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(54) **Thick product feeder**

(57) An apparatus feeds paper inserts or other flat products from one area to another. The apparatus is particularly useful for use with newspaper insert machines. A first rotating disk (204,205) presses against a first roller (210), and a second rotating disk (250) presses against a second roller (260). Each roller is arranged to rotate about an axis of rotation that is movable with respect its opposing disk. Moving each roller toward its opposing disk permits thin products to be fed through the apparatus, and moving each roller away from its associated disk permits thick products to be fed through the apparatus.

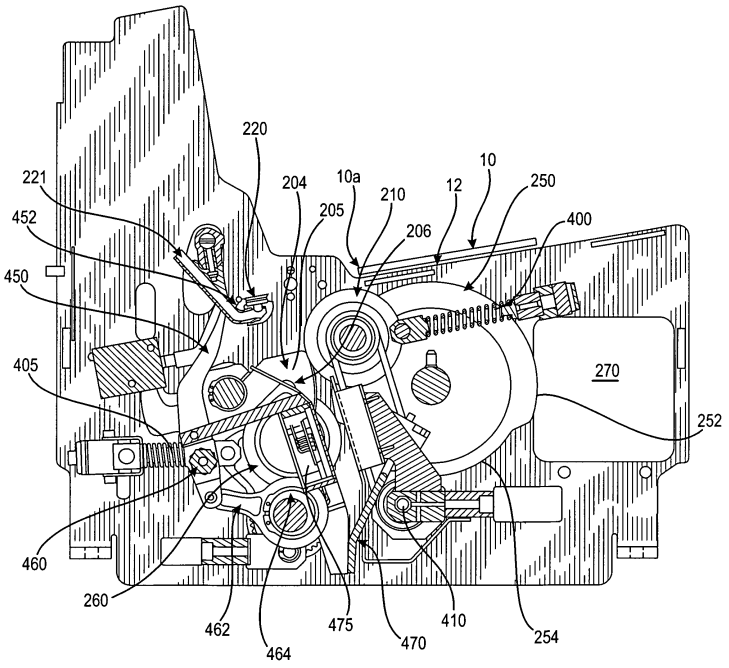

FIG. 2

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Description

[0001] This invention relates to an apparatus for feeding flat products such as newspaper inserts, sheets, signatures and the like into pockets or other areas of a machine. More particularly, the invention relates to an improved feeder capable of feeding products of different thicknesses.

[0002] In the graphic arts and newspaper industries, insert machines are often employed to automatically insert flat printed or other products into newspapers. Examples of some commercially available insert machines are described in US Patent Nos. 4,723,770; 5,823,320; and 6,907,316.

[0003] An insert machine typically has three basic sections that operate together in coordinated fashion. First, a straight-line pocket conveyor is arranged to carry a series of V-shaped or U-shaped pockets along a closed path. The pockets are typically oriented vertically with the open side of the "V" facing up, and they are carried horizontally by the conveyor. An example of one type of pocket is shown as element 300 in FIG. 1 of the above-mentioned '770 patent.

[0004] Mounted above the conveyor are one or more automatic feeder devices. See, for example, feeders 200 and 500 shown in FIG. 1 of the '770 patent. Other types of feeders are shown in US Patent No. 5,823,320 (FIG. 1, element 2), in US Patent No. 6,907,316 (element 16 of FIGS. 1-3), and in pending US patent application Serial No. 11/250,721, owned by the assignee of the present invention. Such feeders typically employ one or more rotating disks, rollers or drums within the feeder, together with suction cups and other devices, to pull sheets from the bottom of the stack and feed them down into the pockets.

[0005] In a typical operation, one feeder feeds a "jacket" of a newspaper vertically down into the pockets, one jacket per pocket. Next, as the pockets move downstream, they pass under other feeders that feed inserts down into each jacket. Finally, when inserting is complete, a gripper conveyor (such as structure 700 in FIG. 1 of the '770 patent) picks up the completed newspapers from the pockets and carries the products away for further handling.

[0006] Several design features need to be employed to achieve very high feeding speeds, consistent with accurate and efficient paper handling. First, the product must be transferred as quickly as possible from a stationary stack to a moving pocket. When the product is being transferred vertically, the force of gravity is used to assist in product transfer. But gravity is not enough. Just letting the product fall into the pocket does not enable transfer speeds at the desired high rate. An additional mechanical pushing or pulling force is also needed. An accelerating device is sometimes used to grab and "shoot" the product down into the pocket or other parts of the machine as fast as possible.

[0007] Next, the product, which is usually a thin, flexible paper insert, must be transferred while keeping the product as straight as possible to maximize transfer speeds while minimizing crumpling or warping in the pocket. Then, once the product has been transferred to the pocket or other area, it must not be allowed to "crash" into, crumple or jam inside the pocket.

[0008] Prior art feeders having a design similar to the design of the feeders described in the above-mentioned patents and pending application are quite suitable for many applications. For example, many newspaper inserts are extremely thin, having a thickness of perhaps one sheet of newsprint-style paper. These sheets can be effectively and rapidly fed from a stack of sheets into a series of pockets using an arrangement of internal rollers or disks pressing against each other to form one or more "pinch" points that grab the inserts and pass them to the pockets. Since the inserts in a particular feeder during a particular machine "run" are normally of uniform thickness, the feeding rollers can be mounted on fixed axes of rotation. This arrangement simplifies the design, and is often necessary. Because of the thinness of the inserts and the high feeding speeds required, the feeding rollers must press against each other firmly and consistently.

[0009] For some applications, however, it is desirable to have the capability to feed relatively thick inserts or other products, such as magazines, computer disks or even paperback books. While some prior art feeders could be manually adjusted to handle products of varying thicknesses, this adjustment process was typically quite time-consuming, particularly if a large number of feeders were being employed. Also, for safety and other reasons, the entire insert machine frequently needed to be shut down while the manual adjustments were being made, which necessarily slowed down the entire inserting process. Thus, a need exists for a feeder that can be quickly adjusted to handle products of different thicknesses. For best results, the adjustment process should be able to be performed automatically or semi-automatically.

[0010] The present invention satisfies the above-mentioned needs. An improved feeder device has been designed that can be quickly adjusted to accommodate widely varying thicknesses of newspaper inserts and other products. Certain features of the invention relate to improvements in the feeder described in the above-mentioned pending application US Serial No. 11/250,721, while other features of the invention are completely new. Feeding speeds of tens of thousands of products, of different thicknesses, per hour can be achieved.

[0011] In one embodiment of the invention, a row of pivoting sucker cups pulls down the leading edge of the lowermost product in the feeder stack. Then another device momentarily holds down the leading edge while the sucker cups pivot out of the way. Next, a segmented pusher disk pushes the leading edge down to a nip or pinch point formed between two opposing rollers. Next, the product is passed to another nip formed between another set of opposing rollers operating at a higher speed. The high speed rollers accelerate the product

down into a pocket passing below. All rollers are spring-loaded and are mounted on axes of rotation that are not fixed. The rollers can pivot toward and away from each other, to allow thicker products to be fed through the machine. The springs pushing on the rollers may be quickly adjusted automatically or semi-automatically to accommodate products of different thicknesses.

[0012] More specifically, in one embodiment, the invention comprises a feeder comprising a housing having a tray for receiving flat products in a stationary stack; a first roller mounted within the housing and biased against a first disk; and a second roller mounted within the housing and biased against a second disk; whereby each roller is arranged to rotate about an axis of rotation that is movable either toward or away from the first and second disks respectively, to allow products of different thicknesses to be fed from the stack, between the first roller and first disk, and between the second roller and the second disk.

[0013] In another embodiment, the invention comprises an apparatus for feeding flat paper products, comprising a housing having a tray for receiving flat products in a stationary stack; a first rotatable backup roller mounted within the housing and biased against a segmented rotating pusher disk, the first backup roller being arranged to rotate about an axis of rotation that is pivotable either toward or away from the pusher disk; and a second rotatable backup roller mounted within the housing and biased against a second disk, the second backup roller being arranged to rotate about an axis of rotation that is pivotable either toward or away from the second disk; whereby the distance between the first backup roller and the pusher disk, and the distance between the second backup roller and the second disk, may be adjusted to permit products of different thicknesses to be fed from the bottom of the stack and between the first backup roller and the pusher disk, and between the second backup roller and the second disk, respectively.

[0014] These and other aspects of the present invention may be more fully understood by reference to one or more of the following drawings, in which:

FIG. 1 is a perspective view showing the external appearance of one embodiment of the invention;

FIG. 2 is a side cutaway view of the invention;

FIG. 3 is a perspective, simplified, cutaway view of the invention showing certain internal structures;

FIG. 4 is a top cutaway view of the invention;

FIG. 5 is a side cutaway close-up view of the main spring adjustment assembly 402 of FIGS. 3 and 4;

FIG. 6 is a perspective, simplified, external view of the invention showing pulsed air separator orifices; and

FIG. 7 is a stripper bar assembly that may be used with the invention.

[0015] The following is a description of one embodiment of the present invention that is particularly useful for feeding flat paper, plastic or other products, such as inserts, sheets, cards, signatures, magazines, books, disks, mail, film packages, etc., from a stationary location to a moving location. Varying thicknesses of products can be accommodated. In this embodiment, a sheet or other product is grabbed from the bottom of a stationary stack, pulled through the machine by a series of disks, rollers and other devices, and is then subsequently delivered at high speed to a moving, vertically-oriented pocket open at the top and being carried by a linear conveyor moving horizontally beneath the product feeder. The invention is not, however, limited to such use and is usable in any environment where feeding of a flat product is needed to transfer the product from one location in a machine to another efficiently and at very high speed.

[0016] The overall external appearance of one embodiment of the invention is shown in FIG. 1. Typical newspaper inserts 10 are shown stacked in tray 12 on top of the machine 1, ready to be fed down into pockets (not shown) moving underneath feeder 1. FIG.6 shows the external appearance of the housing or frame of the invention. The major internal moving parts are shown in FIGS. 2-5. These figures are discussed in more detail below.

[0017] Looking next at FIG. 2, the invention comprises feeder 1 driven by motor 270 for feeding flat products such as paper inserts 10 one at a time from the bottom of a stack resting on tray 12 down into open pockets (not shown). Preferably, feeder 1 is mounted above a horizontal, linear, moving conveyor (not shown) carrying the pockets (not shown) oriented vertically.

[0018] The operation of a preferred embodiment of the invention will now be described in detail. First, as best seen in FIGS. 2 and 4, reciprocating sucker bar 221 pivots upward toward lowermost sheet 10 or other product 10 resting on tray 12. Suckers 220 mounted on sucker bar 221 engage leading edge 10a of lowermost sheet 10, and vacuum is applied. In FIG. 2, "leading edge" 10a is the left edge of sheet 10. After leading edge 10a has been grabbed by suckers 220, sucker bar 221 begins to pivot downward. This bends leading edge 10a downward and forms a triangular-shaped gap (not shown) between leading edge 10a of lowermost sheet 10 and leading edge 10a of next lowermost sheet 10. Next, a pulse of air is blown into the gap (not shown) for a fraction of a second to create an air bearing that helps to maintain separation between two sheets 10. As shown in FIG. 6, the air pulses are blown from one or more orifices 600 mounted slightly below and to the left of tray 12. Air is pulsed in timed relationship with the movement of suckers 220. The air pulses also help to lift the stack to take weight off of the

piece of product 10 being fed, preventing the stack from rolling out.

[0019] Next, in a feature of the invention, hold-down finger 450 (FIG. 2) pivots to the right and downward until finger tip 452 (FIGS. 2 and 4) of each finger presses down against leading edge 10a of lowermost sheet 10 for a fraction of a second. Hold-down finger tip 452 is best seen in FIG. 4. Hold-down finger 450 is driven in an oscillatory motion by eccentric 464 (FIG.2), which is a type of crank, attached to connecting link 462. Finger 450 pivots around pivot point 460.

[0020] In another feature of the invention, one or more rotating, segmented pusher disks 204 are mounted next to hold-down finger 450. Pusher disks 204 are driven by motor 270. As shown in FIG. 2, pusher disks 204, which have two or more drive segments 205 with curved outer surfaces and relatively sharp ends, are constantly rotating clockwise. Drive segments 205 may be coated with a high-friction material.

[0021] Leading edge 10a of lowermost sheet 10 is being momentarily held down, vacuum to suckers 220 is turned off. Next, the sharp end of one of pusher disk drive segments 205 enters the triangular gap (not shown) between two sheets 10 and bends lowermost sheet 10 down further. Next, sucker bar 221 pivots to the left to move suckers 220 out of the way and in preparation for engaging next sheet 10 in the stack. Next, curved outer surface 206 of one of pusher disk drive segments 205 engages low-speed backup roller 210. The outer surface of roller 210 is preferably coated with rubber or other high-friction material.

[0022] The engagement of disk 204 with roller 210 creates a low-speed, frictional nip or pinch point. As soon as leading edge 10a of sheet 10 has been bent down to this pinch point, disk 204 and roller 210 grab sheet 10 and start to pull it linearly to the left off of tray 12 and down into machine 1. Roller 210 may be set to one, two, three or more pre-set gage positions relative to disk 204.

[0023] Mounted next to pusher disks 204 are one or more high-speed disks 250. As shown in FIG. 2, each disk 250 is constantly rotating counterclockwise. Raised portion 252 of the outer periphery of disk 250 is coated with a high-friction material such a rubber. Portion 254 is stepped inward from portion 252 and is coated with a low-friction material, or is simply left uncoated. As disk 250 rotates, raised portion 252 of disk 250 periodically engages the outer periphery of high-speed backup roller 260 mounted adjacent to pusher disk 204. In FIG. 2, backup roller 260 is constantly rotating clockwise. The outer periphery of roller 260 is coated with a high-friction material.

[0024] Disk 250 and roller 260 pressing together form a high-speed, frictional nip or pinch point. As sheet 10 advances down through machine 1, leading edge 10a of sheet 10 is grabbed in the high-speed pinch point, and sheet 10 is immediately accelerated to a faster linear speed down through machine 1. At approximately the same time sheet 10 is being accelerated, drive segment 205 of pusher disk 204 has rotated further clockwise and no longer engages low-speed backup roller 210. In other words, the low-speed pinch point has been released. This prevents sheet 10 from being torn apart as sheet 10 moves from the low-speed pinch point to the high-speed pinch point. Also, at approximately the same time, a clutch (not shown) within low-speed backup roller 210 disengages to improve sheet feeding.

[0025] Shortly thereafter, as sheet 10 approaches the bottom of feeder 1, it passes over adjustable bowing rod 470 (FIG. 2). The purpose of rod 470 is to form a temporary bow in sheet 10, and to slow sheet 10 down slightly with friction. This stiffens sheet 10 so that, as sheet 10 exits feeder 1 and enters a pocket (not shown) beneath feeder 1, sheet 10 is less likely to crumple as it hits the bottom of the pocket (not shown) at high speed.

[0026] A significant feature of the invention is that products of widely varying thicknesses can easily be handled. One way this accomplished is that some of rollers 210, 260 are mounted on pivoting, as opposed to fixed, axes of rotation. For example, as shown in FIG. 2 and more clearly in FIG. 3, one or more low-speed backup rollers 210 are mounted on roller support shaft 211 (FIG. 3) that is arranged to pivot back and forth around pivot point 410 (FIG. 2). This allows roller 210 to pivot to the right (away from) pusher disk 204 if a gap (not shown) is needed to allow thick products 10 to pass between roller 210 and disk 204. Similarly, high-speed backup roller 260 is mounted on separate arm 262 that allows roller 260 to pivot either toward or away from high-speed disk 250. Roller support shaft 211 (FIG. 3), on which low-speed backup rollers 210 are mounted, is also able to pivot around a vertical axis (see FIG. 4). This permits rollers 210 to pivot back and forth horizontally (see FIG.4), to accommodate inserts 10 of uneven or non-uniform thicknesses.

[0027] In addition to pivoting axes of rotation, backup roller 210, 260 are all spring-loaded. This is best seen in FIG. 3. More particularly, main spring 400 is attached to pivoting arm 212 of backup roller 210, and secondary spring 405 is attached to pivoting arm 262 of backup roller 260. Springs 400, 405 are in compression. Spring 400 urges roller 210 against pusher disk 204 (not shown in FIG. 3), and spring 405 urges roller 260 against high-speed disk 250 (not shown in FIG. 3). Main spring 400 is also shown in FIGS. 4 and 5. Springs 400, 405 are mounted to surround spring rods 406, 440, such as spring rod 440 shown in FIG. 5, to add structural support and to facilitate adjustment.

[0028] Compensating rollers (not shown) may also be included in feeder 1.

[0029] In yet another feature of the invention, feeder 1 can be quickly and easily reconfigured between machine runs to accommodate products 10 of different thicknesses. To maintain appropriate bias in springs 400, 405, as products 10 of different thicknesses are introduced, there is provided main spring adjustment assembly 402 and secondary spring adjustment assembly 407. Assemblies

402, 407 are best seen in FIGS. 3-5. Assembly 402 permits adjustment of spring 400, and assembly 407 permits adjustment of spring 405.

[0030] Adjusting spring 400, 405 involves moving spring rod 406,440 either back or forth, to adjust the compression on rollers 210,260. This adjusts the spring bias at the pinch points. In other words, for example, if thick products 10 are to be fed, performance is improved if the spring bias at the pinch point is reduced. Conversely, if very thin products 10 are to be fed, the spring bias should be increased to maintain adequate friction at the pinch points so that products 10 can be fed reliably and quickly through machine 1.

[0031] The mechanism for moving spring rod 440 is shown in FIG. 5. As can be seen, mainspring 400 is wound around spring rod 440. Main spring 400 applies a biasing force to low speed backup roller 210 (FIG. 4), which causes roller 210 to press against curved drive segments 206 of pusher disk 204. Looking again at FIG. 5, spring rod 440 passes through opening 408 in a fixed structural member 409, and rod 440 can move up and down for a short distance. Attached to the lower end of rod 440 is wedge-shaped block 435, which will be called "wedge Y." Second wedge 430 ("wedge X") rests on top of wedge Y 435, with the slanted surfaces pressing against each other. Wedge X 430, in turn, is attached to air cylinder rod 510, which is housed within air cylinder 503. Air cylinder 503 consists of return spring 503 (FIG. 3), air brake fitting 507, air cylinder fitting 508, air cylinder 510, spring 511, and seal 513. Rod 510 is arranged to move back and forth within air cylinder 503 if compressed air is introduced into cylinder 503. Alternatively, air cylinder rod 510 may be moved back and forth by introducing liquid into cylinder 503, or by mechanical or electromechanical means. Another spring 511 is also attached to air cylinder 503 (see FIG. 5).

[0032] The arrangement shown in FIG. 5 permits feeder 1 to be adjusted to accommodate products 10 of different thickness. For example, it can be seen that if wedge X 430 is forced to the left by air in air cylinder 503, the slanted surface of wedge X 430 will slide over the slanted surface of wedge Y 435, which will force wedge Y downward, together with attached spring rod 440. This will reduce the compressive force in main spring 400. A gap (not shown) between rollers 210, 260, is set that is smaller than the thickness of insert 10 being fed. In this way, thicker products 10, can pass between low speed backup roller 210 and pusher disk 204 (FIG. 2). Some force on backup roller 210 is still required, so brake structure 520 driven by brake piston 522 (FIG. 5) prevents wedge X 430 from traveling too far over the top of wedge Y 435. Brake structure 520 consists of brake piston 522, seal 523 and friction material 524. If thin products 10 are to be fed through machine 1, air is again introduced into air cylinder 503, which will force wedge X 430 to the right, which will in turn force spring rod 440 upward to increase the compressive force in spring 400. Wedge X 430 remains firmly adjacent to wedge Y 435 by a return spring 504 (FIG. 3), which is under tension.

[0033] Secondary spring adjustment assembly 407 (FIG. 3) is identical to main spring adjustment assembly 402, except that assembly 407 is arranged to permit the adjustment of high-speed backup roller 260 , to allow products 10 of different thickness to pass between the pinch point formed by roller 260 pressing against high speed disk 250.

[0034] In a preferred embodiment, adjustment of feeder 1 is performed semi-automatically by an operator at the start of a "run" of insert machine 1. The operator will note the thickness of products 10 of feeder tray 12, and then engage air to move spring rod 440 either backward or forward by the proper amount. Alternatively, product thickness may be determined automatically by sensor 475 (FIG. 2) positioned within feeder 1. Sensor 475 may be connected to electromechanical or pneumatic means (not shown) to automatically adjust rollers 210 and 260.

[0035] Typically, after a machine run, roller adjustment will be reset so as to create a zero gap (not shown) between rollers 210, 260. As insert 10 is being fed, forcing rollers 210, 260 apart, wedge 430, 435 automatically moves to the correct position, as long as brake 520 is off (see FIG. 5).

[0036] One aspect of feeder 1 is that pulsed air "kit" (not shown) is available for separate purchase by a customer as a stand-alone unit and installed into feeder 1. FIG. 7 shows stripper bar assembly 800 suitable to use with feeder 1. Assembly 800 can be mounted underneath feeder tray 12 and adjacent to orifices 600 shown in FIG 6. Stripper bar assembly 800 together with other parts of the kit (not shown) may also be retrofitted onto other types of sheet feeders 1 not covered by the present invention, such as gripper-drum types of feeders 1 used with other insert machines and the like.

[0037] Although only a few embodiments of the present invention have been expressly disclosed, the invention is, nonetheless, to be broadly construed, and is not to be limited except by the character of the claims appended hereto.

Claims

1. A feeder for feeding flat products, comprising:

a housing having a tray for receiving flat products in a stationary stack;
a first roller mounted within the housing and biased against a first disk; and
a second roller mounted within the housing and biased against a second disk;
whereby each roller is arranged to rotate about an axis of rotation that is movable either toward or away from the first and second disks respectively, to allow products of different thicknesses to be fed from the stack, between the first roller and first disk, and between the second roller and

the second disk.

2. The feeder of claim 1, in which the first roller is biased against the first disk by a first spring, and the second backup roller is biased against the second disk by a second spring.

3. The feeder of claim 1, in which the first roller can be adjusted to a preset gage position relative to the first disk.

4. The feeder of claim 1, in which the first roller can be adjusted to one of three preset gage positions relative to the first disk.

5. The feeder of claim 2 in which the biasing force in each spring is adjustable by a pneumatically-driven adjustment assembly.

6. An apparatus for feeding flat paper products, comprising:

a housing having a tray for receiving flat products in a stationary stack;
a first rotatable backup roller mounted within the housing and biased against a segmented rotating pusher disk, the first backup roller being arranged to rotate about an axis of rotation that is pivotable either toward or away from the pusher disk; and
a second rotatable backup roller mounted within the housing and biased against a second disk, the second backup roller being arranged to rotate about an axis of rotation that is pivotable either toward or away from the second disk;
whereby the distance between the first backup roller and the pusher disk, and the distance between the second backup roller and the second disk, may be adjusted to permit products of different thicknesses to be fed from the bottom of the stack and between the first backup roller and the pusher disk, and between the second backup roller and the second disk, respectively.

7. The apparatus of claim 6, in which the first backup roller is biased against the pusher disk by a first spring maintaining a biasing force against the first backup roller, and the second backup roller is biased against the second disk by a second spring maintaining a biasing force against the second backup roller.

8. The apparatus of claim 7 in which the biasing force in each spring is adjustable by a pneumatically-driven adjustment assembly.

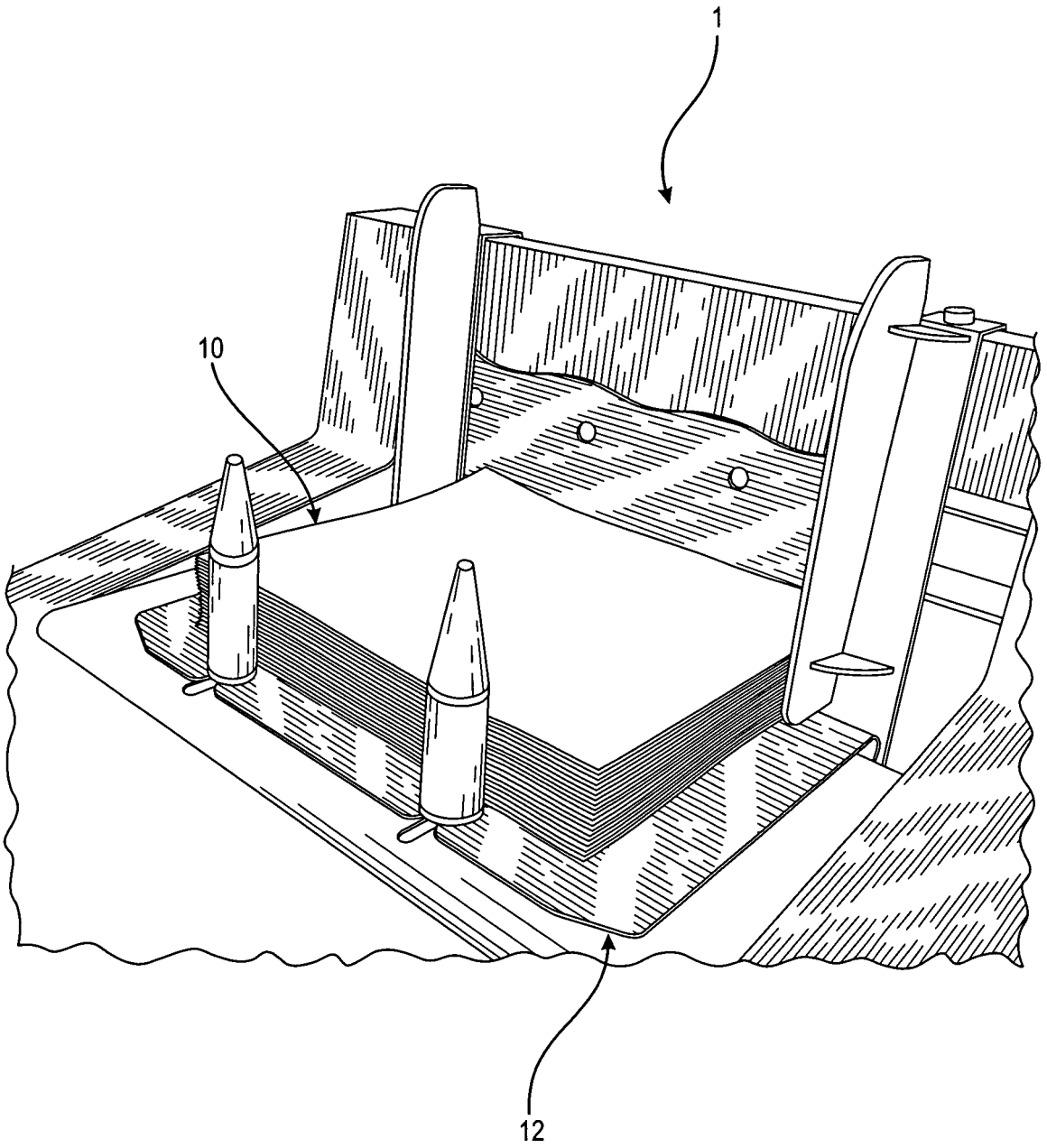

FIG. 1

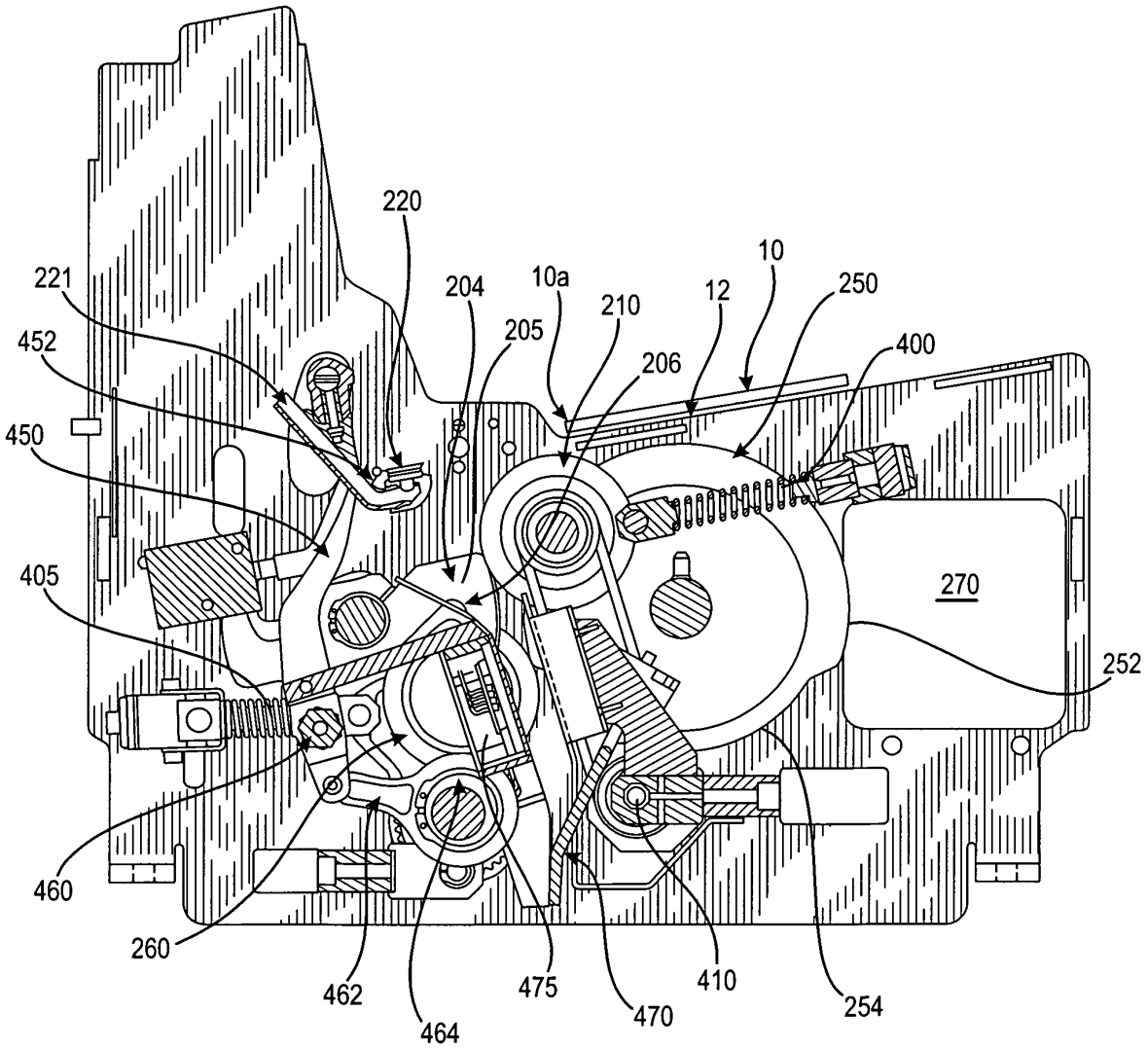
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FIG. 2

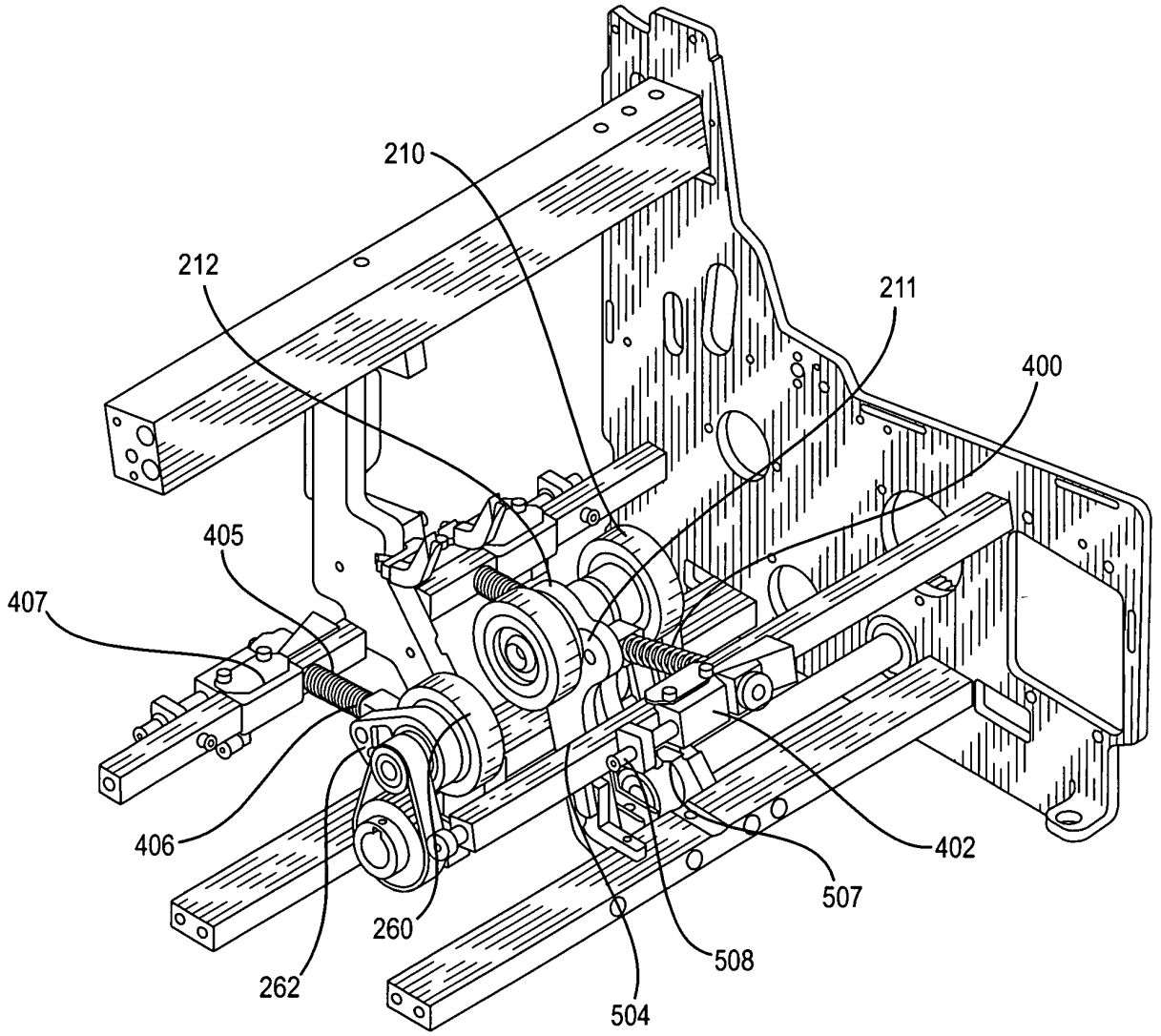

FIG. 3

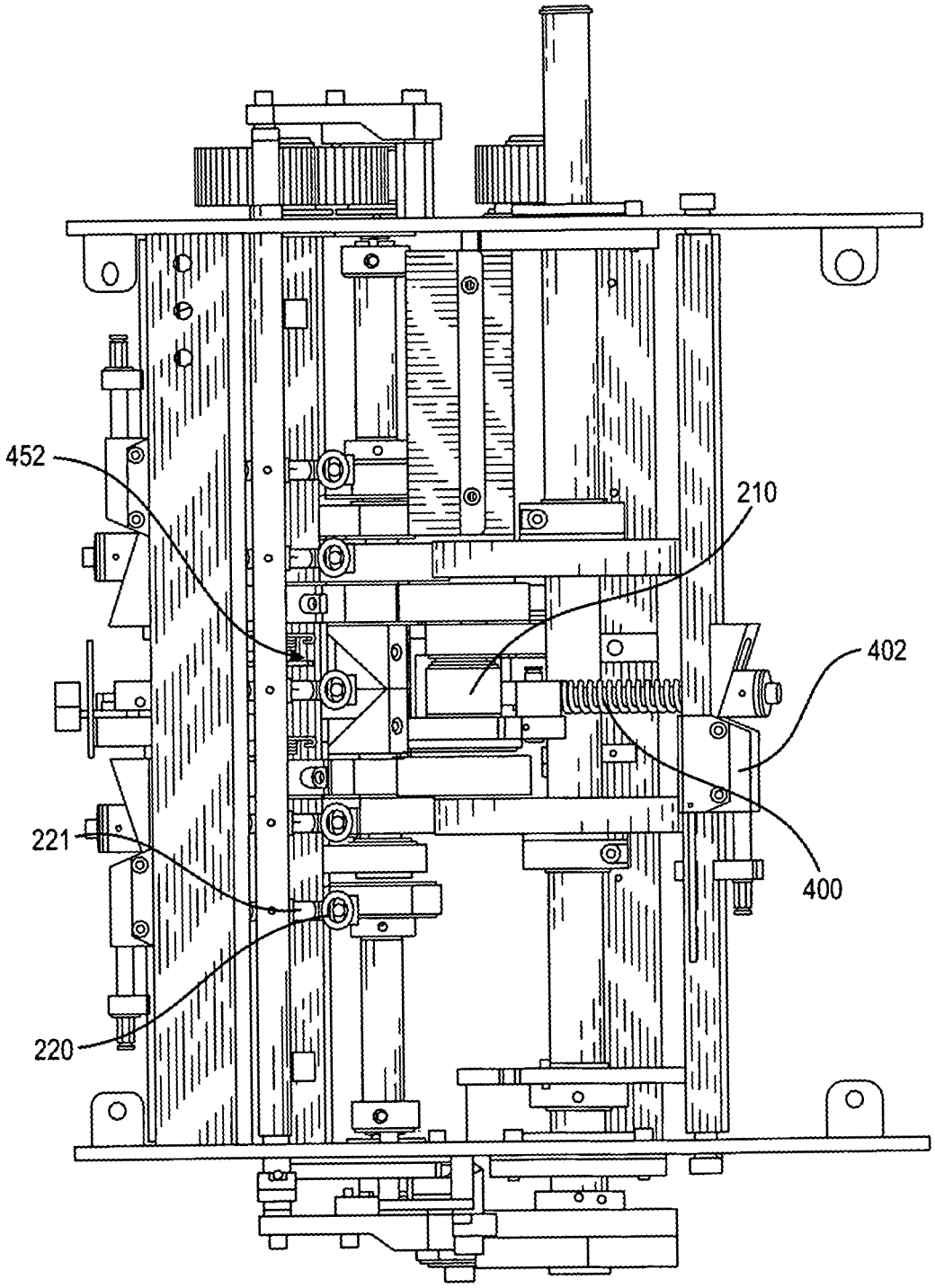

FIG. 4

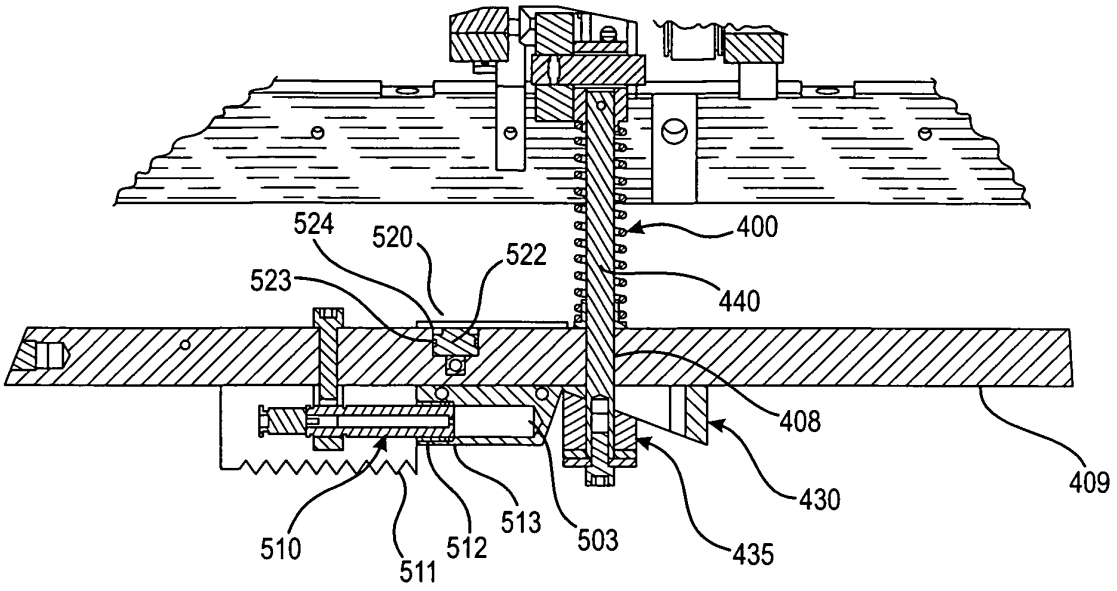

FIG. 5

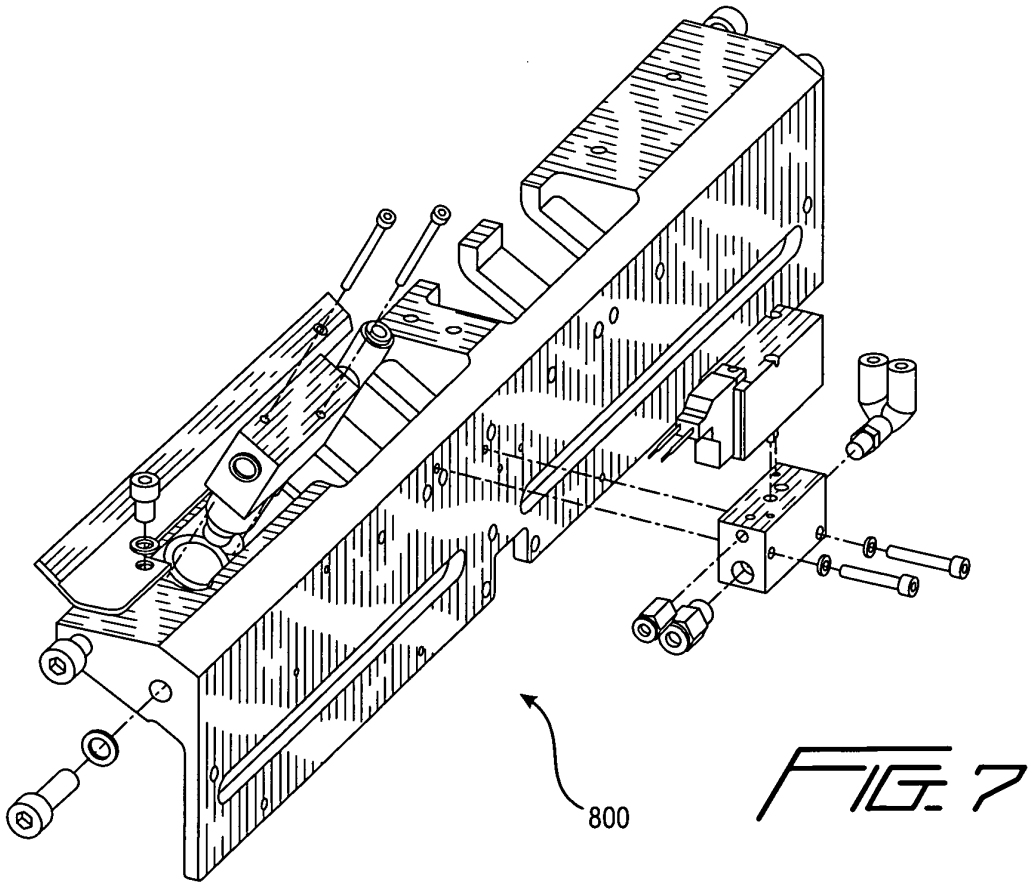

FIG. 7

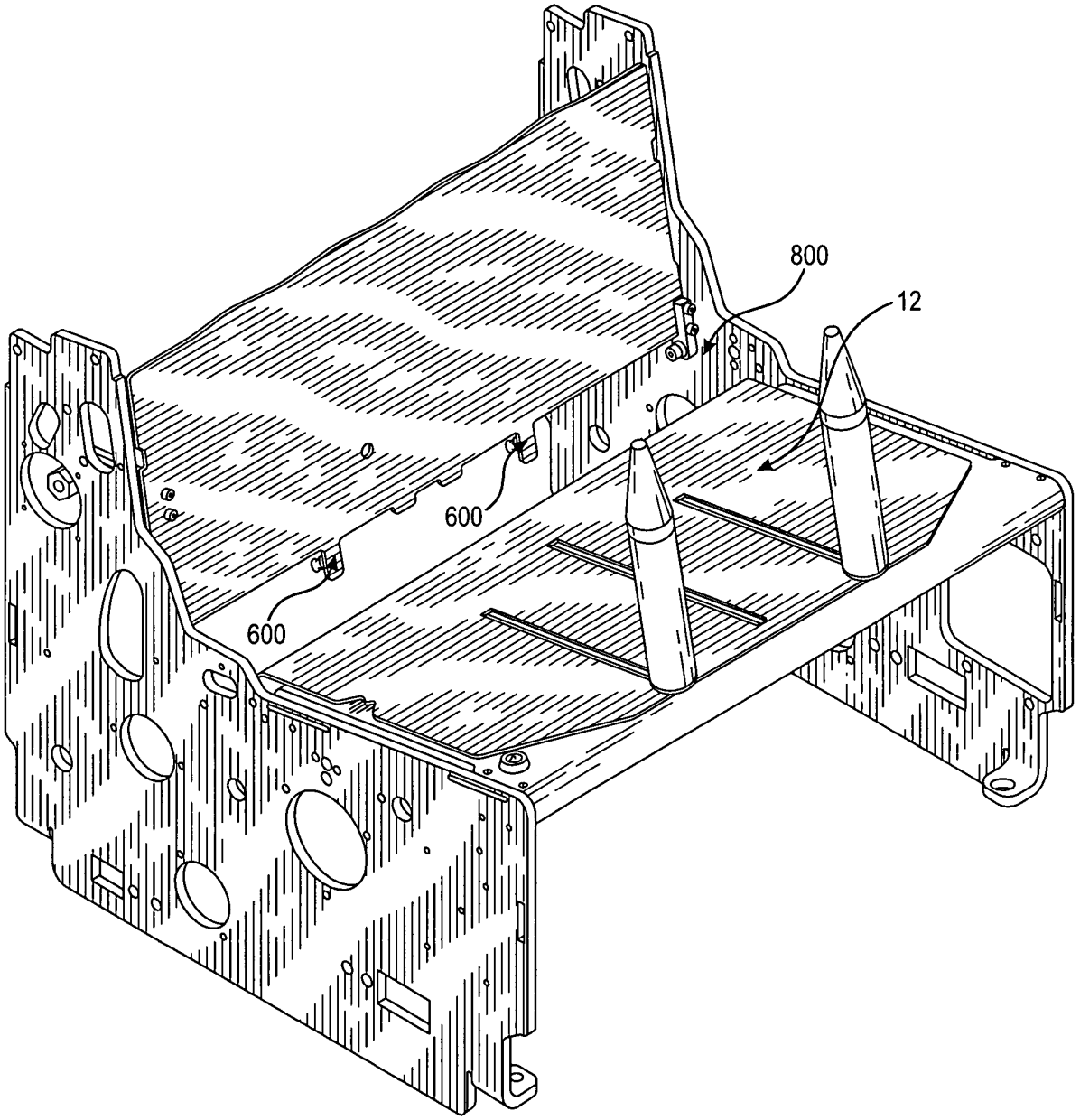

FIG. 6

REFERENCES CITED IN THE DESCRIPTION

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