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(54) Title: ELECTRIC/PNEUMATIC RIM PRESS (57) Abstract A press arrangement having ball-screw drive units for providing rapid opening and closing movement of the press, and having a pneumatic closure arrangement for providing a final small-stroke closing movement and holding force for the mold. The pneumatic closure arrangement acts through the mold to cause the ball-screw drive units to be axially displaced a small amount sufficient to cause automatic engagement of a friction brake which nonrotatably holds the screw shaft to prevent back driving thereof due to the mold closure force.		

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ELECTRIC/PNEUMATIC RIM PRESS

FIELD OF THE INVENTION

This invention relates to a press system for forming plastic parts, such as urethane parts, and more particularly relates to an improved press which utilizes a ball-screw driving arrangement for high-speed closure of the press and an air pressure arrangement for holding the press closed. The press also incorporates a brake which is automatically applied when molds associated with the opposed press platens are loaded so as to prevent back driving of the ball-screw drive arrangement.

BACKGROUND OF THE INVENTION

Copending application Serial No. 09/041 068, owned by the Assignee hereof, illustrates therein a press arrangement which is particularly desirable for permitting molding of large plastic parts, such as urethane parts. The press arrangement of the aforesaid application incorporates ball-screw drive shaft arrangements for effecting relative opening and closing movement of the opposed mold bearing press platens. The drive arrangements of this press have proven highly desirable with respect to the performance they provide, and are particularly desirable where the press is mounted on a mobile carrier, such as an overhead support track, since the press does not have to rely on the use of hydraulic actuators and the like for the major performance functions carried out thereby. In the aforementioned press, the ball-screw drive actuators are controlled by both high speed and low speed drives which react with at least one of the press platens to provide rapid opening and closing movement of the press platen, and provide for slow movement throughout a small stroke which exists at the time the opposed mold parts are being moved into a closed relationship. This arrangement, in conjunction with the brakes associated with the drive

motors for the screw shafts, provides the desired control over the press platens.

The press arrangement of the aforesaid application has proven highly desirable, but nevertheless in some
5 situations the press is of a more sophisticated and complex construction than is necessary or desired.

In other known rim presses, the final closure of the mold has often been accomplished using fluid pressure devices such as air bags or the like. In these known
10 presses, however, the final closure stroke has generally been large (i.e., three-fourths inch or greater), and this has imposed limitations with respect to adapting the press to different tool sizes, and limitations due to the required structure of the air bag and the required large
15 quantity of pressurized air. This press construction also encourages users to insert spacers into the press to minimize the stroke and increase the closure force, but this can often cause damage to the tool (i.e., mold).

Accordingly it is an object of this invention to
20 provide an improved press arrangement which, while it utilizes ball-screw drive units for providing rapid but desirable control over the primary opening and closing movement of the press, it in addition is provided with a pneumatic closure arrangement which provides the final
25 small-stroke closing movement and holding force for the mold, whereby the overall press arrangement is mechanically simplified, and such press arrangement is equally usable either when mounted on a mobile overhead carrier or when provided in association with a stationary
30 floor-supported frame.

In the improved press arrangement of this invention, the ball-screw drive arrangements are activated to permit rapid movement of one of the press platens (the upper press platen in the illustrated embodiment) during the
35 basic opening and closing movements of the press. When substantially in a closed position, that is in a position

which is closely adjacent but spaced from a fully closed position by only a very small distance, then full closure between the mold parts is effected by a mold displacing arrangement such as an air pressure lifting device
5 associated with one of the press platens (the lower press platen in the illustrated embodiment) to effect full closure of the mold and holding of the mold in the closed position during the molding operation. The activation of the mold displacing arrangement also acts through the
10 mold to cause the ball-screw drive arrangement to be axially displaced a small amount sufficient to cause automatic engagement of a friction brake which effectively nonrotatably holds the screw shaft to prevent back driving thereof due to the mold closure force,
15 whereby separate latching of the upper press platen is not required. The friction brake automatically disengages when the mold closing force is released.

In the improved press arrangement of this invention, as aforesaid, the upper and lower press platens are
20 preferably respectively provided with booking plates which mount the mold halves thereon, and which are each preferably supported in such fashion as to permit the booking plates to be pivotally moved so as to face sidewardly, preferably toward opposite sides of the
25 press, to facilitate access to the mold halves mounted thereon. In the preferred and illustrated embodiment, the lower booking plate and the lower press platen in its entirety is vertically swingable through a limited extent about a horizontal pivot axis to permit sideward tilting
30 of the lower press platen to facilitate access to the lower mold half.

The improved press arrangement of this invention, as aforesaid, also includes, as an option thereon, preferably on the lower press platen, a release mechanism
35 which acts in opposition to the mold displacing arrangement so as to facilitate cracking (i.e., initial

opening) of the mold in the event that deactivation of the mold displacing arrangement is inadequate to effect mold separation.

5 The improved press, as aforesaid, also permits a short-stroke, high-force closure of the mold by a pneumatic device which can be maintained of simple construction and function.

10 Other objects and purposes of the invention will be apparent to persons familiar with constructions of this general type upon reading the following specification and inspecting the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

15 Figure 1 is a side elevational view of a press arrangement according to the present invention and illustrating the upper press platen in an open position, and with the booking plate of the upper press platen tilted sidewardly into its access position.

Figure 2 is an end elevational view of the press as appearing in Figure 1.

20 Figure 3 is an end elevational view similar to Figure 2 but also illustrating the lower press platen tilted into its side access position.

Figure 4 is an end elevational view of the press substantially in its closed position.

25 Figure 5 is an enlarged fragmentary sectional view taken generally along line 5-5 in Figure 4.

Figure 6 is a fragmentary sectional view taken generally along line 6-6 in Figure 5.

30 Certain terminology will be used in the following description for convenience in reference only, and will not be limiting. For example, the words "upwardly", "downwardly", "rightwardly" and "leftwardly" will refer to directions in the drawings to which reference is made. The words "inwardly" and "outwardly" will refer to
35 directions toward and away from, respectively, the geometric center of the apparatus and designated parts

thereof. Said terminology will include the words specifically mentioned, derivatives thereof, and words of similar import.

DETAILED DESCRIPTION

5 Referring to the drawings there is illustrated a carrier 10 provided with a press arrangement 11 according to the present invention. The carrier includes a frame structure 12 having, as a part thereof, a top frame 13 which is movably supported under a pair of overhead
10 support rails 14. The support rails 14 are typically positioned in upwardly spaced relation from a floor, such as adjacent a ceiling, and typically define a closed loop so that a plurality of like carriers can be moved along a closed path into a plurality of workstations defined
15 along the path.

In the illustrated embodiment, the top frame 13 is provided with a plurality of support rollers 15 mounted on upwardly projecting yokes 16, which rollers engage the overhead rails 14 to permit the carrier to be rollingly
20 suspended therefrom. The top frame also mounts thereon one or more drive motors 17, typically electric drive motors, which rotate one or more drive rollers 18 which are disposed in driving engagement with the overhead rails.

25 The frame structure 12 also includes a pair of end frames 19 which, in the illustrated embodiment, are fixed to the top frame 13 adjacent opposite longitudinal ends thereof, and project vertically downwardly in generally parallel but spaced relation. These end frames 19
30 resemble vertically elongate posts or columns and, in the illustrated embodiment, are defined by structural elements such as I-beams.

The press arrangement 11 as provided on the carrier 10 is preferably of the type which is often referred to
35 as a rim press, and as such is used for forming parts which are least partially molded of a plastics material

such a polyurethane, which parts are typically rather large in size and may comprise parts such as interior door panels for vehicles and the like. The press arrangement 11 includes an upper or top press structure or platen 21 which in the preferred embodiment is vertically movably supported on and between the end frames 19, and a lower or bottom press structure or platen 22 which is supported on and between the lower ends of the end frames 19. The top press structure 21 is vertically slidably guided on guides or gibs 20 which are fixed to and project vertically along the frame posts 19.

The press 11 is adapted to support thereon a mold which typically includes a top mold part 23 which is fixedly supported on and projects downwardly from the upper press structure 21, and a bottom mold part 24 which is fixedly supported on and projects upwardly from the bottom press structure 22. The top and bottom mold parts 23 and 24 are disposed in vertically aligned relation when the mold is in a closed relationship as illustrated by Figure 4, and they respectively define thereon opposed mold cavity walls which cooperate to define a mold cavity for forming the desired part when the top and bottom mold parts have been relatively moved into a closed engaged relation as diagrammatically illustrated by Figure 4. The construction of the mold parts is conventional, and is designed in accordance with the specific part being molded, whereby further description thereof is believed unnecessary.

The top press structure 21 includes a top press support 25 which extends transversely between the frame posts 19 and is vertically slidably supported thereon. The top press structure 21 also preferably includes a top press plate 26 which is positioned under the top press support 25 and defines thereon, in the normal operating position of the press, a generally horizontally enlarged and downwardly facing surface to which the upper mold

part 23 is fixedly secured. This top press plate 26, often referred to as a booking plate, is secured along one longitudinally extending side edge thereof to the top press support 25 by a hinge structure 27 which defines a
5 generally horizontally extending hinge axis, the latter extending generally in the longitudinal direction of the carrier and being disposed adjacent one side thereof. The hinge structure 27 permits the top booking plate 26 and the top mold part 23 mounted thereon to be vertically
10 swung downwardly through an angle approaching 90° so that the top booking plate is suspended generally vertically downwardly between the end frames 19 adjacent one side of the carrier, substantially as illustrated by Figures 1 and 2. When in this downwardly suspended position, the
15 upper mold part 23 is positioned so that the mold cavity thereof can be readily accessed by a worker standing adjacent one side of the press to permit performance of the necessary manual operations required relative to the upper mold part.

20 To effect movement of the top booking plate 26 between the upper and generally horizontal molding position shown in Figure 4, and the vertically suspended access position shown in Figure 3, an activating mechanism 31 is provided for effecting movement of the
25 top booking plate 26 between the positions shown in Figures 3 and 4. This control mechanism 31 includes a fluid pressure cylinder (i.e. an air cylinder) 32 whose housing 33 is supported at its upper end from the top frame by a hinge 39. A conventional cylinder rod 34
30 projects downwardly from the cylinder housing 33 and at its lower end is connected by a hinge 35 to an elongate control link 36, the latter at its opposite end being connected by a hinge 37 to an arm 38 which is fixed to the booking plate 26. The lowermost chamber of the
35 pressure cylinder 32 is constantly supplied with pressurized air so as to always tend to urge the piston

rod 34 upwardly into a retracted position, substantially as shown in Figure 3, in which position the booking plate is maintained in its open access position whenever the upper press structure 21 is in its raised open position.

- 5 Movement of the upper press structure 21 downwardly toward the closed position, however, causes the upper booking plate 26 to automatically swing upwardly about the hinge 27 into a horizontal position wherein it seats on the underside of the top press support 25.
- 10 Appropriate automatically activated latches 40 are typically provided on the edge of the top press support 25 for locking the booking plate 26 in the horizontal position.

The activating mechanism 31 for causing automatic
15 swinging of the booking plate 26 to and from its sideward access position in response to vertical displacement of the supporting press structure 25 is described in copending Serial No. 09/039 920, also owned by the Assignee hereof. The disclosure of this latter copending
20 application is, in its entirety, incorporated herein by reference.

The bottom press structure 22 as shown in Figures 5 and 6 also includes a horizontally enlarged bottom press plate 42 (often referred to as the bottom booking plate),
25 the latter defining thereon a horizontally enlarged upper surface on which the bottom mold part 24 is fixedly positioned. This bottom booking plate 42 is supported above and on a bottom press support 41, the latter being supported on and extending horizontally between the lower
30 ends of the frame posts 19.

The bottom press support 41 includes a main structural support 43 defined by generally parallel and horizontally enlarged top and bottom support plates 44 and 45, respectively, the latter being rigidly joined
35 together by a plurality of intermediate support channels 46. Opposite ends of the top and bottom plates 44 and 45

are in turn rigidly joined to vertical end plates 47, the latter being positioned inwardly of but in close proximity to the respective end posts 19.

5 The bottom booking plate 42 is supported on the main support 43 for limited vertical displacement, and for this purpose a lifting device 48 cooperates between the main support 43 and the bottom booking plate 42 for controlling vertical raising and lowering of the latter. This lifting device 48, which in use functions for
10 effecting final mold closure, includes a plurality of inflating devices 49, such as flexible air hoses, positioned in interposed relation between the bottom booking plate 42 and the top support plate 44. These hoses 49 extend transversely of the plates 42,44 in the
15 region therebetween, and are closed at one end, and are connected to an air supply conduit 51 at the other end, the latter being connectable to a suitable source of pressurized air.

The bottom booking plate 42 has a plurality of pins
20 52 secured thereto and projecting downwardly therefrom so as to slidably project through the top plate 44. These pins 52 at the lower ends thereof are provided with enlarged heads, and springs 53 surround the pins 52 and coact between the enlarged heads and the underside of the
25 top plate 44 to normally urge the bottom booking plate 42 downwardly into a seated position which is determined by spacers 54 positioned between the plates 42 and 44. These spacers maintain a minimal clearance between these latter plates to accommodate the air hoses 49
30 therebetween when the air hoses are deflated.

The bottom press structure 22 is supported on and between the lower ends of the frame posts 19 by means of a swivel arrangement 55 which cooperates between the frame posts 19 and the main support 43. This swivel
35 arrangement 55 includes a pair of hubs 56 which are fixed to and project outwardly in generally aligned relation

from the opposite end plates 47 so as to define a generally horizontal pivot or swivel axis 57. The hubs 56 project into and are rotatably supported within bearing sleeves 58 which in turn are secured to support blocks 59. Each support block 59 in turn is fixedly secured between a pair of side plates 61, the latter in turn being fixedly secured to and projecting generally transversely relative to the respective end posts 19 adjacent the lower free end thereof. This swivel arrangement 55 enables the lower press structure 22, in its entirety, to be pivotally displaced relative to the frame about the horizontal swivel axis 57 so that the lower press structure can be moved into a sidewardly inclined position substantially as illustrated in Figure 3 so as to facilitate sideward access to the lower mold part 24. This sideward access position, in the illustrated embodiment, is preferably disposed at an angle of about 20 to about 45 degrees relative to the horizontal.

The sideward tilting of the lower press structure 22 is controlled by a tilt actuator 63 which, in the illustrated embodiment, comprises a fluid (i.e. air) pressure cylinder 64 whose housing 65 is connected at its upper end by a hinge 66 to a bracket 67 which is fixed to and projects transversely from the respective frame post 19. A piston rod 68 projects outwardly of and is extendible from the lower end of cylinder housing 65, and the outer (i.e. lower) free end of the piston rod 68 has a connecting pin 69 thereon which couples to the main support 43 so as to permit tilting of the lower press structure 22 from the horizontal molding position of Figure 2 into the sideward access position of Figure 3 when the cylinder 64 is energized so as to extend the piston rod 68 downwardly.

The lower press structure 22 also has, as an option, a mold opening assist mechanism 71 (Figures 5 and 6)

associated therewith. This latter mechanism includes a generally horizontally enlarged actuator plate 72 which is disposed adjacent and is vertically movable through a limited extent relative to the bottom plate 45. For this purpose, the actuator plate 72 has a plurality of pins 73 secured thereto and projecting upwardly through the bottom plate 45, which pins have enlarged upper ends. Springs 74 surround the pins and cooperate between the enlarged heads thereof and the upper surface of the bottom plate 45 so as to normally urge the actuator plate 72 upwardly into a raised position wherein it abuts spacers 75 which in turn abut the underside of the bottom plate 45. In the clearance space defined between the plates 45 and 72, due to the presence of the spacer 75 therebetween, a plurality of actuators formed as elongate inflatable air hoses 76 are disposed so as to extend transversely across the actuator plate 72. These air hoses 76 are closed at one end, and at the other end are connected to a suitable supply conduit 77, the latter in turn being connected to a source of pressurized air.

The mold opening or actuator plate 72 also has a plurality of elongate connectors pins 78 fixed thereto and projecting upwardly therefrom. These latter pins 78 freely pass upwardly through all of the other plates and in fact pass upwardly through openings formed in the bottom booking plate 42 so as to terminate in enlarged heads 79 which are normally spaced upwardly a selected distance above the bottom booking plate 42 when the latter is in its lowered position, and also when the bottom booking plate 42 is in its normally raised position as illustrated by dotted lines in Figure 5.

With the arrangement as described above, and assuming that the upper air hoses 49 are inflated so that the bottom booking plate 42 is raised to provide a closing force between the upper and lower mold parts, then inflation of the lower air hoses 76 (either

simultaneous with or subsequent to deflation of the upper air hoses 49) causes the enlarged heads 79 of the pins 78 to engage the bottom booking plate 42 and exert a downward mold opening force thereon in response to
5 downward displacement of the actuator plate 72 due to inflation of the lower air hoses 76.

As an alternative, the pins 73 and springs 74 (Figure 5) as associated with the actuator plate 72 can be deleted, and in place thereof the elongate connector
10 rods 78 can have the upper and lower ends thereof respectively fixedly connected to the booking plate 42 and actuator plate 72. With this fixed connection between the plates 42 and 72, the actuator plate 72 will normally be maintained downwardly a greater vertical
15 spacing below the bottom plate 45 when the booking plate 42 is in the nonactivated position shown in Figure 5 so that when the air bags 49 are activated, both plates 42 and 72 will be vertically lifted simultaneously. In such situation, if an assist is necessary to crack open the
20 mold following the molding operation, then the lower air bags 76 are energized simultaneous with or following de-energization of the top air bags 49 so that the actuator plate 72 acting through rods 78 exerts a downward force on the booking plate 42.

25 To effect closing and opening of the press, which respectively requires downward and upward displacement of the top press structure 21, the press arrangement 11 includes a pair of screw-type drive units 81 which are disposed adjacent opposite sides of the frame and provide
30 a driving connection between the frame and the upper press structure 21 to effect desired vertical movement of the latter. The pair of screw-type drive units 81 in the preferred embodiment are identical, one being positioned in close proximity to each of the frame posts 19 so as to
35 extend generally parallel therewith, and thus only one of the screw-type drive units will hereinafter be described.

The screw-type drive unit 81 is preferably a ball-screw drive and includes a vertically elongate drive shaft 82 which is disposed adjacent and generally parallel with the respective frame posts 19 so that the axis 83 of the shaft extends generally vertically. The shaft 82 is drivingly connected at its upper end to a drive motor 84 which is carried on the top frame 13. The drive motor 84 is typically a high speed electric motor which is drivingly connected in a conventional manner through a speed reducer or other drive transmitting device, such as a belt drive, to the upper end of the drive shaft 82. The drive motor 84 is of conventional construction and possesses its own internal brake which activates to prevent rotation of the drive motor shaft whenever the drive motor is de-energized. While each drive unit 81 may be provided with its own drive motor, it is also feasible to provide a single drive motor for both drive units. Preferably each drive unit has its own drive motor, but the two drive shafts are drivingly connected through a timing belt or the like to ensure synchronization of driving thereof. These latter variations are disclosed in copending U.S. application Serial No. 09/041 068, and further description thereof is believed unnecessary.

The drive shaft 82 has the lower end portion thereof disposed so as to extend through an opening 87 which projects vertically through the support block 59, with the lower end of the drive shaft being rotatably supported thereon by a conventional anti-friction bearing 85. The upper end of the drive shaft 82 similarly projects through a frame member associated with the top frame 13 and is also appropriately rotatably supported by means of an anti-friction bearing 85A, such being conventional and well understood. The drive shaft 82, adjacent the lower end thereof, has a stop collar 88 fixedly mounted thereon which under normal operation is

adapted to abut against the upper end of the inner race of the lower bearing 85 to maintain a normal vertical position of the drive shaft 82, although the upper and lower bearings which support the drive shaft 82 do permit
5 limited upward axial displacement of the drive shaft 82 for a purpose as described hereinafter.

The elongate intermediate portion of the drive shaft 82 is externally threaded and cooperates with a rotatable ball-nut unit 86 which surrounds the screw portion of the
10 drive shaft. This ball-nut unit 86 incorporates therein a plurality of balls (not shown) which cooperate in a rolling and recirculating manner with the screw portion of the drive shaft 82 in response to relative rotation between the nut 86 and the drive shaft 82, such ball-
15 nut-screw drives and their construction being conventional and well understood.

The housing of the ball-nut unit 86 is fixed to the top press support 25 associated with the top press structure 21 so that the latter is vertically displaced
20 upwardly or downwardly along with the ball-nut units 86 in response to rotation of the drive shafts 82, depending upon the direction of rotation of the latter.

To provide a positive braking of the drive shafts 82 independent of the brakes associated with the driving
25 motors therefor, the drive shaft 82 of each drive unit 81 has a friction brake 91 (Figure 5) which cooperates between the lower end of the drive shaft 82 and the frame of the press. This friction brake 91 includes an annular brake plate 93 which is fixed to the respective drive
30 shaft 82 adjacent the lower free end thereof, whereby this brake plate 93 is disposed closely adjacent and substantially directly under the support block 59. The brake plate defines thereon a substantially flat upper brake surface 94 which is normally disposed in opposed
35 but slightly axially spaced relation (typical between about .020 and about .040 inch) from a substantially

planar lower brake surface 95 as defined on the lower end of the support block 59. These opposed brake surfaces 94 and 95 are conventional friction brake surfaces, and during normal rotation of the drive shaft 82 are spaced from one another in non-engaged relation. However, when the drive shaft 82 is displaced axially upwardly a small extent, as explained hereinafter, the brake plate 93 is moved upwardly so that the upper brake surface 94 thereon engages the lower brake surface 95 provided on the stationary support block 59, thereby creating a frictional braking engagement between the opposed surfaces 94-95 to provide a positive restraint against rotation of the drive shaft 82.

The operation of the press 11 will now be briefly described.

In the following description of a typical operational cycle of the press arrangement 11, it will be assumed that the press is initially in its open position wherein the upper press structure 21 is in its raised or uppermost position, and that the upper and lower booking plates 26 and 42 are angled sidewardly into their access positions, substantially as illustrated in Figure 3. In this latter position the booking plates are angled so as to face sidewardly toward opposite sides of the press, whereby workers positioned adjacent opposite sides can respectively access the upper and lower mold parts 23-24 to carry out whatever operations are required with respect to preparing the mold. The press cycle is then activated by supplying air to the bottom of the tilt cylinder 64 so as to cause the piston rod 68 to be pulled upwardly, thereby causing the bottom press structure 22 to be pivotally displaced so as to return to its substantially horizontally oriented position as illustrated by Figure 2. This latter position can be determined by appropriate stops (not shown) associated either with the frame or the pressure cylinder, and in

addition appropriate latches (not shown) can optionally be provided and activated so as to latch the lower press structure in this horizontal orientation if desired.

5 With the lower press structure 22 in its horizontal orientation so that the lower mold part 24 is oriented with its cavity projecting generally upwardly, then if the press involves an open pour, a predetermined quantity of plastics material, particularly polyurethane, is poured or injected into the mold cavity of the lower mold
10 part. While an open pour technique is conventionally utilized, it will be appreciated that in some situations the polyurethane is injected into the mold cavity when the press is closed.

15 Subsequent to or simultaneous with the movement of the lower press structure 22 into its horizontal orientation, the upper press structure 21 is activated so as to move downwardly toward the closing position of the mold. For this purpose the motors 84 of the drive units 81 are energized, causing the internal motor brakes to
20 release, and causing synchronous rotation of the drive shafts 82. These rotating shafts 82 react with the ball-nut units 86 and hence cause the top main support 25 to be slidably displaced downwardly away from its uppermost position. During this downward displacement of the top
25 press support 25, pressurized air acts upwardly against the piston of the pressure cylinder 32 so that as the top press support 25 is moved downwardly carrying with it the hinge 27, the control link 36 and cylinder rod 34 are urged upwardly due to the internal pressure in the
30 cylinder 32, thereby causing the top booking plate 26 to swing upwardly (clockwise in Figures 2 and 3) about the hinge 27. The top booking plate 26 continues to swing upwardly synchronously with the downward displacement of the top press support 25 until the top booking plate 26
35 is disposed substantially horizontally and seats against the top press support 25, at which time the latches 40

will be automatically activated. This now results in the upper mold part 23 being generally vertically aligned with but spaced upwardly from the lower mold part 24.

The drive units 81 remain energized so that the
5 continued rotation of drive shafts 82 causes the entire upper press structure 21 to move downwardly toward the lower mold part, and during this continued downward movement the cylinder rod 34 due to its connection to the top booking plate is extended downwardly in opposition to
10 the internal cylinder pressure.

When the upper mold part 23 has been moved downwardly so as to be positioned close to a position of closure with the lower mold part 24, but normally spaced a small distance from such closure, which small distance
15 will typically be in the order of about 0.100 inch or less, the drive units 81 are de-energized and the internal brakes associated with the drive motors 84 are automatically applied. The stoppage of the top press structure 21 can be readily controlled by appropriate
20 programming of the overall drive system or by appropriate position sensors, such being conventional.

After stoppage of the upper mold part 23 in very close positional relationship to the lower mold part 24, pressurized air is supplied to the air hoses 49 which
25 cause the bottom press plate 42 to be lifted upwardly away from the bottom press support 43 whereby the lower mold part 23 is lifted upwardly to effect a full closing engagement with the upper mold part 24. The inflation of the air hoses 49 is also of sufficient magnitude to cause
30 the lower mold part 23 to exert a significant closure force against the upper mold part 24 so as to permit the mold parts to be maintained fully closed during the molding process which takes place within the mold. This imposition of a high closure force from the lower mold
35 part to the upper mold part, however, results in this force being applied to the upper press structure 21 and

hence to the ball units 86 which react against the screw portions of the drive shafts 82. This upward force as transmitted from the ball-nut units 86 to the screw shafts 82 causes the latter to lift axially upwardly a small extent, as permitted by the top and bottom bearings 84 and 84A, thereby causing the friction brake plates 93 at the lower ends of the drive shafts to also be lifted upwardly so that the upper brake surfaces 94 move into frictional engagement with the stationary lower brake surfaces 95 defined on the support blocks 59. This thus effectively prevents the shafts 82 from rotating, and hence the continued imposition of the upward force on the upper mold part, and the transmission of this force to the drive shafts, is thus ineffective in causing reverse driving (i.e. reverse rotation) of the drive shafts due to their coaction with the ball-nut units.

Once the molding cycle has been completed, then the air hoses 49 are de-energized and, in some situations, this release of the upwardly directed force on the lower mold part is sufficient to effect release between the mold parts, thereby enabling the lower mold part to move downwardly out of engagement with the upper mold part. At the same time, the release of the upward force from the upper mold part enables the upper press structure 21 and the drive shafts 82 to move downwardly a small extent due to the urging of gravity, thus causing a separation between the brake surfaces 94 and 95, with the limited downward movement being controlled by the stop collars 88 re-engaging the bearings.

In many situations, however, the magnitude of the force applied to effecting closure of the mold parts is such as to cause the mold parts to become tightly adhered together, and thus the mere release of the upward mold closure force may be incapable of effecting cracking or separating of the upper and lower mold parts. In such situation, when the press is equipped with the optional

mold release assist mechanism 71, the lower air hoses 76 can be inflated substantially simultaneous with the deflation of the upper air hoses 49. The inflation of the lower air hoses 76 forcibly drives the actuator plate 72 downwardly which, acting through the pins 78, cause the enlarged heads 79 of the pins 78 to engage the bottom booking plate 42. A downwardly directed opening or cracking force is thus imposed on the bottom booking plate 42, and on the lower mold part 24 attached thereto, so as to effect opening or cracking of the lower mold part 24 from the upper mold part 23. Once this has been accomplished, then the lower air hoses 76 are also de-energized.

With the upper and lower mold parts cracked or opened, then the drive motors 84 are energized to cause reverse rotational driving of the drive shafts 82 so that the upper press structure 21 is quickly moved upwardly away from the mold closure position. During the initial upward movement, the pressure in the cylinder 32 causes the cylinder rod 34 to be retracted through its maximum extent. Thereafter continued upward movement of the upper press structure 25 causes the upper booking plate 26 to swing sidewardly (counterclockwise) about the hinge 27 so as to cause the top booking plate to swing into its full sideward access position wherein it is substantially vertically suspended simultaneous with the continued upward displacement of the top press support 25 into its uppermost open position, substantially as illustrated in Figure 3.

Simultaneous with or subsequent to the upward opening movement of the top press structure, the lower press structure is sidewardly tilted by applying fluid pressure to the upper end of the pressure cylinder 64 so that the piston rod 68 is extended downwardly to cause the lower press structure to be sidewardly tilted into its side access position as illustrated by Figure 3.

This also enables the molded workpiece to be readily removed from the mold cavity associated with the lower mold part.

5 The molding cycle has now been completed, and the press is again in its open and access position so as to permit initiation of a new molding cycle.

10 With the press 11 of the present invention, when it is mounted on and associated with a mobile overhead carrier 10, the carrier and press can be moved sequentially along a closed path into and through a plurality of workstations, whereby various operations can be carried out at sequential workstations disposed along the closed work path. This thus enables the mold operation when the mold is closed to take place as the carrier is moving between two adjacent workstations. At the same time, electricity can be supplied to the carrier and to the press from an overhead arrangement such as is conventional, and the press can be automatically coupled to a supply of compressed air when it is disposed in a desired working station.

15 As an alternative, it will be appreciated that the press and its frame can be disposed in a stationary arrangement on a support floor, and all of the operational relationships are still substantially the same with respect to the basic molding cycle.

20 For further detail with respect to a rim press employing screw-type drive arrangements, and the general type of molding operation carried out in such press, attention is directed to aforementioned copending U.S. Serial No. 09/041 068, the entire disclosure of which is incorporated herein by reference.

25 Although a particular preferred embodiment of the invention has been disclosed in detail for illustrative purposes, it will be recognized that variations or modifications of the disclosed apparatus, including the rearrangement of parts, lie within the scope of the present invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

- 5 1. A press for molding an element in a mold defined by upper and lower mold parts which when closed cooperate to define a mold cavity therebetween, said press comprising a frame, an upper platen arrangement mounted on the frame and defining thereon a generally
10 horizontally enlarged and downwardly facing press surface on which the upper mold part is mounted, a lower platen arrangement defining thereon a generally horizontally enlarged and upwardly facing press surface on which the lower mold part is mounted, at least one of said platen
15 arrangement being vertically movable toward and away from the other platen arrangement for movement between respective closed and open positions of the mold, at least a pair of generally vertically elongated and substantially parallel drive shaft units drivingly
20 connected to at least said one platen arrangement for effecting movement thereof between said open and closed positions, each said drive shaft unit comprising a recirculating ball-screw arrangement having a vertically elongate screw shaft which extends vertically and is
25 rotatably supported relative to the upper and lower platen arrangements and which is rotatably engaged with a recirculating ball-nut unit which surrounds the screw shaft and is vertically non-movably mounted on said one platen arrangement, a drive mechanism connected to said
30 screw shafts for effecting simultaneous and synchronous rotation thereof, said drive shafts being mounted on said frame for at least limited vertical displacement generally parallel to the axes of the drive shaft in response to mold closure, and a friction brake
35 arrangement associated with said drive shafts and being moved into frictional braking engagement to prevent

rotation of said drive shafts in response to axial lifting of the drive shafts responsive to mold closure.

2. A press according to Claim 1, wherein said ball-nut units are mounted on said upper platen arrangement and cooperate with the drive shafts to effect closing and opening movement of the upper platen arrangement in downward and upward directions respectively.

3. A press according to Claim 1, wherein the friction brake arrangement includes a brake member which is fixedly secured to the screw shaft and defines thereon a first brake surface which is normally axially spaced a small distance from an opposed second brake surface which is stationarily mounted with respect to the frame, whereby axial displacement of the screw shaft causes the first brake surface to frictionally engage the second brake surface.

4. A press according to Claim 3, wherein the normal spacing axially between the first and second brake surface is a maximum of about .040 inch.

5. A press for molding an element in a mold defined by upper and lower mold parts which when closed cooperate to define a mold cavity therebetween, said press comprising a frame, an upper platen arrangement mounted on the frame and defining thereon a generally horizontally enlarged and downwardly facing press surface on which the upper mold part is mounted, a lower platen arrangement defining thereon a generally horizontally enlarged and upwardly facing press surface on which the lower mold part is mounted, at least one of said platen arrangement being vertically movable toward and away from the other platen arrangement for movement between respective closed and open positions of the mold, at

least a pair of generally vertically elongated and substantially parallel drive shaft units drivingly connected to at least said one platen arrangement for effecting movement thereof between said open and closed positions, each said drive shaft unit comprising a recirculating ball-screw arrangement having a vertically elongate screw shaft which extends vertically and is rotatably supported relative to the upper and lower platen arrangements and which is rotatably engaged with a recirculating ball-nut unit which surrounds the screw shaft and is vertically non-movably mounted on said one platen arrangement, a drive mechanism connected to said screw shafts for effecting simultaneous and synchronous rotation thereof, a mold closing device associated with a first said platen arrangement for permitting limited vertical displacement of the mold part associated with said first platen arrangement for displacing said last-mentioned mold part vertically toward and into closing engagement with the opposed mold part and for holding said opposed mold parts closed with a closure force, said drive shafts being mounted on said frame for at least limited upward vertical displacement generally parallel to the axes of the drive shaft in response to said mold closure force generated by said mold displacement device, and a friction brake arrangement associated with said drive shafts and being moved into frictional braking engagement to prevent rotation of said drive shafts in response to upward axial lifting of the drive shafts responsive to the mold closure force.

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6. A press according to Claim 5, wherein said ball-nut units are mounted on said upper platen arrangement and cooperate with the drive shafts to effect closing and opening movement of the upper platen arrangement in downward and upward directions respectively, and wherein said mold closing device is mounted on said lower platen

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arrangement and effects upward lifting of a bottom
booking plate which mounts the lower mold part thereon to
cause the lower mold part to be lifted into a closed
engaged position with respect to the upper mold part and
5 to impose an upwardly directed closing force on the
latter.

7. A press according to Claim 6, wherein the lower
platen arrangement is supported for pivoting movement
10 about a generally horizontal axis for pivoting movement
between a generally horizontal orientation and a
generally sidewardly angled orientation which facilitates
access to the lower mold part.

15 8. A press according to Claim 6, wherein the upper
platen arrangement includes a top booking plate which
mounts the upper mold part therein and which is swingable
sidewardly about a generally horizontal axis into an
access position to facilitate access to the upper mold
20 part when the upper platen arrangement is in a raised
open position.

9. A press according to Claim 8, wherein the lower
platen arrangement is supported for pivoting movement
25 about a generally horizontal axis for pivoting movement
between a generally horizontal orientation and a
generally sidewardly angled orientation which facilitates
access to the lower mold part.

30 10. A press according to Claim 6, including a mold
cracking assist mechanism provided on said lower platen
arrangement for imposing a downwardly directed opening
force on the lower mold part to assist in effecting
separation thereof from the upper mold part.

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11. A press according to Claim 6, wherein the mold closing device comprises a first inflatable fluid pressure device which is mounted on said lower platen for effecting upward vertical displacement of a bottom
5 booking plate which mounts the lower mold part thereon to cause the lower mold part to be lifted into a closed engaged position with respect to the opposed upper mold part and for imposing an upwardly directed closing force on the upper mold part, and a mold cracking assist
10 mechanism mounted on said lower platen arrangement for imposing a downwardly directed opening force on the lower mold part to assist in effecting separation thereof from the upper mold part, said cracking assist mechanism
15 comprising a second inflatable fluid pressure device which is mounted on the lower platen arrangement for imposing a downwardly directed opening force on the bottom booking plate to effect separation of the lower mold part from the upper mold part.

20 12. A press according to Claim 6, wherein the friction brake arrangement includes a brake member which is fixedly secured to the screw shaft and defines thereon a first brake surface which is normally axially spaced a small distance from an opposed second brake surface which
25 is stationarily mounted with respect to the frame, whereby axial displacement of the screw shaft causes the first brake surface to frictionally engage the second brake surface.

30 13. A press according to Claim 12, wherein the normal spacing axially between the first and second brake surface is a maximum of about .040 inch.

35 14. A press for molding an element in a mold defined by upper and lower mold parts which when closed cooperate to define a mold cavity therebetween, said

press comprising a frame, an upper platen arrangement mounted on the frame and defining thereon a generally horizontally enlarged and downwardly facing press surface on which the upper mold part is mounted, a lower platen arrangement defining thereon a generally horizontally enlarged and upwardly facing press surface on which the lower mold part is mounted, at least one of said platen arrangement being vertically movable toward and away from the other platen arrangement for movement between respective closed and open positions of the mold, a drive unit drivingly connected to at least said one platen arrangement for effecting movement thereof between said open and closed positions, a mold closing device associated with a first said platen arrangement for permitting limited vertical displacement of the mold part associated with said first platen arrangement for displacing said last-mentioned mold part vertically toward and into closing engagement with the opposed mold part and for holding said opposed mold parts closed with a closure force, said mold closing device comprising an inflatable fluid pressure device which is mounted on said first platen arrangement for effecting vertical displacement of a booking plate which mounts the respective mold part thereon to cause the respective part to be vertically displaced into a closed engaged position with respect to the opposed mold part and for imposing a vertically directed closing force on the latter, and a mold cracking assist mechanism provided on said first platen arrangement for imposing a vertically directed opening force on the respective mold part to assist in effecting separation thereof from the opposed mold part.

15. A press according to Claim 14, wherein said cracking assist mechanism comprises a second inflatable fluid pressure device which is mounted on said first platen arrangement and which when pressurized imposes a vertically directed opening force on the respective mold part.

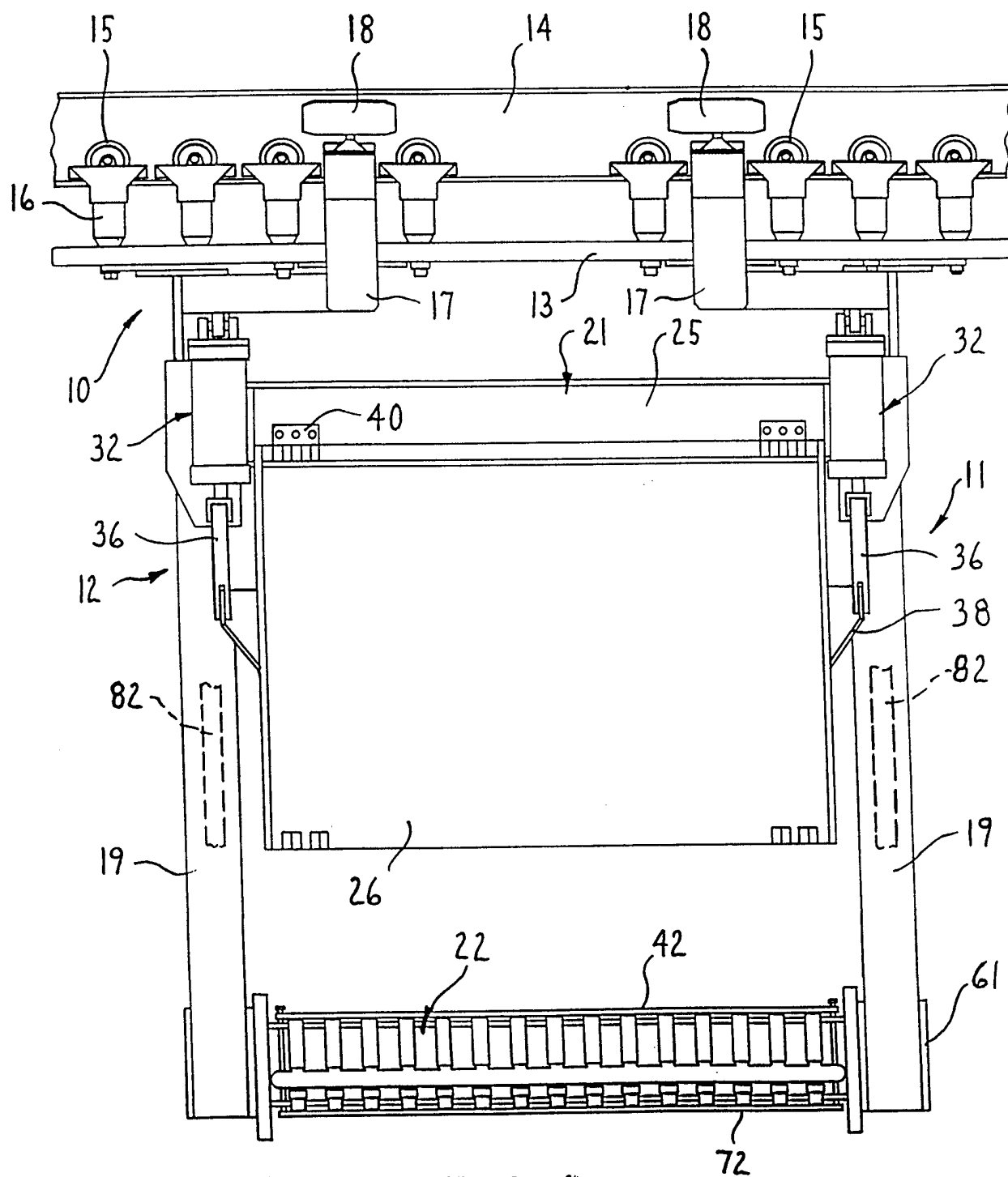
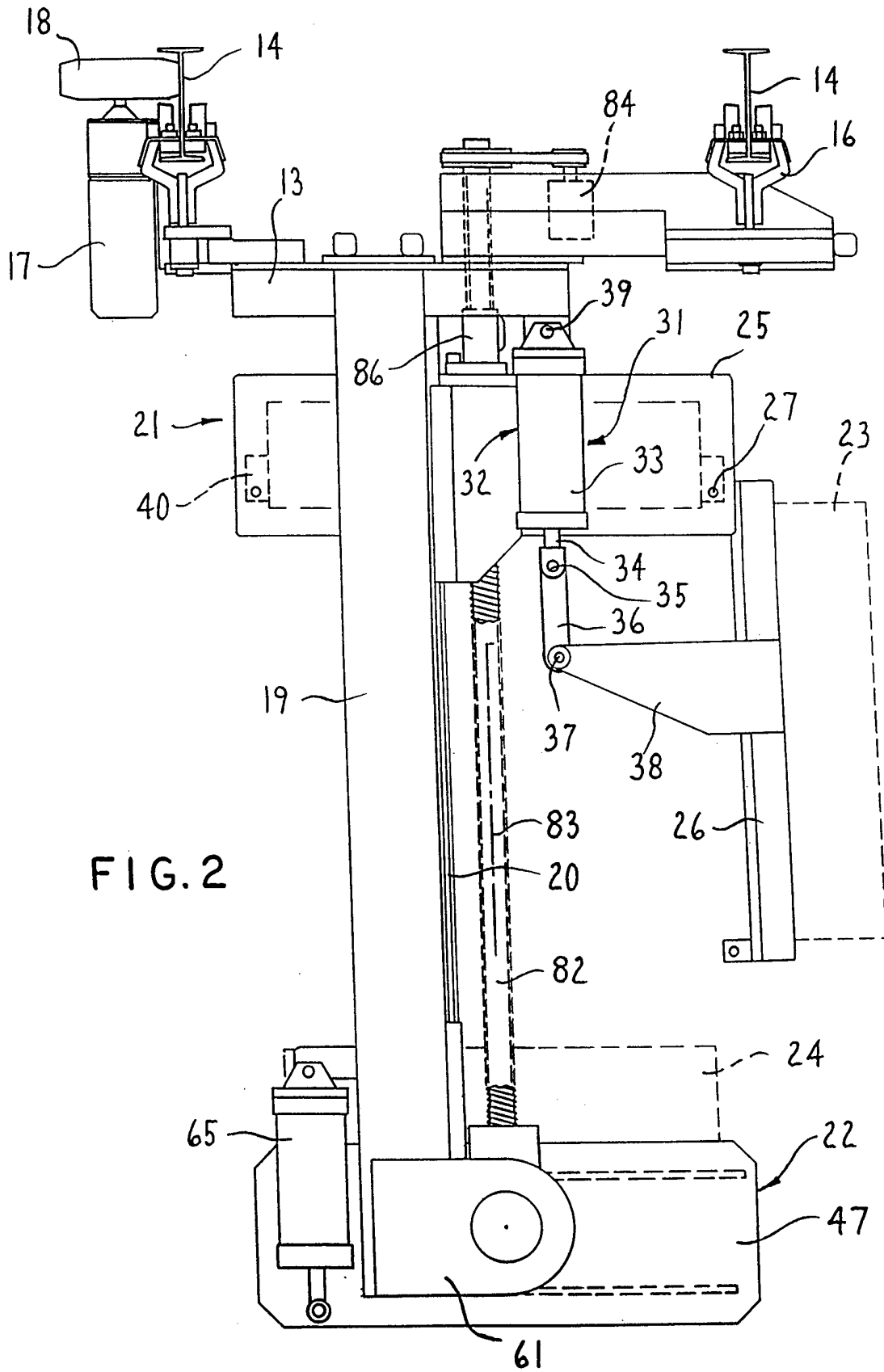
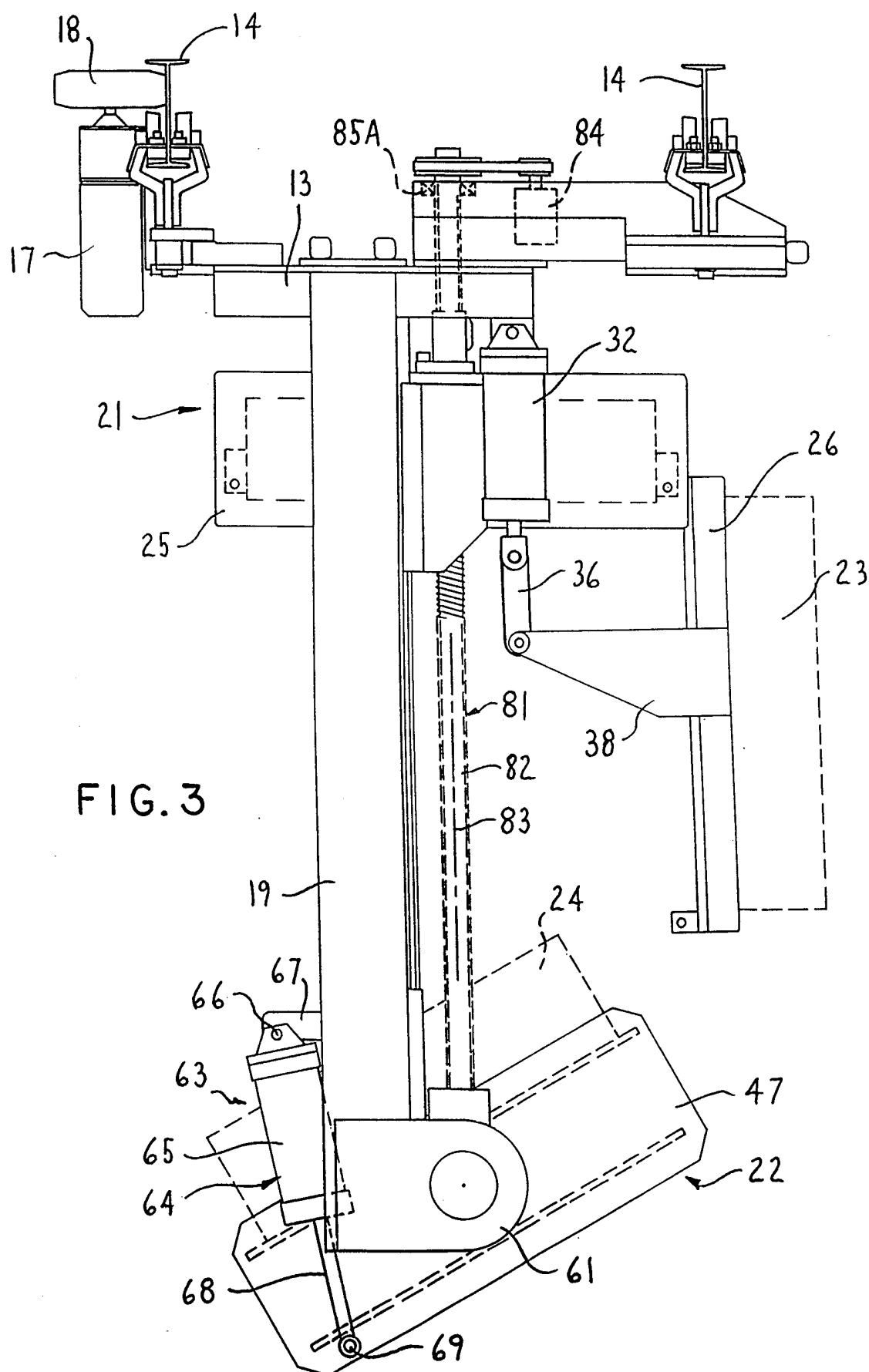
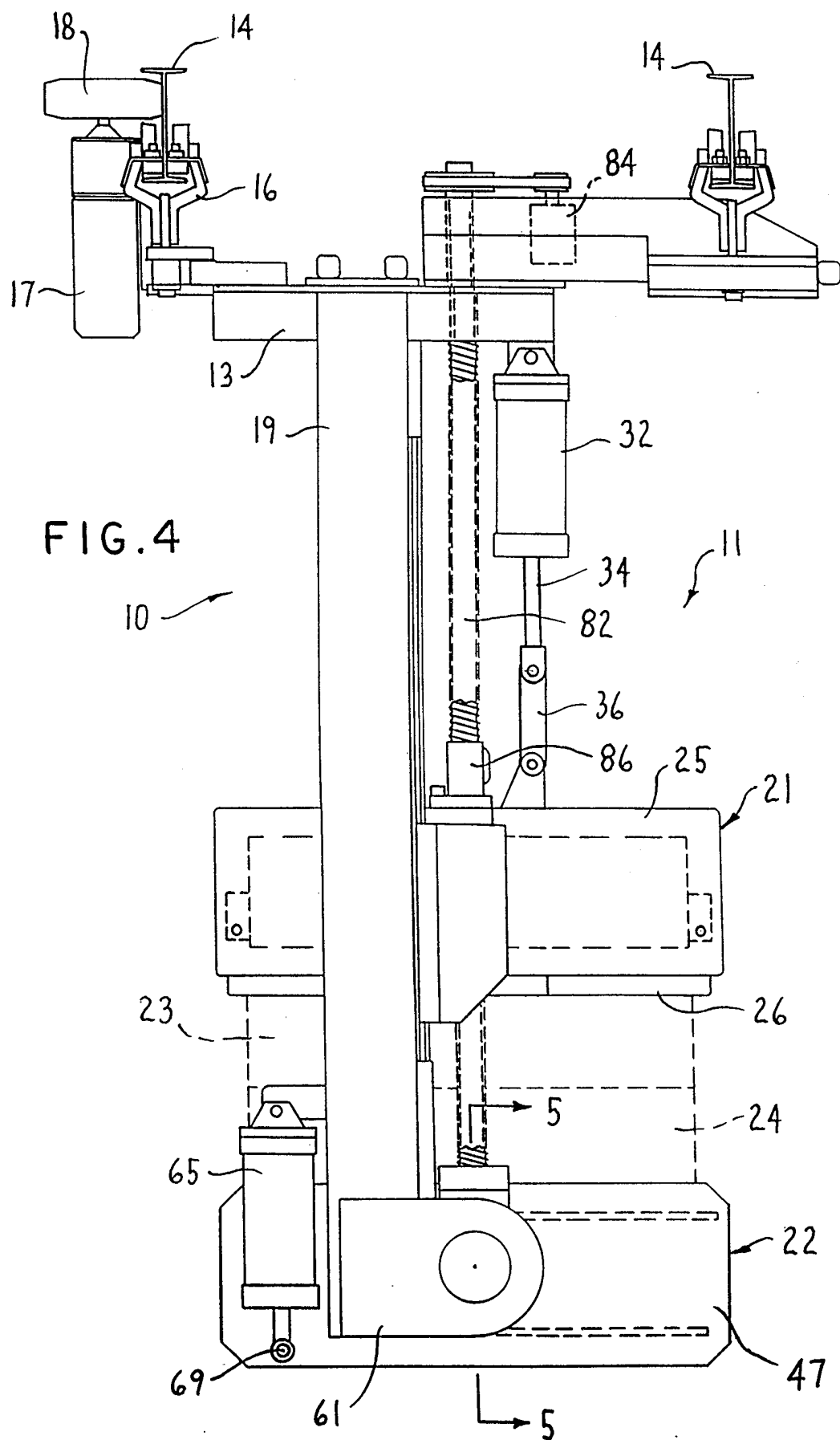


FIG. 1







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