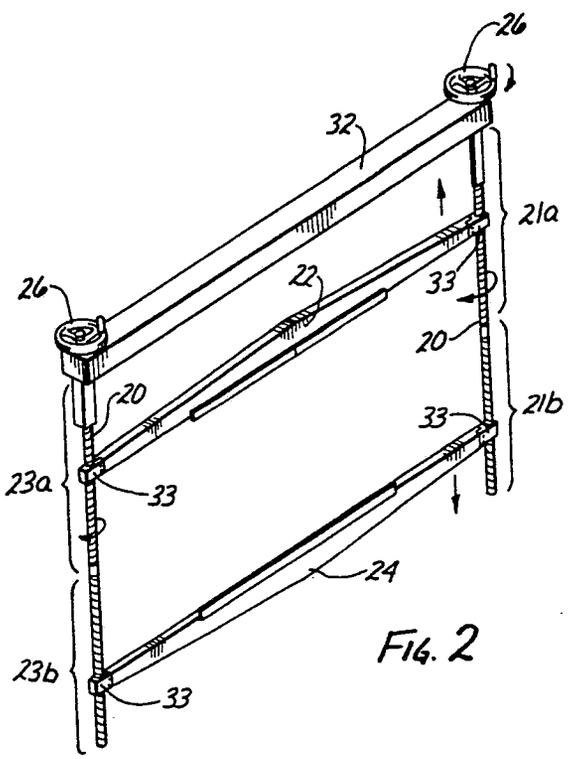

FIG. 2

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DIE CUTTERS

The invention relates to an apparatus and method for die cutting in a press and in particular to die cutting cardboard in a clam shell press.

Containers and cartons are manufactured by die cutting, sometimes with intricate shapes. In the basic die-cutting process sharp metal edges in the form of a die are brought with pressure against a cardboard surface to cut through the cardboard and are then retracted. When cutting complex shapes in corrugated cardboard, a substantial amount of pressure must be brought on the die to cut through the cardboard and the knife edge of the die must be forced into the cardboard, which in turn is forced with extreme accuracy through the cardboard against a solid backing plate, typically within a few thousandths of an inch.

As the knives of the die wear or when the die is originally made ready, a displacement of the knife edges even by a few thousandths of an inch causes the cut through the cardboard to be unclean and the product becomes unusable. A "make ready" process must be performed wherein portions of the die knife edges are shimmed by layers of adhesive tape. Cardboard tape of a few thousandths of an inch or metal shims ranging from one to ten thousandths of an inch are placed between selected portions of the die's rear edge and the surface of the press and are used to cleanly force the die into the cardboard. The make-ready process must be practiced to both to set up the die when first cutting and to adjust the die as it wears during a cutting project. If the make ready process is not at first successful, the die must be removed from the press readjusted and again tested until satisfactorily adjusted. This is a process which can be time consuming even for a skilled press operator.

A method and apparatus are needed whereby this make-ready process can be simplified.

The invention is an improvement in a die cutting press for cutting sheet material comprising a die for cutting the sheet material. A first mechanism provides support for the die. A second mechanism is adapted for pressing the sheet material against the die. The sheet material is cut by the die. A clamping mechanism temporarily fixes the die supported by the first mechanism. The clamping mechanism is operable to selectively and quickly release and clamp the die to allow removal, manipulation and insertion of the die onto the first mechanism.

As a result, the die may be readily manipulated to perfect cutting of the sheet by the die.

In the first embodiment the clamping mechanism is comprised of a first and second clamping bar and a motive mechanism for simultaneously displacing the first and second bars in opposing directions to selectively bring the first and second bars together or to draw the first and second bars apart.

The first and second bars each comprise generally straight cross bars and the first mechanism for providing support for the die is a generally flat surface. The first and second cross bars are displaced by the motive mechanism across the flat surface of the first mechanism.

In the second embodiment the first and second bar are at least partial rings and the first mechanism is a cylinder. The first and second rings are displaced by the motive mechanism along the axial length of the cylinder.

In the first embodiment the motive mechanism comprises a first and second drive screw. The first and second drive screws are threaded to opposing first and second ends of the first and second cross bars. The drive screw has two threaded portions. The threaded portions of each drive screw have an opposite screw direction so that rotation of the drive screw displaces the cross bars in opposing directions.

The motive mechanism further comprises a connection mechanism for connecting the first and second drive screws so that rotation of one drive screw causes rotation of the other drive screw.

In the first embodiment the connection mechanism comprises a sprocket affixed to each drive screw and a chain engaging each sprocket of each drive screw and disposed therebetween so that rotation of one drive screw rotates its corresponding sprocket, displaces the chain and rotates the other sprocket to rotate the other drive screw.

In the first embodiment the press is a clam shell press; the first mechanism for providing support to the die comprises a stationary frame; and the second mechanism adapted for pressing a sheet against the die comprises a movable bridge. The bridge is adapted for pressing against the frame. The first and second cross bars and motive mechanism for displacing the cross bars are coupled to the frame.

In the second embodiment the press is a rotary press. The first mechanism for providing support to the die is a cylinder. The rings is disposed on the cylinder and displaced by the motive mechanism along the axis of the cylinder. The second mechanism adapted for pressing the sheet against the die is a pressure cylinder characterized by a conformable portion of its surface. The portion is selectively brought into contact with the sheet when the sheet is disposed in contact with the die.

The invention is also a method for adjusting a die within a press for cutting a sheet by the die comprising the steps of disposing the die in the press, and positioning the die in the press by simultaneous movement of two opposing clamping mechanism cutting the sheet by the die.

As a result, the die is quickly and easily adjusted at the predetermined position within the press.

The method further comprises the steps of examining the cut sheet for a satisfactory cut, and releasing the die from the press by moving the two opposing clamping mechanism away from each other. The die is adjusted to improve the cut provided by the die in the sheet. The die is repositioned into the press by simultaneous opposing movement of the two opposing clamping mechanism against the die. The die is accurately repositioned at the predetermined position.

The step of positioning the die accurately at the predetermined position comprises the steps of simultaneously driving two straight cross bars toward each other with the die disposed between the cross bars and clamped therebetween thereby limiting further movement of the cross bars and thereby accurately positioning the die in the predetermined position.

In a second embodiment of the method the step of accurately positioning the die at the predetermined position comprises the steps of simultaneously displacing two rings along the length of a cylindrical press member. The die is disposed between the two rings and is securely clamped by the two rings when the die is accurately positioned at the predetermined position.

In the first embodiment the step of releasing comprises the steps of simultaneously driving two straight cross bars away from each other and the step of repositioning comprises simultaneously driving again the two straight cross bars toward each other and limiting further movement of the cross bars thereby accurately positioning the die in the predetermined position.

In the second embodiment the step of releasing comprises the step of simultaneously displacing two rings along the length of a cylindrical press member away from each other, and the step of repositioning comprises the step of simultaneously again displacing two rings along the length of a cylindrical press member toward each other. The die is disposed between the two rings and is securely clamped by the two rings when the die is accurately positioned at the predetermined position.

The invention is still further characterized as an improvement in a clam shell press having a stationary frame for supporting a die member at a predetermined position and a movable bridge for pressing sheet material against the die member causing the die member to cut into the sheet material. The improvement comprises a clamping mechanism for selectively and securely, but temporarily, accurately fixing the die at a predetermined position within the press. A motive mechanism is selectively operates the clamping mechanism to clamp die at the predetermined position or to release the die from the press.

As a result, the die may be repeatedly fixed and removed from the press for adjustment, refixed, tested and readjusted until a satisfactory cut of the sheet is obtained.

The invention and its various embodiments can best be visualized by now turning to the following drawings.

Figure 1 is a front perspective view of an open clam shell press depicting the overall structure of the improvement to the press.

Figure 2 is a perspective view of the screw driven clamping mechanism installed in the clam shell press as shown in Figure 1.

Figure 3 is an enlarged partially cutaway view of the driving mechanism of the drive screw of the mechanism illustrated in Figure 2.

Figure 4 is a side diagrammatic view of a second embodiment of the invention incorporated in a rotary press.

Figure 5 is a perspective view of the embodiment of Figure 4.

The invention and its various embodiments may be better understood by now turning to the following detailed description.

An improvement is made to a die cutting press and to the method of die cutting in a press by providing two opposing and oppositely driven clamping bars which move together to clamp the die board and to accurately position the clamped die board at a predetermined location within the press. The press is operated to determine the adequacy of the cut produced by the die in sheet material fed into the press. If the cut is unsatisfactory, the opposing clamp bars are quickly driven apart thereby releasing the die board. The die board can be removed from the press and then manipulated or modified to cure any imperfection in the cut. The modified die board is then reinserted into the press and accurately repositioned at the predetermined location within the press by driving the opposing clamping bars towards each other against the die board. The drive mechanism of the clamping bars insures that when the die board is securely clamped, the die board will always be accurately repositioned in the same press at exactly the location assumed by the die board when it was inserted. The opposing moving clamps automatically move the die board to the predetermined position without the need for measurement, reg-

istration or concern for variations in tolerances within a jig.

Turn now to the perspective view of Figure 1 which shows the invention in a first embodiment incorporated within a clam shell die press. A first rigid metal bridge 10 is provided with a facing metal plate 12 which is about one eighth of an inch thick. Bridge 10 may be one or two inches thick. The die board 14 is bolted to a frame 16 which is a similar rigid metal plate of one or two inches in thickness. A cardboard sheet 18, which is to be cut, is placed between bridge 10 and frame 16 and then bridge 10 is driven upward against frame 16 by the mechanism of the press (not shown) to cut the die pattern of die 15 through cardboard 18.

However, the upper cutting edges of die 15 is almost never perfectly leveled and must be adjusted by shims. The shimming process is a process reminiscent of the princess and pea under the mattress, the smallest adjustment or misadjustment can often be noticed. A thin piece of cardboard or shim is placed between these plates 10 and 12 underneath that portion of plate 12 which will be proximate to or adjacent to a selected knife-edge portion of die 15. If the shim is in the correct position and has the correct thickness, the cutting action of the die into cardboard sheet 18 will be appropriately adjusted, leaving a clean cut.

Die-cut patterns are sometimes exceedingly intricate, e.g., when they include cut-outs, perforations and curvilinear edges. The position of the shim between facing plate 12 and bridge 10 must be measured or positioned rather painstakingly in order to place it under the appropriate portion knife-edge of die 15 which is bolted to frame 16 when the press closes.

When die board 14 is removed from the press after a portion of the job is run and then reinserted to finish the job, it must be repositioned on frame 16 and the position of shims underneath plate 12 remeasured with respect to the assumed, predetermined position of die 15 on frame 16. Die board 14 once attached then detached and reattached almost never ends up exactly in its original position with respect to shims which have been removed along with die board 14 in any case. The normal tolerances in the threading or bolt which attaches die board 14 to frame 16 are typically sufficient to render any prior adjustment suspect or even useless.

Even skilled operators require five to fifteen minutes depending upon the complexity of the die and the problems encountered in order to "make-ready" a die for cutting. Sometimes plate 12 must be removed and shims readjusted four to five times before the make-ready procedure is successfully completed. At least five minutes are required in order to make these adjustments.

The improvement of the invention is shown in the perspective view of Figure 1 as installed on the press and in isolation in the perspective view of Figure 2. Threaded rods 20 are provided on each side of frame 16 with rigid cross beams 22 and 24 driven by rods 20 toward and away from a predetermined position on frame 16, usually the center of frame 16. A hand wheel 26 is used to rotate the right rod as seen in the Figures. The left rod 20 may also be provided with a handwheel and it must understood that nonmanual automated means of any type may be substituted for the hand wheel if desired. The right rod 20 as seen in Figure 2 is connected through a sprocket 28 and chain 30 to a matching sprocket used to turn the left rod 20. Thus, cross bars 22 and 24 are either simultaneously both moved away from the predetermined fixation point of die board 14 in frame 16 or towards the predetermined fixation point. In the illustrated embodiment, the predetermined fixation point is at or near the center of the press or at least frame 16 since clamshell presses usually apply the most even pressure over die 15 if die board 14 is placed in the center of the press.

When the clamshell press is used with this method and apparatus, die board 14 can be removed or inserted within frame 16 in three seconds or or less and a shim placed behind die board 14 between the die and frame 16. This has the same effect as shims laid underneath plate 12 and will raise any selected portion of the die knife edge. A pressing can be made and the cut cardboard examined to determine whether other adjustments are needed. Three seconds are required to release the die, and the shims are applied directly to the back of the die according to the cut pattern in the cardboard.

The method works quite well and allows very small runs, as small as few hundred cartons, to be die-cut in a profitable manner which was not previously possible when die adjustments had to be handled as described in connection with Figure 1.

Sprockets 28 and chain drive 30 are concealed from view in Figures 1 and 2 by means of casing 32 disposed horizontally across the top of frame 16. As shown in Figure 3, the drive screw is journalled in casing 32 and fixed to sprocket 28. Rotation of hand wheel 26 rotates sprocket 28 and displaces chain 30, thereby rotating the opposite or left drive rod 20 as seen in the Figures. Each drive rod 20 continues downwardly from casing 32 and is threaded into block 33. Block 33 in turn is connected or bolted in Figure 3 to cross bar 22. As better depicted in Figure 2, each drive rod 20 continues downwardly to a similar block 33 into which is it is threaded. Lower blocks 33 are also bolted or connected to the lower cross bar 24. Die board 14, carrying the cutting die 15, is then easily

clamped and centered on frame 16 by cross bars 22 and 24.

Therefore, when the right hand handwheel 26 as seen in Figure 2 is rotated in a clockwise direction, lead rod 20 also rotates in a clockwise direction. The upper portion 21a of lead rod 20 has a lefthand thread machined therein so that clockwise rotation of rod 20 causes upper crossbar 22 to move upwardly. Lower portion 21b of the threading defined in lead rod 20 has a righthand thread defined therein so that clockwise rotation of lead rod 20 causes lower cross bar 24 to move downwardly as depicted in Figure 2. Threaded portions 21a and 21b are defined in equal portions of lead rod 20, allowing for a range of adjustments of cross bars 22 and 24 from the center of the mechanism of Figure 2 to the outward extremities of threaded portions 21a and 21b.

Similarly, the left hand screw drive 20 as seen in Figure 2 is provided with an upper threaded portion or half 23a and a lower threaded portion or half 23b. Clockwise rotation of the right screw drive 20 in Figure 2 will similarly be translated through chain 30 in casing 32 to cause a clockwise rotation of the left side screw drive 20 in Figure 2. Thus, threaded portion 23a is a left hand screw cut while threaded portion 23b is a right hand screw cut therefore driving each end of cross bars 22 and 24 simultaneously and uniformly in the same direction. This allows for even pressure to be applied by cross bars 22 and 24 against the upper and lower edges of die board 14 in Figure 1.

Figures 4 and 5 show a press which is a rotary press. The same concept of Figures 1-3 can be applied according to the teachings of the invention to a rotary die cutter. Here the die boards are cylindrical and instead of being bolted to the roller as in the prior art, the die board is clamped into the press by two slidable rings 36, one of which is shown in Figure 4 and both of which are visible in the perspective view of Figure 5. Rings 36 are driven by longitudinal screw rods 38 which are ganged together by chains and sprockets, or beveled gears and shafts as desired. Such screw rods 38 would be driven appropriately through a pneumatic air ratcheting mechanism 46 attached to the driving chain or driveshaft coupled to screw rods 38. In the embodiment of Figures 4 and 5 die board 14′ on rotor 34 is pressed against a pinch roller 40 about which is wrapped a tough urethane blanket 42. A cardboard sheet 44 to be cut is inserted therebetween. Again, a few thousandths of an inch shimming is necessary to make ready die board 14′. As before, the shimming is inserted at the back of die board 14′ between die board 14′ and roller 34 instead of under polyurethane blanket 42 and die board 14′ is quickly positioned and repositioned by clamping rather than by bolting or other type of affixation to roller 34.

Claims

1. An improvement in a die cutting press for cutting sheet material comprising:
a die means for cutting said sheet material;
first means for providing support for said die means;
second means adapted for pressing said sheet material against said die means, said sheet material being cut by said die means;
clamping means for temporarily fixing said die means supported by said first means, said clamping means being operable to selectively and quickly release and clamp said die means to allow removal, manipulation and insertion of said die means onto said first means,
whereby said die means may be readily manipulated to perfect cutting of said sheet by said die means.

2. The improvement of Claim 1 wherein said clamping means is comprised of a first and second clamping bar and motive means for simultaneously displacing said first and second bars in opposing directions to selectively bring said first and second bar together or to draw said first and second bar apart.

3. The improvement of Claim 2 wherein said first and second bar comprise generally straight cross bars and wherein said first means for providing support for said die means is a generally flat surface, said first and second cross bars being displaced by said motive means across said flat surface of said first means.

4. The improvement of Claim 2 wherein said first and second bar are at least partial rings and wherein said first means is a cylinder, said first and second rings being displaced by said motive means along the axial length of said cylinder.

5. The improvement of Claim 3 wherein said motive means comprises a first and second drive screw, said first and second drive screw being threaded to opposing first and second ends of said first and second cross bars, said drive screw having two threaded portion, said threaded portions of each drive screw having an opposite screw direction so that rotation of said drive screw displaces said cross bars in opposing directions.

6. The improvement of Claim 5 wherein said motive means further comprises connection means for connecting said first and second drive screws so that rotation of one drive screw causes rotation of said other drive screw.

7. The improvement of Claim 6 wherein said connection means comprises a sprocket affixed to each drive screw and a chain engaging each

sprocket of each drive screw and disposed therebetween so that rotation of one drive screw rotates its corresponding sprocket, displaces said chain and rotates said other sprocket to rotate said other drive screw.

8. The improvement of Claim 3 wherein said press is a clam shell press, said first means for providing support to said die means comprises a stationary frame, wherein said second means adapted for pressing a sheet against said die means comprises a movable bridge, said bridge being adapted for pressing against said frame, and wherein said first and second cross bars and motive means for displacing said cross bars are coupled to said frame.

9. The improvement of Claim 4 wherein said press is a rotary press, wherein said first means for providing support to said die means is a cylinder, said rings being disposed on said cylinder and displaced by said motive means along the axis of said cylinder, and wherein said second means adapted for pressing said sheet against said die means is a pressure cylinder characterized by a conformable portion of its surface, said portion being selectively brought into contact with said sheet when said sheet is disposed in contact with said die means.

10. A method for adjusting a die means within a press for cutting a sheet by said die means comprising the steps of:
disposing said die means in said press; and
positioning said die means in said press by simultaneous movement of two opposing clamping means cutting said sheet by said die means,
whereby said die means is quickly and easily adjusted at said predetermined position within said press.

11. The method of Claim 10 further comprising the steps of:
examining said cut sheet for a satisfactory cut;
releasing said die means from said press by moving said two opposing clamping means away from each other;
adjusting said die means to improve the cut provided by said die means in said sheet;
repositioning said die means into said press by simultaneous opposing movement of said two opposing clamping means against said die means, said die means being accurately repositioned at said predetermined position.

12. The method of Claim 10 where said step of positioning said die means accurately at said predetermined position comprises the steps of simultaneously driving two straight cross bars toward each other with said die means disposed between said cross bars and being clamped and limiting further movement of said cross bars thereby accurately positioning said die means in said predetermined position.

13. The method of Claim 10 where said step of accurately positioning said die means at said predetermined position comprises the steps of simultaneously displacing two rings along the length of a cylindrical press member, said die means being disposed between said two rings and being securely clamped by said two rings when said die means is accurately positioned at said predetermined position.

14. The method of Claim 11 where said step of releasing comprises the steps of simultaneously driving two straight cross bars away from each other and said step of repositioning comprises simultaneously driving again said two straight cross bars toward each other and limiting further movement of said cross bars thereby accurately positioning said die means in said predetermined position.

15. The method of Claim 11 where said step of releasing comprises the step of simultaneously displacing two rings along the length of a cylindrical press member away from each other, and said step of repositioning comprises the step of simultaneously again displacing two rings along the length of a cylindrical press member toward each other, said die means being disposed between said two rings and being securely clamped by said two rings when said die means is accurately positioned at said predetermined position.

16. An improvement in a clam shell press having a stationary frame for supporting a die member at a predetermined position and a movable bridge for pressing sheet material against said die member causing said die member to cut into said sheet material, an improvement comprising:
clamping means for selectively and securely but temporarily accurately fixing said die means at a predetermined position within said press; and
motive means for selectively operating said clamping means to clamp said die means at said predetermined position or to release said die means from said press,
whereby said die means may be repeatedly fixed and removed from said press for adjustment, refixed, tested and readjusted until a satisfactory cut of said sheet is obtained.

17. The improvement of Claim 16 wherein said clamping means is fixed to said frame.

18. The improvement of Claim 16 wherein said clamping means comprises a first and second opposing bar and wherein said motive means is operative to drive said first and second opposing bars simultaneously in opposite directions with respect to each other.

19. The improvement of Claim 18 wherein said first and second bars are fixed to said frame and wherein said motive means comprises a first and

second opposing drive screw, said first and second drive screw threadably coupled to opposing ends of both said first and second bars, said drive screws being simultaneously driven to move said first and second bars in opposing directions on said frame to clamp or release said die means.

20. The improvement of Claim 19 wherein said motive means comprises means coupling said first and second drive screws for transferring rotary motion from one drive screw to said other drive screw to simultaneously and synchronously rotate said first and second drive screws.

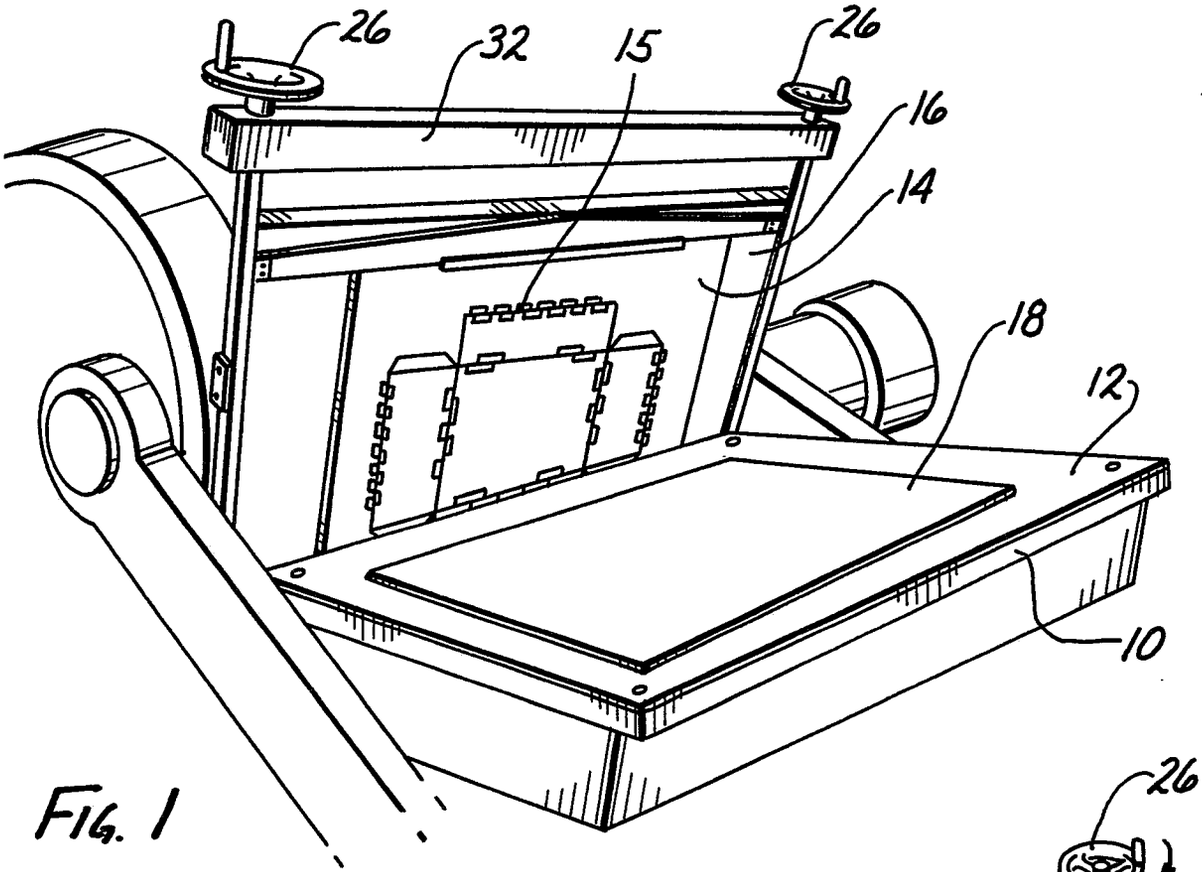
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FIG. 1

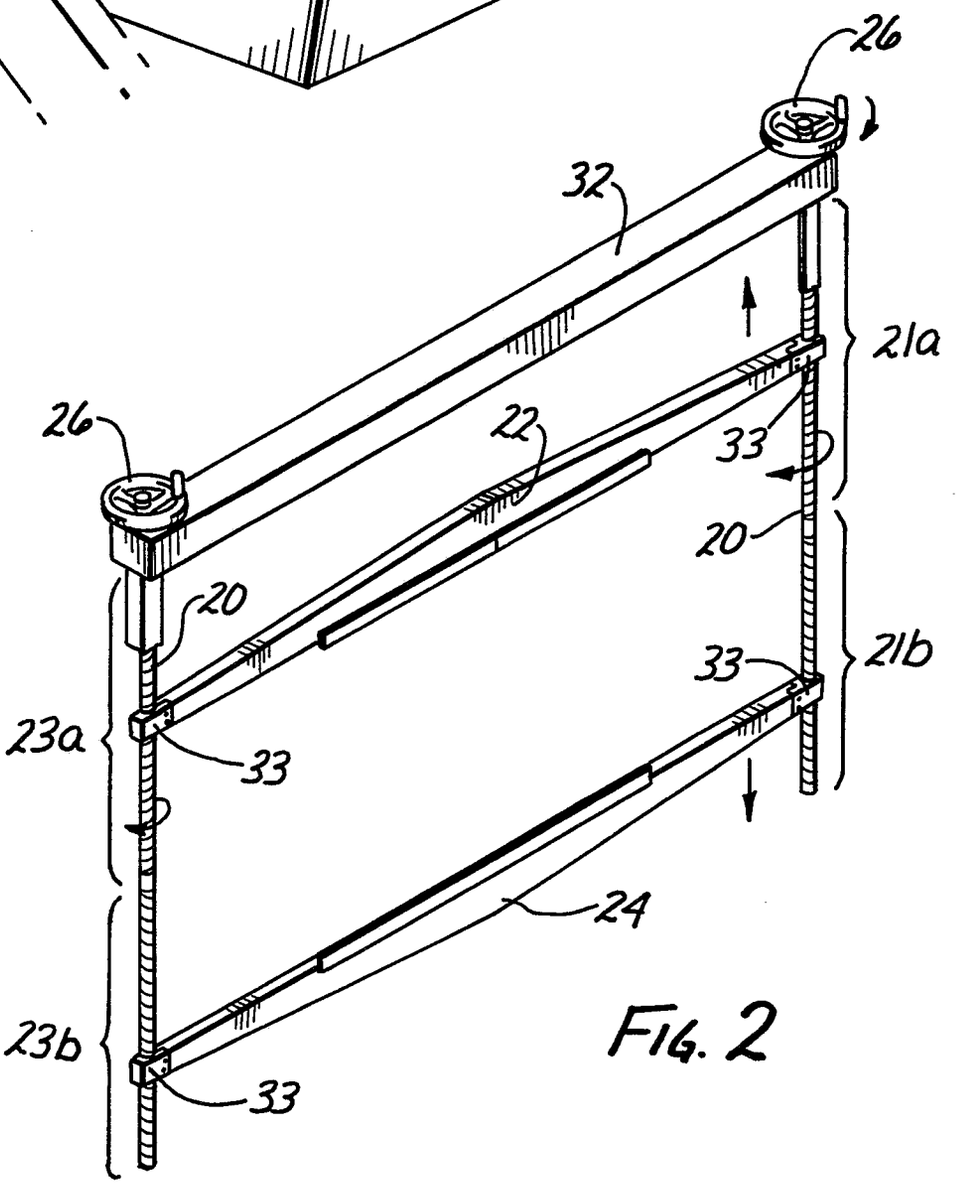
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FIG. 2

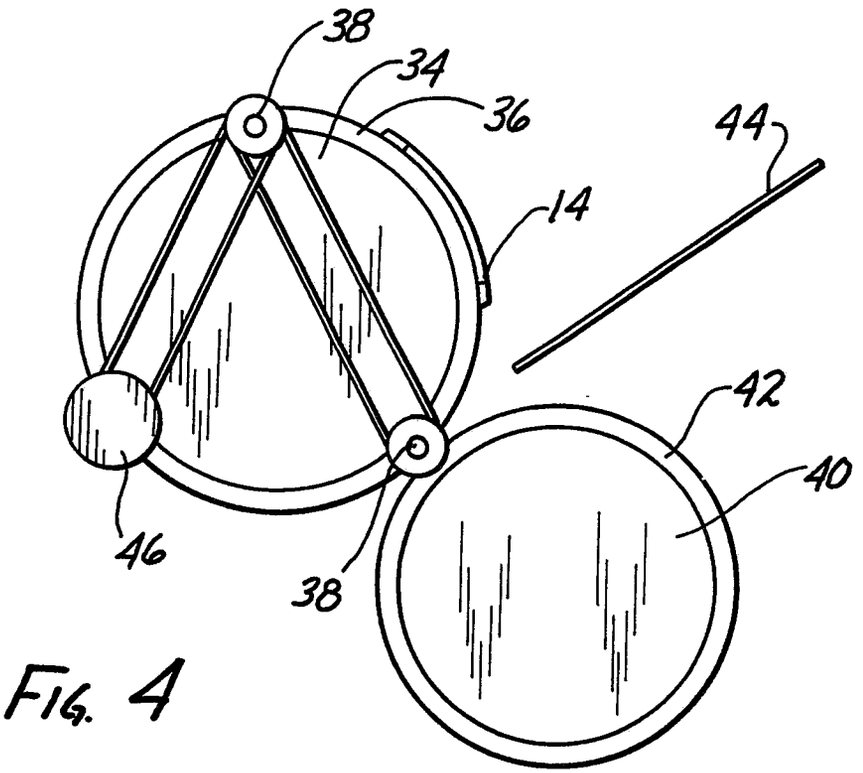

FIG. 4

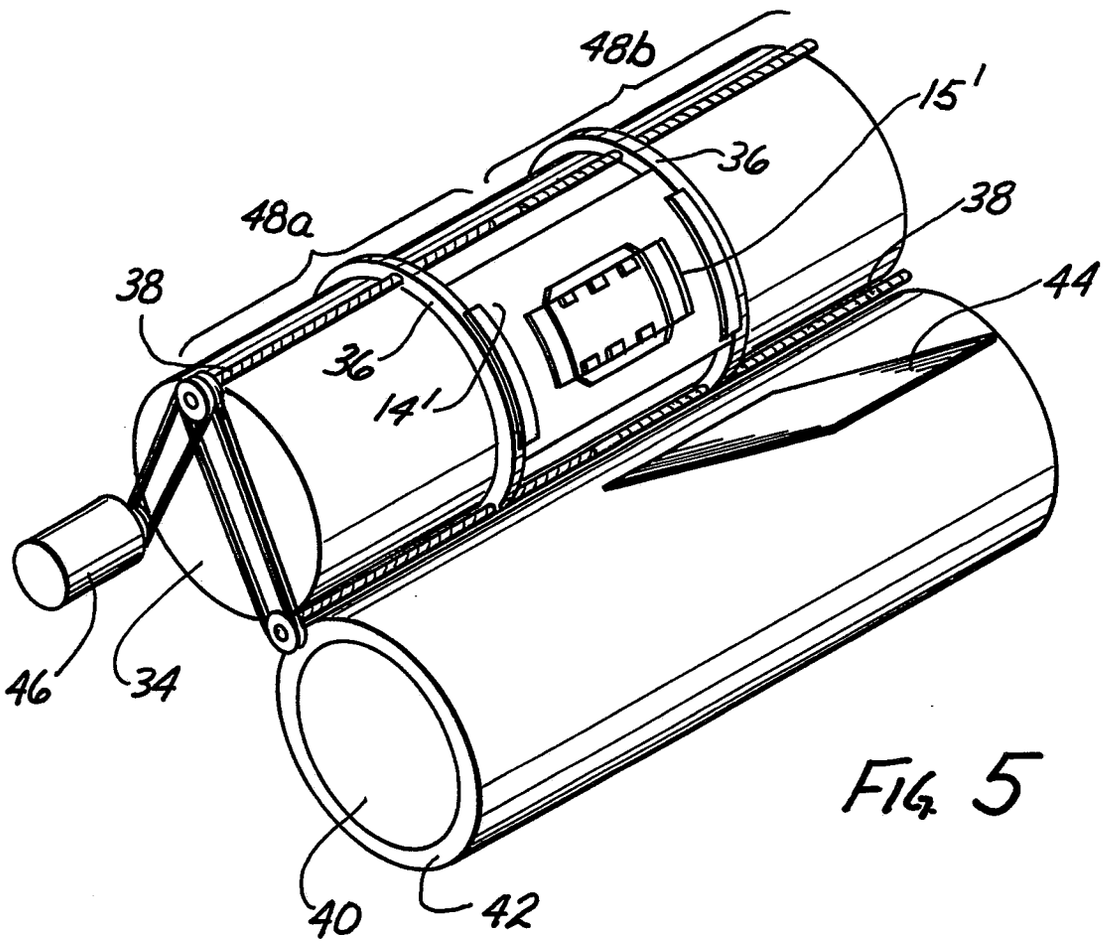

FIG. 5

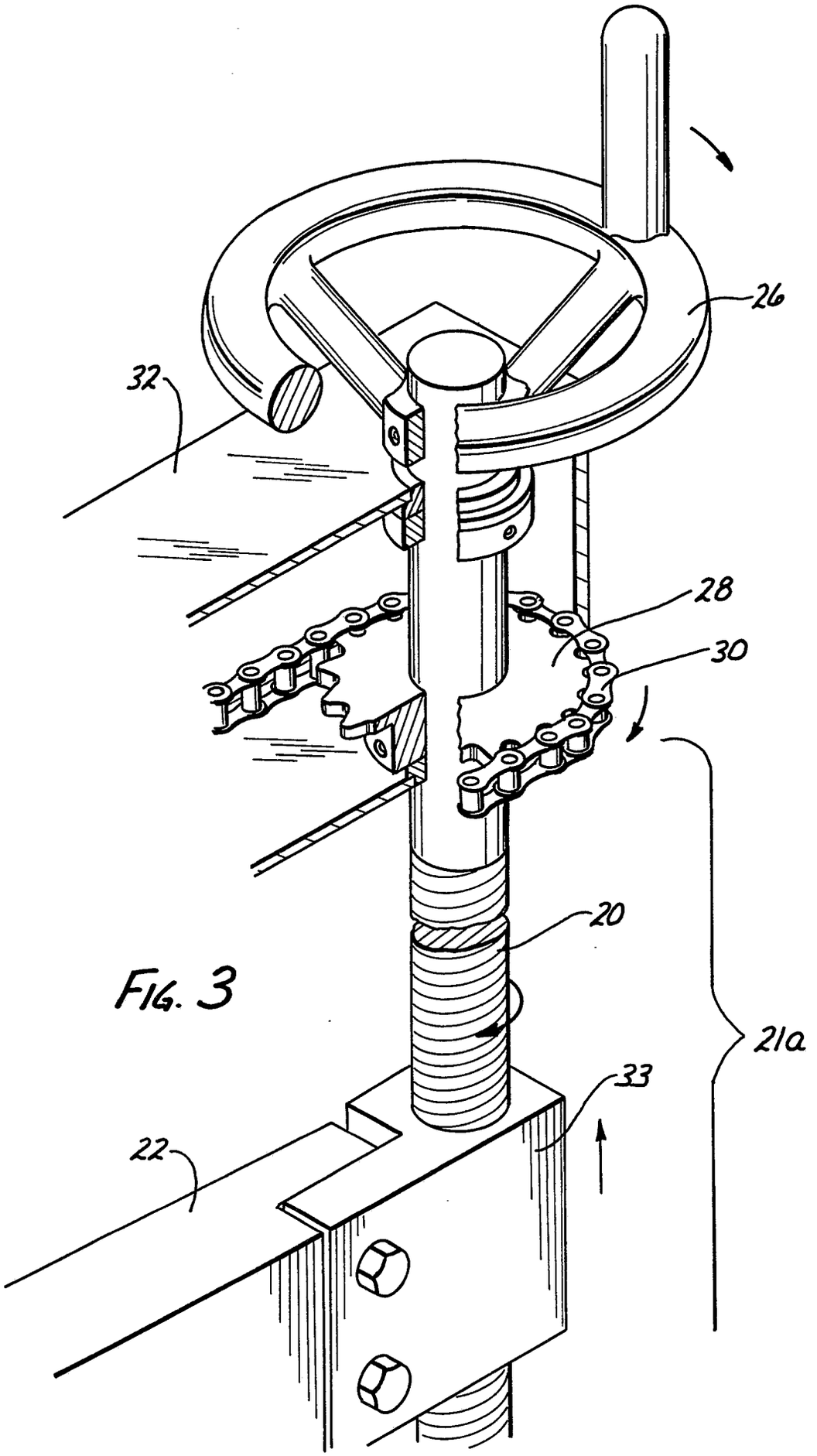

FIG. 3