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(71) Applicant: **PEMCO COMPANY**
3333 Crocker Avenue
Sheboygan Wisconsin 53081(US)

(72) Inventor: **Vorachek, Michael J.**
724 Dartmouth Drive
Sheboygan Falls Wisconsin 53085(US)

(72) Inventor: **Entringer, Guy P.**
1020 Custer Avenue
Sheboygan Wisconsin 53081(US)

(72) Inventor: **Meives, Otis E.**
Route 1
Cleveland Wisconsin 53015(US)

(72) Inventor: **Lynch, Gary L.**
3501 Main Avenue
Sheboygan Wisconsin 53081(US)

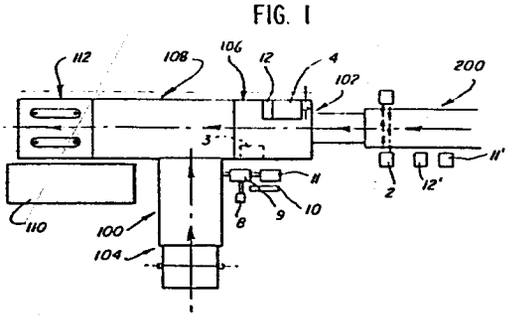
(72) Inventor: **Lutzke, Anthony J.**
Route 2
Elkhart Lake Wisconsin 53020(US)

(74) Representative: **Herrmann, Günther**
c/o Hauni Werke Körber & Co. KG Patentabteilung
Kampchaussee 8-30
D-2050 Hamburg 80(DE)

(54) Method of and apparatus for wrapping reams of paper or the like.

(57) Reams of paper sheets are wrapped in sheets (S) of wrapping material (W) in a wrapping apparatus (100) which is electronically coupled to the sheeter (200) that produces the reams so as to automatically and continuously synchronise their operation. The position of the wrapping apparatus (100) relative to the position of the sheeter (200) is automatically adjusted to ensure synchronisation of the operation of the wrapping apparatus with that of the sheeter. The reams which are randomly received by the wrapping apparatus (100) from the sheeter (200) are monitored and selected reams are delayed (15) to obtain a desired spacing therebetween. The delayed reams are fed to the wrapping section (106) of the wrapping apparatus (100) during predetermined stages of successive cycles of the wrapping section, and the drive (4) for the wrapping apparatus is coupled to the drives for the web positioning and wrapper sheet transfer means (26) for advancing the web (W) and the wrapper sheets (S) to the cutting (104) and draping (104) positions, respectively, at a gradually increasing, constant and gradually decreasing speed conforming to the cycle of the wrapping section.

FIG. 1



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METHOD OF AND APPARATUS FOR WRAPPING REAMS OF PAPER OR THE LIKE

This invention relates to a method of and to an apparatus for wrapping articles, and more particularly to a method of and to an apparatus for wrapping block-shaped units, such as reams of paper, in wrappers constituted by sheets of paper or other suitable wrapping material. For the sake of simplicity, reference is made herein to "reams"; however, it is to be understood that the improved method and apparatus are equally suited for the wrapping of other commodities and that such reference is not intended to limit the scope of the claims. A ream generally comprises a stack of five hundred sheets of paper, e.g., 8½" by 11" or 8½" by 14". Such reams are presently produced in vast quantities by an apparatus called a "sheeter" which cuts paper webs into sheets of the desired size (e.g., 8½" by 11") and assembles the sheets into reams of five hundred sheets each.

The method and apparatus of the present invention belong to the same field as the methods and apparatus disclosed in U.S. Patents Nos. 4,029,194, 4,073,375, 4,193,491, 3,458,026, 4,203,694, 3,533,496, 3,861,120, 4,279,116, 3,213,591 and 4,011,155, and in applicant's literature describing its Model 66 wrapping apparatus (designed to operate at speeds of between 20 and 41 reams per minute) and its Model 35 and 36 wrapping apparatus (designed to operate at speed of up to 60 and up to 80 reams per minute, respectively).

Wrapping of reams of paper, and especially wrapping of reams at relatively high production rates, presents special problems. First of all, it is difficult to maintain the integrity of the reams (i.e., to maintain all sheets of a ream in accurate register). Secondly, problems are encountered because the reams are delivered to the wrapping apparatus with slight spacing irregularities between successive reams (in other words, the reams are randomly received, i.e., they are not equally spaced from one another), and the rate at which the reams are delivered

is not necessarily fixed relative to the speed at which the wrapping apparatus is operated (i.e., the sheeter, the ream delivery system and the wrapping apparatus may not share a common drive). The spacing variations between the reams and the differences between the delivery rate of the reams and cycling rate of the wrapping apparatus cause the reams to be delivered periodically in and out of phase with the cycle of the wrapping apparatus. This can result in jamming of the wrapping apparatus.

Problems are further encountered in connection with the operation of the web positioning and wrapper sheet transferring portions of the wrapping apparatus which position and supply wrapper blanks for wrapping around the reams. These aspects of the wrapping operation are particularly important because the wrapping sheet is often imprinted. Unless these operations are properly carried out, the web may be cut through the imprint or the wrapper sheet may be wrapped around the ream with the imprint improperly positioned on the ream. Prior art methods and apparatus for accomplishing web positioning and wrapper sheet transfer have utilized electronic controls (e.g., printed circuit boards) for controlling the drives for the web positioning and wrapper sheet transferring mechanisms. Such electronic controls have been able to effect positioning of the web and wrapper sheets, but with rapid acceleration and deceleration of the web and wrapper sheets. The time constraints under which the web must be paid out, positioned and cut, and under which the cut wrapping sheet must be subsequently transferred to assume a proper position for draping around the ream require operating speeds which can involve jerky starts and stops of the apparatus using such prior art techniques. Damage to the web and wrapper sheet and undesirable excessive wear upon the components of the wrapping apparatus can result. Moreover, such prior art solutions are expensive.

Still further, problems are encountered in operating the cutting mechanism. Conventional reciprocating guillotine type cutting blade mechanisms generate excessive noise, and

prior art rotary cutting mechanisms which are disposed above the path of the web are difficult to adjust and to replace and they interfere with the positioning of the following wrapper sheet transfer mechanism (in the form of a vacuum belt at the underside of which the wrapper sheet is held by suction) in such a way that the cut wrapper sheet is held against curling along its cut edge.

Finally, problems are encountered in handling of the reams during outfeed (which commences while the reams are in the process of being wrapped by the wrapping means) so as to ensure that the reams are not damaged. High-speed motion must be imparted to each ream as it is being acted upon by the wrapping means so as to effect its removal from the wrapping station in a highly expeditious manner in order to permit entry of the next-following web. And yet, such high-speed motion must be imparted to the stationary ream without damaging the ream or knocking the ream out of alignment. A greater variation in the speeds and a more gradual acceleration of the overhead discharge conveyor, which effects removal or outfeed of each ream being acted upon, by the wrapping means than has been possible with conventional apparatus is required.

The aforementioned problems become particularly acute when the wrapping apparatus is operated at speeds in excess of 100 reams per minute. The prior methods and apparatus have worked satisfactorily at lower speeds of 60-80 reams per minute, but they have proved unsatisfactory and unreliable at higher operating speeds, namely at speeds in excess of 100 reams per minute. They either cannot operate at such speeds at all, or they cannot sustain such speeds, i.e., they have a very short service life at such speeds.

An object of the present invention is to overcome the aforementioned problems in such a way as to permit routine operation at speeds in excess of 100 reams per minute. The present method and apparatus are not merely an improvement over prior art methods and apparatus but rather represent a "second (or

third) generation" wrapping method and apparatus which overcome the aforementioned problems in novel and unique ways so as to permit operation of the wrapping apparatus at speeds which, for industry conceptions, are significantly higher than in and unattainable with conventional methods and apparatus.

An additional object of the invention is to provide an improved method of and an improved apparatus for wrapping reams of paper or other block-shaped piles or units at a relatively high production rate without affecting the integrity of the units.

Another object of the invention is to provide a novel and unique method of and a novel apparatus for coupling the sheeter and wrapping apparatus so as to automatically and continuously synchronize their operations.

A further object of the invention is to provide a novel and unique method of and a novel apparatus for adjusting the wrapping apparatus to keep it in phase with the sheeter.

An additional object of the invention is to provide a novel and unique method of and a novel apparatus for adjusting the positions of the reams which are discharged by the sheeter in the event that the positions of the discharged reams are not always the same relative to the position of the sheeter.

A further object of the invention is to provide a novel and improved wrapping apparatus which can accommodate variances in spacing between successive reams to be wrapped.

Another object of the invention is to provide a novel and improved method of and a novel and improved apparatus for effecting desired spacing between reams which are delivered to wrapping means of the wrapping apparatus so that randomly received reams can be routinely handled without requiring operation of the wrapping apparatus and sheeter at different speeds.

Another object of the invention is to provide a novel and improved method of and a novel and improved apparatus for feeding reams to be wrapped to continuously operable wrapping means of the wrapping apparatus which cycles at a steady rate.

An additional object of the invention is to provide a novel and improved method of and a novel and improved apparatus for conveying reams to wrapping means and for delaying conveyance of the reams to the wrapping mrans without damage to the reams.

Another object of the invention is to provide a novel and improved method of and a novel and improved apparatus for effecting precise control of wrapper web positioning and wrapper sheet transferring means keyed to cycling of the wrapping apparatus.

A further object of the invention is to provide a novel and improved method of and a novel and improved apparatus for coupling the drives for the wrapper web positioning and wrapper sheet transfer means to the drive of the wrapping apparatus so as to avoid sudden starts and stops and possible damage to the web or wrapper sheets.

Another object of the invention is to provide a novel and improved wrapper web cutting mechanism which ensures adequate support of the wrapper sheet which is cut off so as to avoid curling.

An additional object of the invention is to provide a novel and improved wrapper web cutting mechanism which facilitates convenient replacement and adjustment of the cutting means.

A further object of the invention is to provide a novel and improved method of and a novel and improved apparatus for expeditiously discharging wrapped reams without damage.

Another object of the invention is to provide a wrapping apparatus which is of relatively simple construction, which is reliable in operation, and which has a long service life.

The improved method comprises the step of feeding successive reams one after the other to a wrapping apparatus which cycles continuously at a steady rate with a ream being receivable by wrapping means of the wrapping apparatus only during a selected portion of each cycle of the wrapping means. The reams

to be fed to the wrapping apparatus are randomly delivered from a sheeter, one at a time and at an average rate. The method further comprises the step of electronically coupling the sheeter and the wrapping apparatus so that they operate in synchronism at the same speed. The reams coming from the sheeter are monitored and the operation of the wrapping apparatus is modified to conform the cycle phases of the sheeter and wrapping apparatus. The reams are fed in a straight line, one at a time, to a holding or delaying station where a ream may dwell for a certain interval of time. Each ream which has been delivered to the holding station is fed further forward in a continuation of the straight-line motion in time for delivery to the wrapping means of the wrapping apparatus during the selected portion of the cycle of the wrapping means when the latter is positioned to receive and wrap a ream. The feeding of a randomly received ream to the holding station occurs at a relatively low speed while the transport through and away from the holding station takes place at a higher speed. The feeding forward of a ream which has been delivered to the holding station too late for delivery to the wrapping means during the selected portion of a cycle is deferred until the next-following cycle of the wrapping means. A ream which has been delayed at the holding station is rapidly accelerated to the higher speed and thus moves ahead of any following ream which may have been in contact with it while it was delayed inasmuch as the following ream is still travelling at the lower speed. The components at the holding station are operated in phased relation to delivery of a delayed ream through and away from the holding station so as to reduce the likelihood of contact of components at the holding station with the delayed ream, which contact could be deleterious to the integrity of the ream.

The improved method further comprises the steps of positioning the wrapper web, subdividing the wrapper web into wrapper sheets, and transferring the wrapper sheets. The web positioning and wrapper sheet transfer means are coupled to the

main drive for the wrapping apparatus so that, dependent upon the required length of the wrapper sheets, the wrapper web will move to a certain extent prior to cutting and the wrapper sheets will move to a different extent (possibly even to the same extent as the wrapper web) after cutting in a gradually accelerating, constant, gradually decelerating motion keyed to the cycle of the wrapping apparatus, thus avoiding sudden start and stop motions. The cutting means is disposed below the wrapper web such that a larger portion of the wrapper sheet which is cut off can be supported by the transfer means against curling.

The improved method further comprises controlled removal of reams being acted upon by the wrapping means of the wrapping apparatus from the wrapping means and all the way to ultimate discharge from the wrapping apparatus. Reams which are in the process of being wrapped by the wrapping means are engaged by overhead conveyor means travelling at a significantly reduced rate of speed. After initial engagement, the overhead conveyor means progressively accelerates the reams to a high speed so as to expeditiously move the reams from the wrapping means without jarring the reams or causing misalignment of their sheets. Before engaging the next-following ream, the overhead conveyor means is decelerated so that, upon initial engagement of the next-following ream, no bouncing or jarring of the next-following ream occurs.

The improved wrapping apparatus comprises conveying apparatus for feeding reams one after the other to wrapping means which cycles continuously at a steady rate with a ream being receivable by the wrapping means only during a selected portion of each cycle. The reams to be fed to the wrapping means are randomly delivered to the conveying apparatus from a sheeter, one at a time and at an average rate. The wrapping apparatus further comprises delaying or holding means for delaying reams which are fed by the conveying apparatus so as to ensure that they are delivered to the wrapping means during the selected

portions of the respective cycles, namely when the receiving means is able to receive and handle the reams. The wrapping apparatus further comprises an electronic line shaft for coupling the sheeter and the wrapping apparatus so as to synchronize their operation, and a phase adjust loop which is incorporated into the electronic line shaft for adjusting the phase relationship between the positions of the reams on the sheeter and in the wrapping apparatus.

The novel wrapping apparatus further comprises positioning means for advancing a web of paper to be cut into wrapper sheets to a predetermined position where it is cut, and means for transferring each wrapper sheet to an overlying position with respect to the ream about which it is to be draped. The positioning and transfer means comprise an independent DC servo motor which is connected to a cam unit driven by the main drive of the wrapping apparatus and whose velocity is determined by the velocity curve of the cam unit as if the motor and the cam unit were mechanically coupled. Means is provided for readily varying the relationship between the velocities of the motor of the positioning and transfer means and the cam unit so that different-size wrapper sheets can easily be produced as needed. The cutting means is a rotary cutting means which is mounted beneath the web and acts against a counterknife mounted above the web, thus permitting the transfer means which is disposed above the web to more fully support the web which is cut off as a wrapper sheet and to thereby avoid curling of the cut edge of the wrapper sheet. Such mounting of the counterknife above the rotary knife facilitates access for repair or replacement and for convenient adjustment.

The improved wrapping apparatus also comprises overhead discharge conveyor means which operates at varying rates of speed under the control of a conjugate cam. The overhead conveyor means initially engages reams being processed by the wrapper means at a relatively low speed in order to avoid jarring and bouncing of the reams as well as to avoid damage to the reams.

The overhead conveyor means then progressively accelerates the reams to expedite their removal from the wrapping means. Thereafter, the speed of the overhead conveyor means remains constant until it is about to engage the next-following ream, at which point the overhead conveyor means is rapidly decelerated such that it is again moving at the lower speed, whereupon it engages the next-following ream.

The invention will be described in greater detail with reference to the accompanying drawings in which:

Figure 1 is a plan view showing the locations of components of the resolver phase adjusting system of the invention;

Figure 2 is a schematic view showing the connections between various components of the resolver phase adjusting system;

Figure 3 is a plan view showing the locations of components at the holding station;

Figure 4 is a schematic view showing the connections between various components at the holding station;

Figure 5 is a timing graph for various components of the apparatus;

Figure 6 is a plan view showing the locations of various components of the web positioning and wrapper sheet transfer system in the improved apparatus;

Figure 7 is a schematic view showing the connections between various components of the web positioning and wrapper sheet transfer system;

Figure 8 is a schematic view showing the mechanical connections between various components of the improved apparatus;

Figure 8A is a schematic view showing the mechanical connections between various components of the web positioning system;

Figure 8B is a schematic view showing the mechanical connections between various components of the wrapper sheet transfer system;

Figure 9 is a top plan view of an embodiment of the

improved apparatus;

Figure 10 is a side elevational view of the embodiment of Figure 9;

Figure 11 is an end elevational view of the embodiment of Figure 9;

Figure 12 is a schematic perspective view of the ream wrapping sequence in the embodiment of Figure 9;

Figure 13A is a top plan view of one-half of the infeed conveyor of the embodiment of Figure 9;

Figure 13B is a top plan view of the other half of the infeed conveyor of the embodiment of Figure 9;

Figure 14A is a side elevational view of the one-half of the infeed conveyor shown in Figure 13A;

Figure 14B is a side elevational view of the other half of the infeed conveyor shown in Figure 13B;

Figure 15A is a top plan view of one-half of the structure over which the upper reaches of the infeed conveyor section of Figure 13A travel and of the associated guide rails and stop gates at the holding station of Figure 3;

Figure 15B is a top plan view of the other half of the structure over which the upper reaches of the infeed conveyor section of Figure 13B travel and of the associated guide rails;

Figure 16A is a side elevational view of the one half of the structure, guide rails and stop gates at the station which is shown in Figure 15A;

Figure 16B is a side elevational view of that (other) half of the structure which is shown in Figure 15B;

Figure 17A is a top plan view of one-half of discharge conveyor of the embodiment of Figure 9;

Figure 17B is a top plan view of the other half of the discharge conveyor of the embodiment of Figure 9;

Figure 18A is a side elevational view of the one half of the discharge conveyor shown in Figure 17A;

Figure 18B is a side elevational view of that (other) half of the discharge conveyor which is shown in Figure 17B;

Figure 19 is a top plan view of the shear assembly including the web positioning and wrapper sheet transfer system of the embodiment of Figure 9;

Figure 20 is a side elevational view of the shear assembly of Figure 19;

Figure 21 is an enlarged vertical sectional view as seen in the direction of arrows from the line 21-21 of Figure 19;

Figure 22 is a top plan view of the wrapper sheet folding assembly in the embodiment of Figure 9;

Figure 23 is a side elevational view of the folding assembly of Figure 22;

Figure 24 is an end elevational view of the folding assembly of Figure 22, looking in an upstream direction;

Figure 25 is a top plan view of the compression assembly in the embodiment of Figure 9; and

Figure 26 is a side elevational view of the compression assembly of Figure 25.

Figure 1 shows a wrapping apparatus or ream wrapper 100 and a sheeter 200 as well as various components of a resolver phase adjusting system for regulating the operation of the wrapping apparatus 100 so as to synchronize it with the operation of the sheeter 200. The resolver phase adjusting system comprises an electrical line shaft between the sheeter 200 and the wrapping apparatus 100, and such line shaft has a phase adjust loop. When the electrical line shaft is activated, the wrapping apparatus 100 operates as if it were mechanically coupled to the sheeter 200 and follows both the speed and position of the sheeter. The purpose of the phase adjust loop is to adjust the phase of the wrapping apparatus 100 so as to align it with the positions of the reams on the discharge conveyor of the sheeter 200.

The wrapping apparatus 100 includes an infeed section 102, a shearing assembly 104, a wrapping section 106, an overhead discharge section 108, an electrical enclosure 110 and a compression assembly 112. Within the electrical enclosure 110 are

the following components of the resolver phase adjusting system (shown schematically in Figure 2): a programmable controller 1, a servo pulse width modulated drive 5, a transducer interface 6 and an electronic relay 7. Mounted on the wrapping apparatus 100 are the following components of the resolver phase adjusting system: a rotating cam limit switch and pulse generating disc 3, a DC servo motor 4 which is the main drive for the wrapping apparatus 100, a reversible stepping motor 8, a dynamic differential input/output phase adjuster drive 9, a counter proximity switch 10, a slave resolver or feedback assembly 11, and a tachometer generator 12. Mounted on the sheeter 200 are the following components of the resolver phase adjusting system: a master feedback assembly or resolver 11', a master tachometer generator 12' and a photoelectric product detector eye 2. The slave resolver 11 is mechanically coupled to the wrapping apparatus 100. The resolver 11' and the tachometer generator 12' are mechanically coupled to the sheeter 200 and essentially provide a position and velocity reference. Signals from the master and slave resolvers 11' and 11, respectively, are summed into the transducer interface board 6. The output of the transducer interface board 6 transmits an analog signal which is proportional to the position error of the two resolvers (11' and 11). The position error signal, along with the speed reference command from the tachometer generator 12' coupled to the sheeter 200, provide the reference command for the pulse width modulated (P.W.M.) drive 5. The P.W.M. drive 5 controls the velocity of the motor 4. The tachometer generator 12 monitors the speed of the motor 4 and provides the velocity feedback signal.

The connections between the various components of the resolver phase adjusting system are shown in Figure 2. Such connections and the nature of the resolver phase adjusting system itself will be best understood by considering the operation of the resolver phase adjusting system. Initially,

when the operator presses the line drive set push button to begin operation and the speed of the sheeter (source of stacks, piles or reams) 200 is below 40 reams per minute, the wrapping apparatus 100 will run at a preset speed. At such time, the drive motor 4 for the wrapping apparatus is merely speed-regulated and the electrical line shaft between the sheeter and the wrapping apparatus is inactive. When the sheeter 200 reaches a speed of 40 reams per minute, which is indicated by the amplitude of the signal from the tachometer generator 12' that is located on the sheeter 200, the voltage sensing relay 7 is energized. This activates the electrical line shaft, switching the speed reference command from the present speed potentiometer 13 to the tachometer generator 12' located on the sheeter 200, and opens up a contact that is connected to the sheeter so that the speed of the sheeter cannot increase. At this point, the phase adjusting loop is also activated. When the leading edge of the first ream blocks the product detector eye 2, the programmable controller 1 ascertains whether or not to advance the position of the wrapping apparatus by sensing the position of the rotating cam limit switch 3. The wrapping apparatus always advances when initial synchronisation occurs to ensure that a back-to-back ream condition will not take place at the holding station. In addition, at the time the leading edge of the first ream blocks the ream detector eye 2, the programmable controller 1 begins to count pulses from the pulse generating cam 3 in order to determine how far out of the timing window the ream is. A pulse is produced every 20 degrees of machine rotation. After the programmable controller 1 has ascertained by how many pulses the ream is out of the window, it energizes the stepping motor 8 in either the forward or reverse direction so as to advance or retard the slave resolver 11. The stepping motor 8 is mechanically coupled to the dynamic differential input/output phase adjuster 9. Through such coupling, the relative shaft

position relationship between the resolver 11' on the sheeter 200 and the resolver 11 on the wrapping apparatus 100 is changed. When the stepping motor 8 is energised in either the forward or reverse direction, the counter proximity switch 10 located on the shaft of the stepping motor 8 produces a count proportional to the number of revolutions of the stepping motor shaft such that the stepping motor will remain energised until the count that was established by the pulse generating cam 3 reaches zero. It will remain energized until a count representative of one-half the timing window area has also expired. The resultant position of the resolver shaft will have changed, which will send the phase correction error signal through the transducer interface 6 and speed up or slow down the motor 4 to correct the phase error. As additional reams are detected by the product detector eye 2, the phase adjustment system continues to advance or retard the position of the wrapping apparatus 100 with respect to the position of the ream. When the ream detector eye 2 has seen three reams in the timing window (the timing window is a cam located on the timing cam 3), the programmable controller 1 energises a contact that enables the sheeter 200 to increase its speed.

The following commercially available products sold under the indicated company/product names may be used in the resolver phase adjusting system according to Figures 1 and 2: The programmable controller 1 can be an Allen Bradley Mini PLC 2/15 programmable controller. The photo-electric eye 2 can be a Banner electric eye consisting of an emitter ET-1 and a receiver RT-3. The timing unit 3 can be a Gemco #1983-12-08-D-L1 rotating cam limit switch and S-580-B pulse generating disc. The DC main drive motor 4 can be a DC servo motor Inland #TT4503-1000-B. The servo pulse width modulated drive 5 can be an A2274 NC740 pulse width modulated drive. The transducer interface board 6 can be a Systrol #A0902 transducer interface. The voltage

sensing relay 7 can be a Systrol #A0907 electronic relay 5 Amp. The reversible electric stepping motor 8 can be a Superior #M092-FD08 stepping motor. The dynamic differential input/output phase adjuster drive 9 can be a Candy dynamic differential #DD-IA input/output phase adjuster drive. The proximity switch 10 can be a Turck #B15-G18-AN7 NPN output proximity switch. Each of the resolvers or feedback assemblies 11 and 11' can be a Systrol #1127-0000-M0D-705 feedback assembly. The tachometer generators 12 and 12' can each be a Wertronic #601A100-1 flange mount 100 VDC 5 PY tachometer generator. Finally, the present speed potentiometer 13 can be an Allen Bradley 2-1/4 Watt 10K potentiometer.

Figure 3 shows the components at a holding station or ream stop gate system of the wrapping apparatus 100. The holding station is a part of the infeed section 102 of the wrapping apparatus 100. The components of the holding station operate in conjunction with other components of the infeed section 102 shown in Figures 13A, 13B, 14A, 14B, 15A, 15B, 16A and 16B to ensure the establishment of a desired spacing between reams which are delivered by the infeed section 102 to the wrapping section 106 of the wrapping apparatus 100 and to ensure that the reams which are supplied to the wrapping section 106 are delivered in phase with the operation of the wrapping section 106 such that they can be routinely handled by the wrapping section when it is operating at a steady rate.

The holding station comprises a photoelectric eye 14 for monitoring the reams which are delivered to the infeed section 102 of the wrapping apparatus 100, stop gates 15 in the nature of air cylinders with shock pads driven by air valves 16 (see Figure 4) provided downstream of the photoelectric eye 14 in order to prevent the flow of reams under certain undesirable conditions indicated by the programmable controller 1 and timing unit 3.

The connections between the various components of

the holding station are shown in Figure 4. Such connections and the nature of the holding station itself will be best understood by considering the operation of the holding station. When a ream is detected by the photoelectric eye 14, the stop gates 15 will close if the ream is out of a predetermined timing window set by the timing unit 3. This will prevent the ream from travelling further until such time as the infeed timing window on the timing unit 3 is detected. Such detection will entail energisation of the solenoid-operated air valve 16 and open the gates 15. The gates 15 will remain open until another ream has been detected outside of the timing window. If two reams are discharged into the infeed section 102 of the wrapping apparatus 100 next to each other with no gap separating them, the conveying means of the infeed section shown in Figures 13A et. seq. will accelerate the first ream to a higher rate of speed than the speed at which the next-following ream is moving, thus separating the first ream from the next-following ream and creating a gap therebetween. When the photoelectric eye 14 detects the trailing edge of the first ream, it starts to count pulses which are transmitted by the counter disc of the timing unit 3. One pulse is generated every 20 degrees of the cycle of the wrapping apparatus 100. The gap which develops between the two reams will be too narrow to have placed them both in phase, i.e., if the first falls in the timing window the second will follow too soon afterwards to fall into the next-following window. Therefore, the photo-electric eye 14 will sense that the next-following ream is not within the window and will transmit a signal to close the gates 15. However, the gates 15 will not close immediately but rather after two counts. This provides adequate time for the first ream to clear the gates 15 before they again close. The second ream will be held by the stop gates 15 until the infeed timing window is again detected. At such time, the stop gates 15 will open again. If, rather than two

reams being discharged into the infeed section 102 in abutting relation, actual contact between two previously spaced apart reams takes place because the first ream is delayed by the gates 15 at the holding station when it is out of phase with the window of the wrapping section 106, then once the gates 15 open to release the first ream, the system will operate in the aforementioned manner as if the reams had been delivered to the infeed section 102 in abutment.

The following commercially available products sold under the indicated company/product names may be used in the holding station of Figures 3 and 4: The photoelectric eye 14 can be a Banner emitter, receiver electric eye, emitter ET-1, receiver RT-3. The air cylinder with shock pads 15 can be a Tom Thumb #AUT-1-1/8-1/2-B air cylinder with shock pads. The air valve 16 can be a MAC #224B-121C air valve.

Figure 5 is a timing graph for various components of the wrapping apparatus 100. The wrapping section 106 of the wrapping apparatus 100 comprises an outside elevator, an inside elevator, a rear tucker, a rear underfolder, a front underfolder, a loader finger advance and a loader finger raise shown in Figures 9, 10, 22, 23 and 24. The seven curves designated by letters A-G inclusive reflect the extent of movement of the aforementioned seven elements of the wrapping section 106 at various points during the machine cycle from zero to 360 degrees. The overhead discharge section 108 of the wrapping apparatus 100 comprises overhead conveyor means which acts to remove reams from the wrapping section under the control of a novel and improved camming means. The curve designated by the letter H reflects the extent of movement of the overhead conveyor means. Specifically, the outside elevator (curve A) commences its upward movement at zero degrees; it reaches its fully raised position at 125 degrees; it reaches its fully lowered (or original) position at 225 degrees; and it dwells from 225 degrees to zero degrees. The inside elevator (curve B) also commences its

upward movement at zero degrees and reaches its fully raised position at 125 degrees. However, the inside elevator begins to descend at 125 degrees and reaches a slightly lowered dwell position at 150 degrees. The inside elevator dwells at the slightly lowered position from 150 degrees to 160 degrees; thereafter, the downward movement of the inside elevator commences again and the inside elevator finally reaches its fully lowered position at 260 degrees and dwells in such position from 260 degrees to zero degrees. The rear tucker (curve C) commences its outward movement at 142 degrees; it completes such outward movement at 282 degrees; it dwells from 282 degrees to 302 degrees; then moves to its fully retracted position at 72 degrees where it again dwells from 72 degrees to 142 degrees. The rear underfolder (curve D) commences its outward movement at 113 degrees; it completes such outward movement at 223 degrees; it dwells from 223 degrees to 273 degrees, at which point it starts its retraction stroke; it is fully retracted at 53 degrees, and it dwells from 53 degrees to 113 degrees. The front underfolder (curve E) starts out at 85 degrees for an 8-inch ream (108 degrees for a 9-inch ream); it completes its outward movement at 165 degrees (188 degrees for a 9-inch ream); it dwells from 165 to 275 degrees (188 to 298 degrees for a 9-inch ream); it is fully retracted at 355 degrees (18 degrees for a 9-inch ream); and it again dwells from 355 to 85 degrees (18 to 108 degrees for a 9-inch ream). The loader finger advance (curve F) commences at 180 degrees; this finger completes its outward movement at 360 degrees; it dwells from 360 to 20 degrees; and it is fully retracted at 180 degrees. The loader finger raise (curve G) starts up at 168 degrees; this finger completes its upward movement at 228 degrees; it dwells from 228 degrees to 3 degrees; it is fully lowered at 78 degrees; and it dwells from 78 to 168 degrees. The overhead discharge conveyor is continuously in motion, i.e., it cycles between a slow speed at 165 degrees when

it picks up reams and a high speed but it never stops moving.

Figures 6 and 7 show various components of a web positioning and wrapper sheet transferring system of the wrapping apparatus. Such system includes optical incremental encoders 17, 17' and 17a, rate multiplier units with encoder interfaces 18, 18' and 18a, system 55 logic boards 19 and 19', servo controllers 20 and 20' each consisting of a panel mounting unit with an 8KW power supply and an internal shunt regulator and a servo controller consisting of two plug-in assemblies, servomotors 21 and 21' with type B winding tachometers 22 and 22', respectively, and mounting adapter 7 couplings for mounting encoders 17 and 17', respectively, the programmable controller 1, a conjugate cam 23 and thumbwheel switches 24 and 24'.

The purpose of the web positioning and wrapper sheet transfer system is to cut webs of paper to specific lengths, and then to transfer the lengths to a specific location. The two independent DC servomotors 21 and 21' control these functions. One motor 21 is coupled to nip rollers 26 shown in Figures 8A, 19, 20 and 21 and serving to feed the web to a rotary shear 28 that cuts the web. The length of web that is fed by the feed nip rollers 26 determines the cut-off length of the resulting wrapper sheet. The velocity at which the feed nip rollers 26 travel is determined by a velocity curve that is generated by the conjugate cam 23. The second motor 21' is coupled to vacuum transfer belts 30 shown in Figures 8B, 19, 20 and 21 and serving to transfer the cut wrapper sheet to a specific location. The transfer belts 30 follow the velocity curve which is generated for the feed nip rollers 26. However, the actual index distance of the transfer belts 30 is completely independent from that of the feed nip rollers 26.

The input shaft 32 of the conjugate cam 23 is rotated at a constant velocity. The output shaft 34 of the cam 23 generates a velocity curve which is similar to a

modified sine curve. An optical incremental encoder 17a is mechanically coupled to the output of the cam 23. The encoder 17a generates a pulse train representative of the velocity curve generated by the cam 23. This pulse train is transmitted to the rate multiplier units 18 and 18' via conditioner board 18a. The machine operator selects the desired shear cut-off length by manipulating the thumbwheel switches 24 and 24'. Two switches 24 and 24' are provided to enable the operator to control both the transfer distance and cut-off length independently. The information from the thumbwheel switches 24 and 24' is transmitted to the programmable controller 1 and is processed therein. After the information is processed, it is transmitted to the rate multiplier units 18 and 18'. These units receive the pulse train and transmit a pulse train command. However, the frequency of pulses to each individual system 55 control logic board 19 and 19' changes depending upon the multiplier factor that is generated by the programmable controller 1. The system 55 control logic boards 19 and 19' receive position command signals from their respective rate multiplier units 18 and 18'. They also receive direction signals from the pulse conditioner board 18a such that the drives 20 and 21' follow the master encoder 17a in both directions. The system 55 control logic boards 19 and 19' transmit a position error or current command signal to the pulse width modulated drives 20 and 20'. Each of the system 55 control logic boards 19 and 19' is a closed loop system that controls both the velocity and the position of the associated motor 21 or 21'. The position error signals which are transmitted to the drives 20 and 20' control the velocities and positions of both motors 21 and 21'. The drives 20 and 20' can produce torque at zero speed and each has a zero dead band such that the shafts of the servomotors 21 and 21' follow the cam 23 as if they were mechanically coupled.

The web positioning and wrapper sheet transfer

system can be operated to handle wrapping paper with preprinted registration marks. For the nip roller 26 to rotate, a position error is generated by pulses transmitted by the rate multiplier unit 18 to the system 55 logic board 19. These pulses are stored in an up/down counter. While the rate multiplier unit 18 is putting pulses to the up count, rotation of the motor 21 puts pulses to the down count, trying to achieve a zero count in the counter. When running a preprinted wrapper, the nip roller system is programmed to feed a sheet about 1/4" longer than the length of the printed sheet. When the nip rollers 26 approach the end of their cycle, an electric eye senses the presence of the register mark on the wrapper. At this point, the electric eye prevents the rate multiplier unit 18 from transmitting any more pulses to the system 55 logic board 19. It also sends a 1-millisecond pulse to the system 55 logic board 19 to reset the counter to zero. The nip roller drive 21 then comes to a stop, sending pulses to the counter while decelerating, and reverses to get the counter back to zero, i.e., to where the electric eye originally sensed the register mark.

Commercially available items sold under the following company/product names can be used as the indicated components. The optical incremental encoders 17a, 17 and 17' can be B.E.I. #H25G-SB-1250A-B2C SM18-5 optical incremental encoders. The pulse conditioner board 18a and the rate multiplier units 18 and 18' can be C.S.R. RMU-T-4 rate multiplier units with encoder interfaces. The system 55 logic boards 19 and 19' can be C.S.R. #1583 system 55 logic boards. The PWM servo drives 20 and 20' can be NC700 servo controllers each consisting of an A2318 panel mounting unit with 8KW power supply and an internal shunt regulator and A2273 NC730 servo controller consisting of two plug-in assemblies. Each of the DC servomotors 21 and 21' can be an Inland #TT-4501-1200-B DC servomotor with a type B winding, tachometer 22

and 22' and a mounting adapter 7 coupling for mounting a BEI H25G encoder 17 and 17'. The conjugate cam 23 can be a P-250-P1.5 H20-270 MSC.33 Camco cam unit. The thumbwheel switches 24 and 24' can be C.S.R. thumbwheel switches.

Figure 8 shows the mechanical connections between various components of the improved production line. In particular, Figure 8 shows the mechanical coupling of the dynamic differential input/output phase adjustor drive 9, the rotating cam limit switch and pulse generating disc 3, the resolver 11 of the wrapping apparatus 100 and the stepping motor 8 of the resolver phase adjusting drive 9. In addition, there is shown the mechanical coupling between the conjugate cam 23 and the optical incremental encoder 17a of the web positioning and wrapper sheet transfer system. Various other components of the web positioning and wrapper sheet transfer system are shown in Figures 19, 20 and 21.

Figure 8 also depicts the mechanical coupling of components of the improved production line which will be discussed hereinafter. For example, Figure 8 shows the mechanical coupling of various components of the infeed section 102, which components are shown in Figures 13A, 13B, 14A, 14B, 15A, 15B, 16A and 16B. Figure 8 also shows the mechanical coupling of various components of the wrapping section, which components are shown in Figures 9, 10, 11, 22, 23, and 24. In addition, Figure 8 shows the mechanical coupling of various components of the discharge section 108, which components are shown in Figures 17A, 17B, 18A and 18B, to the main drive 4 for the wrapping apparatus 100 through the medium of a novel conjugate cam 38 which will be described more fully hereinafter.

Figure 8A shows the mechanical coupling of the motor 21 to the feed nip rollers 26.

Figure 8B shows the mechanical coupling of the motor 21' to the pulleys 29 over which the vacuum transfer belts 30 are trained.

Figures 9, 10 and 11 show the basic physical layout of the wrapping apparatus 100 which forms part of the improved production line. The piles, stacks or reams to be wrapped are delivered to the infeed section 102. The infeed section 102 comprises a conveying mechanism 40 (Figure 13A) having variable speed first conveyor means 48 operated at the same speed as the discharge conveyors or feeding means of the sheeter or source 200, second conveyor means 50 disposed upstream of the stop gates 15 at the holding station shown in Figure 3, third conveyor means 52 which operates at a higher speed than the conveyor means 50 so that the conveyor means 50 initially slows down the reams which are being received from the sheeter 200 and thereafter the conveyor means 52 accelerates the reams so as to ensure that desired spacing between the reams is effected, and fourth conveyor means 54 (Figure 13B) for delivering the reams released from the holding station to the phased flights or loading fingers 56 (FIG. 13B) of the wrapping section 106 of the wrapping apparatus 100 and for subsequent transfer to elevator means. Simultaneously, i.e., while the ream is being delivered to the elevator means 58, the shearing assembly 104 is advancing a length of wrapping material off a spool 60 of wrapping material, positioning the web above a rotary shear such that the rotary shear cuts off a desired wrapper sheet length, and transferring the wrapper sheet to a position in which the sheet overlies the ream on the elevator means 58. As the elevator means 58 raises such ream, mechanisms are provided for wrapping the wrapper sheet around the ream so that the sheet assumes a tubular shape. Thereafter, other known mechanisms glue the overlying sides of the wrapper sheet and subsequently fold and glue the ends of the wrapper sheet. Once the ream has been elevated by the elevator means 58 and partially wrapped, it is engaged by the overhead discharge mechanism 108. The overhead discharge mechanism 108 comprises a pair of belts

or chains 62 which carry pusher members or arms 64 for engaging the partially wrapped reams on the elevator means 58 and for transferring them to the left, as seen in Figure 9. Once folding and glueing of the ends of the wrapper sheet about the ream is completed, the overhead discharge mechanism 108 delivers the ream to the compression assembly 112 which applies pressure to the ends of the wrapped reams to ensure adequate sealing.

Figure 10 shows the various components of the wrapping apparatus 100 from another perspective. The operation of the overhead discharge mechanism 108 will be more readily understood from a review of Figure 10. The chains or belts 62 which carry the pusher members or arms 64 are shown by phantom lines. These chains or belts form part of a conveyor means 36 (Figure 8) of the mechanism 108. Figure 10 shows how the pusher arms 64 first come in behind the reams which are raised by the elevator means 58 in a counterclockwise motion from the left, as seen in Figure 10, and thereafter urge the partially wrapped reams to the right, as seen in Figure 10, toward the compression assembly 112.

FIG. 11 is an end elevational view of the apparatus of Figure 9 showing on a larger scale certain details of the shear assembly 104. The web of wrapping material fed from the spool 60 by the feed nip rollers 26 driven by the motor 21 passes between the rotary shear 28 and a stationary counter-knife 66. Once a selected length of web is cut off by the rotary shear 28 in cooperation with the stationary counter-knive 66, the resultant wrapper sheet is advanced in a direction to the right as seen in Figure 11 by the vacuum transfer belts 30 driven by the motor 21' to a position overlying the elevator means 58 and shown by phantom lines Figure 11 and denoted by the letter S.

Figure 12 shows generally the stages through which successive reams pass in the wrapping sequence. After passing through the holding station past the

photoelectric eye 14 and gates 15, a ream is placed on the elevator means 58 and the wrapper sheet S is cut from the web W and is transferred to a position in which it overlies the ream. Subsequently, when the elevator means 58 raises the ream, the wrapper sheet S is folded down around the sides of the ream and tucked underneath the ream so that parallel marginal portions of the wrapper sheet are in overlapping relationship. The pusher arms 64 of the overhead discharge conveyor mechanism thereupon come in behind the partially wrapped ream by moving in the direction denoted by the arrow P, engaging the partially wrapped ream and shifting it in the direction of arrows Q while the wrapping means 106 completes folding and glueing of the ends of the wrapper sheet about the ream as shown.

The various components of the infeed section 102 are shown in Figures 13A, 13B, 14A, 14B, 15A, 15B, 16A and 16B. The infeed section 102 comprises the infeed conveying mechanism 40 and the photoelectric eye 14 and stop gates 15 of the holding station. The infeed conveying mechanism 40 comprises the aforementioned first, second, third and fourth conveyor means 48, 50, 52 and 54, a composite table 68 and side guide rails 70. The conveyor means 48, 50, 52 and 54 comprise belts trained over pulleys and tensioning members in a manner well known in the art, and the upper reaches of such belts are trained over the table 68.

Figures 17A, 17B, 18A and 18B show the aforediscussed components of the overhead discharge conveyor means 36 of the discharge section 108. The overhead discharge conveyor means 36 comprises two sets of double chains 62, a series of pusher arms 64 (also referred to as paddles, flights, fingers, tines or entraining elements) carried by each set of double chains, and pulleys 72 around which the double chains are trained in the same manner as was accomplished in applicant's prior Model 35 and Model 36 ream wrappers.

Figures 19, 20 and 21 show various components of the web positioning and wrapper sheet transfer system and their positions relative to the other components of the apparatus. The cut sheets are fed in an upward direction as seen in Figure 19, and products to be wrapped are fed from the right to the left, as seen in Figure 19. The rotary cutter 28 is continuously cycled with the apparatus irrespective of whether a length of wrapper has been advanced. The wrapper is fed from the right to the left, as seen in Figure 20, and from left to right as seen in the reverse view of Figure 21.

Figures 22, 23 and 24 show various components of the top folding portion of the wrapping section. Those components of this section which accomplish the folding are the same as the components previously employed in applicant's Model 35 and 36 ream wrappers. Prior art systems showing such wrapping sections are disclosed in U.S. Patents Nos. 3,861,120 and 3,213,591. As the product is raised on elevator means 58, the cut wrapper sheet is draped around the product by downwardly extending plates (not shown) such that the product/wrapper sheet configuration is as shown at stage I in Figure 12. As the product is elevated, front and rear underfolding plates (not shown) move underneath the product to drape the wrapper sheet around the product so that the product/wrapper sheet configuration is as shown at stage II in Figure 12. Thereafter, the product is engaged by the overhead discharge conveyor system 108 and it begins to move from the left to the right, as seen in Figures 22 and 23. The ends of the wrapper sheet are tucked in about the product by stationary front tuckers 152 and movable rear tuckers (not shown). The tucked in ends are thereafter creased by the action of plates 154 and then the top and bottom end flaps are folded against the ends of the product as the product continues to travel under the urging of the overhead conveying system 108.

Figures 25 and 26 show various components of the compression assembly 112 which comprises a belting arrangement whereby the wrapped product is advanced by conveyor belts 170 which engage and compress the folded sides of the wrapped product to ensure proper setting of the glue.

The apparatus and method of the invention are susceptible of many additional modifications without departing from the spirit of the invention.

Claim(s) Nr 30 deemed to be abandoned

CLAIMS

1. A production line, particularly for wrapping reams of paper sheets or analogous piles into sheets of wrapping material, wherein a conveyor system of a sheeter or an analogous source feeds piles at regular and/or random intervals to the wrapping station of a wrapping apparatus having means for confining successive piles in sheets of wrapping material, characterised by means (110) for electronically synchronising the velocity of operation of the wrapping apparatus (100) with the rate of delivery of piles by the conveyor system (102).

2. A production line according to Claim 1, characterised in that the synchronising means (110) comprises means (1-3) for automatically and continuously adjusting the position of the wrapping apparatus (100) relative to the positions of piles which are fed by the conveyor system of the source (200).

3. A production line according to Claim 1 or 2, characterised in that the synchronising means (110) comprises means (14-16) for automatically and continuously controlling the spacing between the piles which are being fed to the wrapping apparatus (100).

4. A production line according to one of Claims 1 to 3, characterised in that the confining means of the wrapping apparatus comprises wrapping means (106) for applying sheets (S) of wrapping material (W) to the piles and in that the synchronising means (110) comprises means (1) for controlling the advancement of piles which are received from the conveyor system of the source (200) to the wrapping means (106) so as to effect the delivery of piles to the wrapping means (106) in phase with the operation of the wrapping means.

5. A production line according to Claim 1, characterised in that the synchronising means (110) comprises phase adjust loop means (1-3) for automatically adjusting the phase relationship between the source (200) and the wrapping apparatus (100) and means (14-16) for automatically adjusting the spacing between the piles which are received from the conveyor system of the source (200) prior to delivery to the wrapping means (106) and for controlling the delivery of piles to the wrapping means (106) so as to effect such delivery in phase with the operation of the wrapping means.

6. A production line according to Claim 5, characterised in that the synchronising means (110) further comprises first signal generating means (11', 12') which is mechanically coupled to the source (200) and is arranged to generate a first position and velocity reference signal, second signal generating means (11, 12) mechanically coupled to the wrapping apparatus (100) and arranged to generate a second position and velocity reference signal, means (6) for comparing the two signals and for generating a third signal which is proportional to the position error of the source (200) and the wrapping apparatus (100), and means (4, 5) for adjusting the operation of the wrapping apparatus (100) in response to the third signal and the velocity portion of the first signal.

7. A production line according to Claim 6, characterised in that the first signal generating means (11', 12') comprises a master resolver (11') and a master tachometer generator (12') mounted on the source (200) for respectively providing the position and velocity portions of the first reference signal.

8. A production line according to Claim 7, characterised in that the second signal generating means (11, 12) comprises a slave resolver (11) and a slave tachometer generator (12) mounted on the wrapping apparatus (100) for respectively providing the position and velocity portions of the second reference signal.

9. A production line according to Claim 8, characterised in that the signal comparing means (5) comprises a transducer interface board for summing the position signals received from the master and slave resolvers (11', 11) and for transmitting an analog third signal which is proportional to the position error of the master and slave resolvers.

10. A production line according to Claim 9, characterised in that the means (4, 5) for adjusting the operation of the wrapping apparatus (100) in response to the third signal comprises a pulse width modulated drive (5) and a motor (4), and in that the third signal, together with the velocity portion of the first signal, provides the reference command for the pulse width modulated drive (5) which, in turn, controls the velocity of the motor (4).

11. A production line according to Claim 5, characterised in that the phase adjust loop means (1-3) comprises means (2) for detecting the presence of piles at an infeed position (102) of the wrapping apparatus (100), means (3) for generating pulses based upon the operation of the wrapping apparatus (100) in response to activation by the detecting means (2), signal generating means (1) for monitoring the pulse generating means (3), and means (8, 11, 12) for adjusting the position of the wrapping apparatus (100) in response to signals from the monitoring means (1).

12. A production line according to Claim 11, characterised in that the means (8, 11, 12) for adjusting the position of the wrapping apparatus (100) comprises a slave resolver (11) for controlling the position of the wrapping apparatus (100) and a stepping motor (8) for advancing or retarding the slave resolver (11).

13. A production line according to Claim 12, characterised by the provision of means (9) for altering the coupling between the source (200) and the wrapping apparatus (100) in response to pulses which are generated by the pulse generating means (3).

14. A production line according to Claim 5, characterised in that the means (14 - 16) for adjusting the spacing between the piles which are received from the conveyor system of the source (200) comprises means for slowing down the piles which are about to be wrapped and means for thereafter accelerating the piles.

15. A production line according to Claim 14, characterised by the provision of means (14) for monitoring the spacing between successive piles and means (15) for holding the piles against further movement in the absence of desired spacing.

16. A production line according to Claim 15, characterised in that the monitoring means comprises a photoelectric detector (14) and the holding means comprises fluid-operated openable and closable gates (15) and valves (16) which control the operation of the gates.

17. A production line according to Claim 15, characterised by the provision of means for delaying the closing of the gates (15) to thus prevent the gates (15) from interfering with the feeding of piles.

18. A production line according to Claim 16, characterised in that the phase adjust loop means comprises means (3) defining a timing window corresponding to those portions of the operation of the wrapping apparatus (100) during which the wrapping apparatus is capable of receiving piles for wrapping and means (1) for delaying reopening of the gates (15) until the timing window is registered.

19. Apparatus for positioning and severing web material, particularly wrapping paper, to form discrete sheets in a wrapping apparatus, characterised by means (26) for positioning the web, means (28) for severing the web (W) so as to form cut sheets (S), means (30) for transferring the cut sheets (S), and means (1) for electronically synchronising the operation of the positioning (26), severing (28) and transferring (30) means such that they operate as if they were mechanically coupled to each other.

20. Apparatus according to Claim 18, characterised in that each of the positioning (26) and transferring (30) means comprises an independent servomotor (21, 21') and driven cam means (23) arranged to transmit a signal for driving the servomotor (21, 21') such that the velocity curve of the servomotor is determined by the velocity curve of the cam means (23).

21. Apparatus according to Claim 18 or 19, characterised in that each of the servomotors (21, 21') is a DC motor.

22. Apparatus for wrapping commodities, particularly reams of paper sheets, characterised by means (28) for repeatedly severing a running web (W) of wrapping material at a severing station (104) to form a succession of cut sheets (S), and means (30) for supporting successively cut sheets (S) closely adjacent to the severing station (104).

23. Apparatus according to Claim 21, characterised in that the severing means (28) comprises rotary cutting means mounted beneath the path of the running web (W) and a stationary counterknife (66) mounted above the web (W).

24. Apparatus according to Claim 21 or 22, characterised in that the means (30) for supporting cut sheets (S) comprises vacuum transfer conveyors (30) means overlying the cut sheets (S).

25. Apparatus according to one of Claims 21 to 23 for wrapping commodities into cut sheets which are obtained by severing a web having registration marks, characterised by means for monitoring the registration marks on the web (W), movable means (26) for positioning the web (W) relative to the severing means (28), means (18, 19) for arresting the positioning means (26) in response to a signal from the monitoring means, and means (21) for reversing the positioning means (26) so as to move sections of the web (W) backwards when such sections advance beyond a predetermined position.

30 Claims
to be abandoned

26. A method of wrapping block-shaped commodities, particularly piles of paper sheets which are received by a wrapping apparatus from a sheeter or an analogous source, into sheets of paper or like wrapping material, characterised in that the wrapping apparatus (100) is electronically coupled to the source (200) so as to automatically and continuously synchronise the velocity of operation of the wrapping apparatus with the rate of delivery of commodities from the source.

27. A method according to Claim 25, characterised by continuous and automatic adjustment of the position of the wrapping apparatus (100) relative to the commodities which are received from the source (200).

28. A method according to Claim 25 or 26, characterised by automatic and continuous controlling of the spacing between the commodities which are received from the source (200).

29. A method according to one of Claims 25 to 27, characterised in that the wrapping apparatus (100) is operated continuously and in that the delivery to the wrapping apparatus of commodities which are received from the source (200) is controlled so as to effect the delivery of commodities to the wrapping apparatus in phase with continuous operation of the wrapping apparatus.

30. A method according to one of Claims 25 to 28, characterised by automatic adjustment of the phase relationship between the source (200) and the wrapping apparatus (100) and by automatic adjustment of the spacing between commodities which are delivered by the source prior to introduction of such commodities into the wrapping apparatus.

1/30

FIG. 1

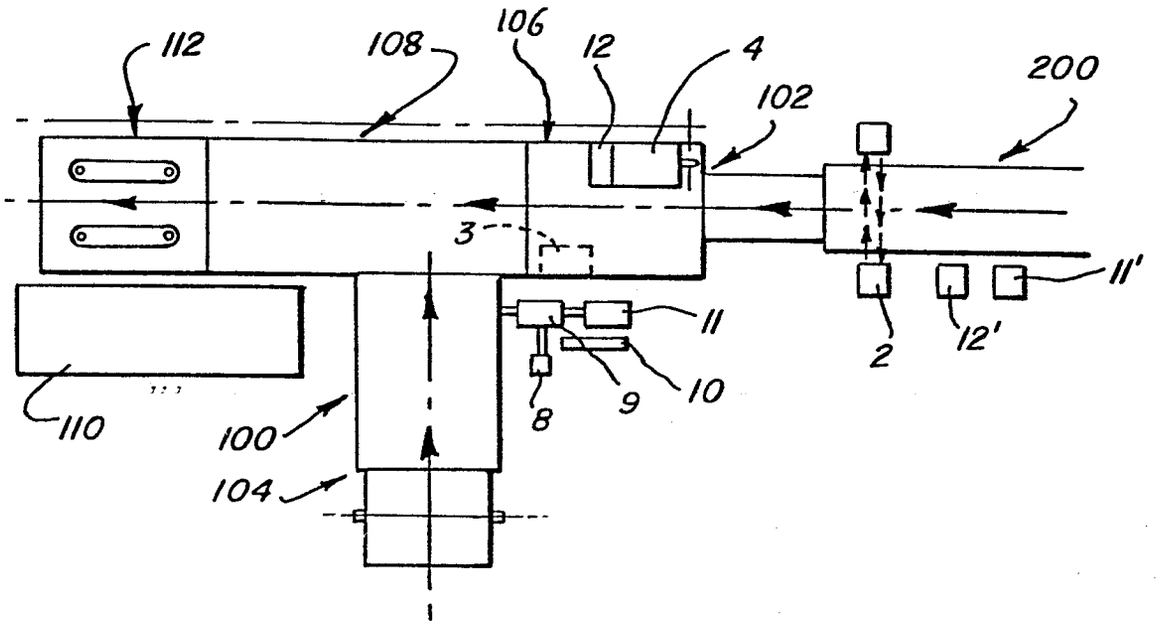


FIG. 6

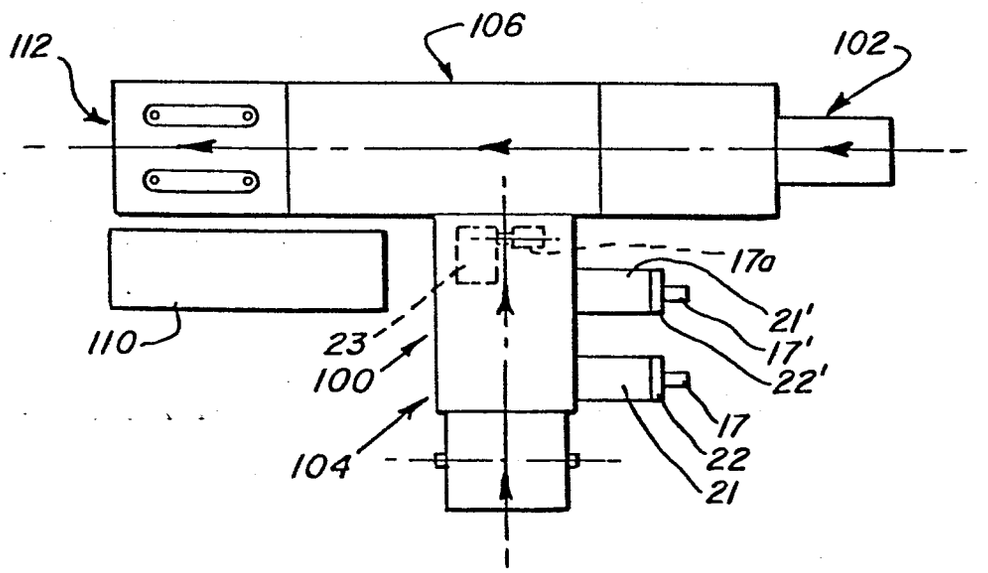
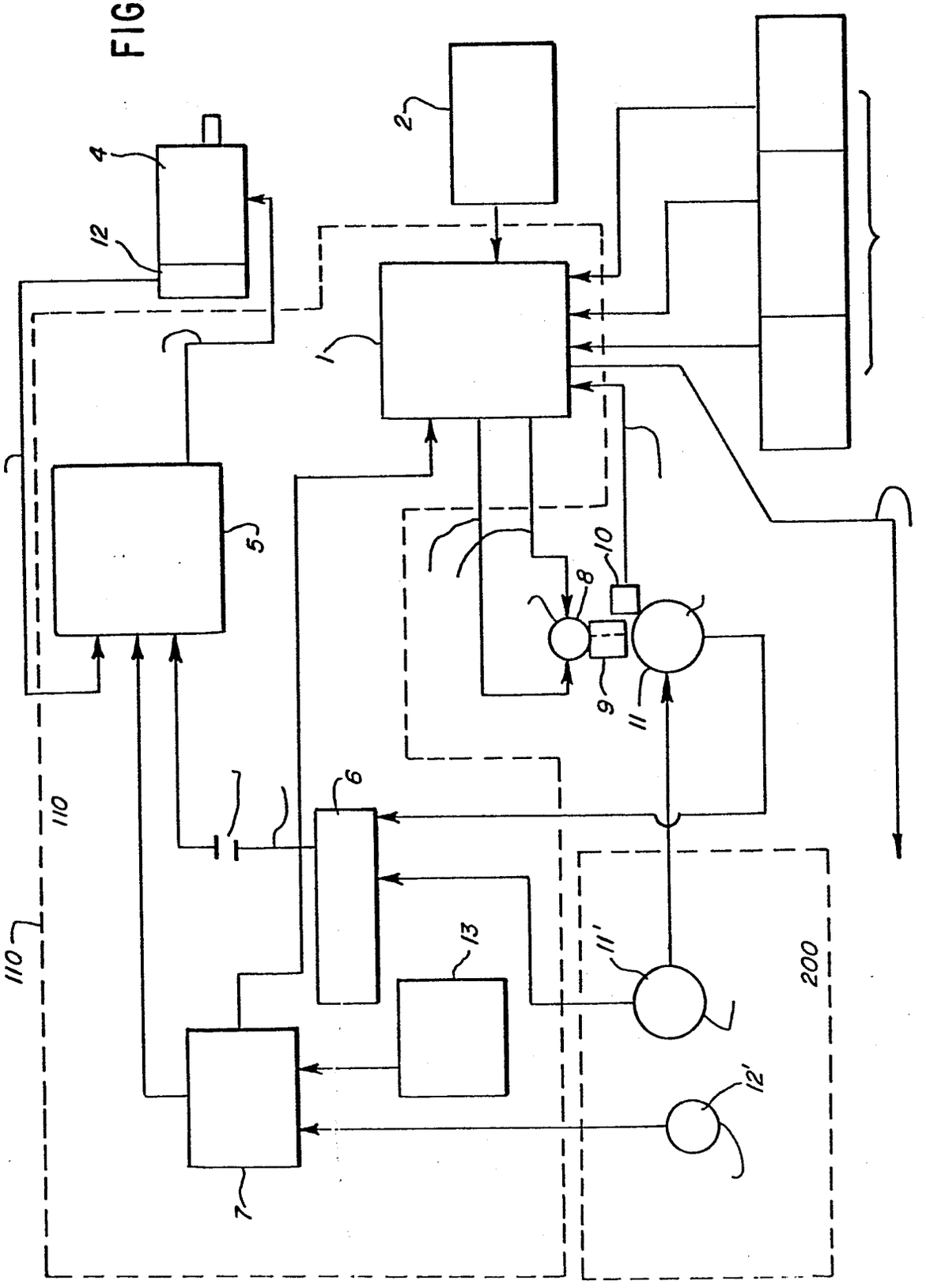


FIG. 2



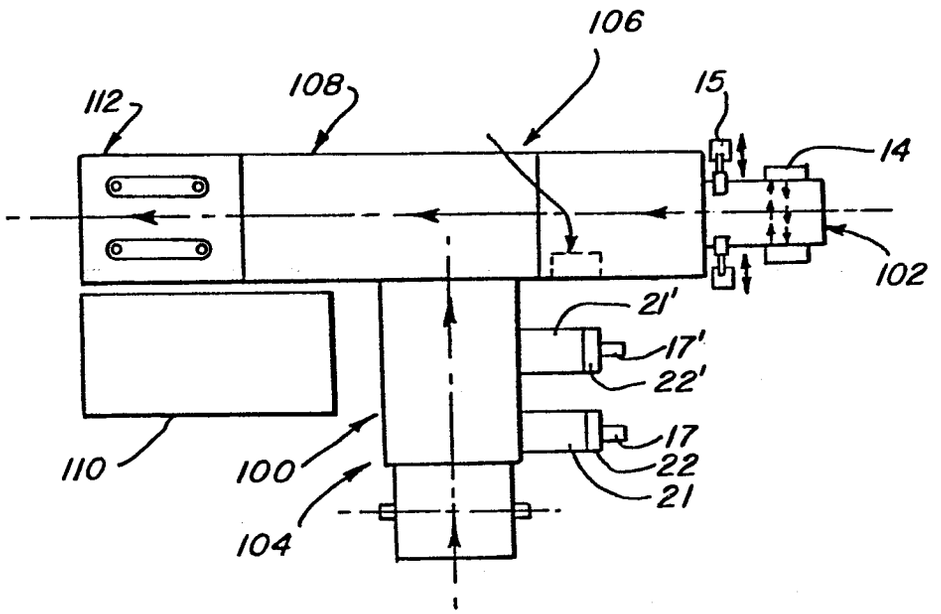
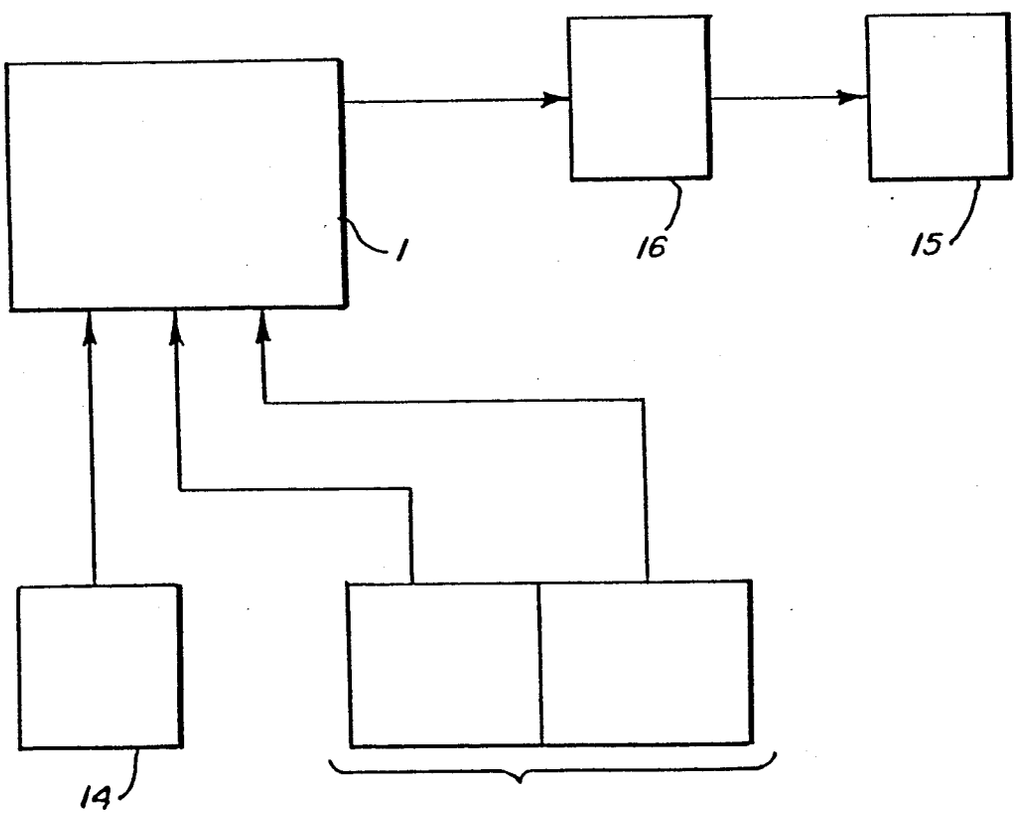


FIG. 3

FIG. 4



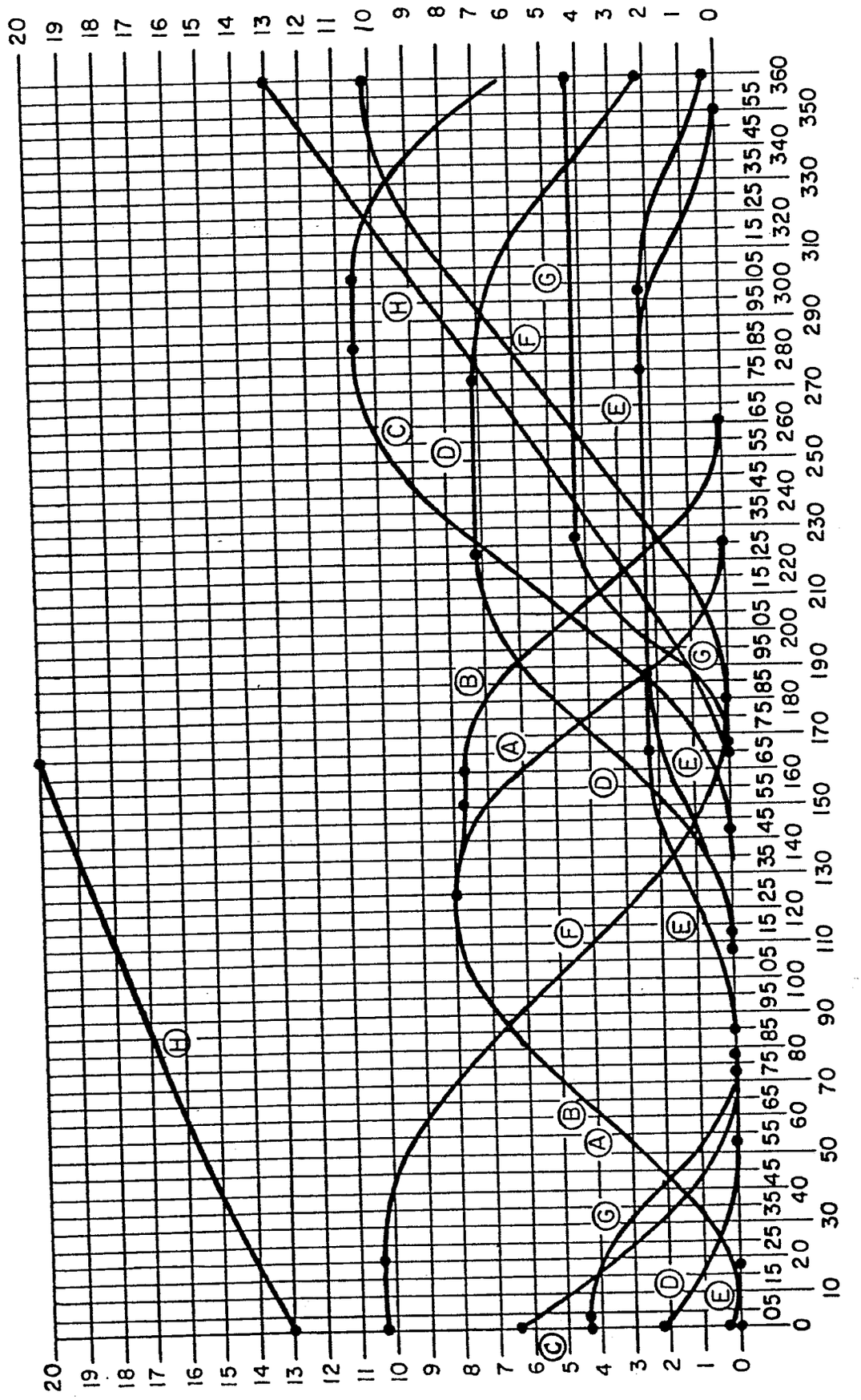
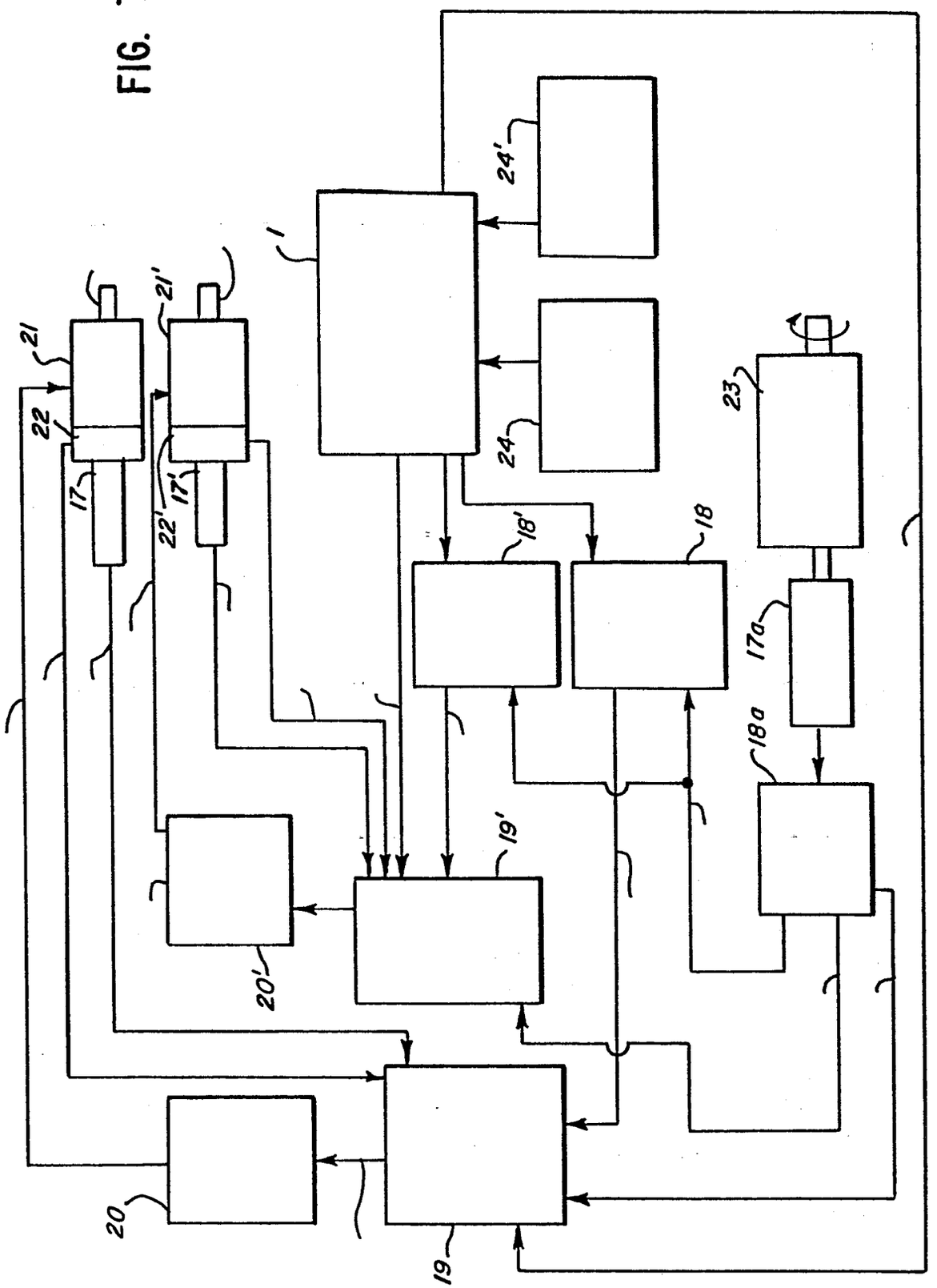

20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
0 05 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 05 110 15 120 25 130 35 140 45 150 55 160 65 170 75 180 85 190 95 200 05 210 15 220 25 230 35 240 45 250 55 260 65 270 75 280 85 290 95 300 05 310 15 320 25 330 35 340 45 350 55 360
A
B
C
D
E
F
G
H

FIG. 5

FIG. 7



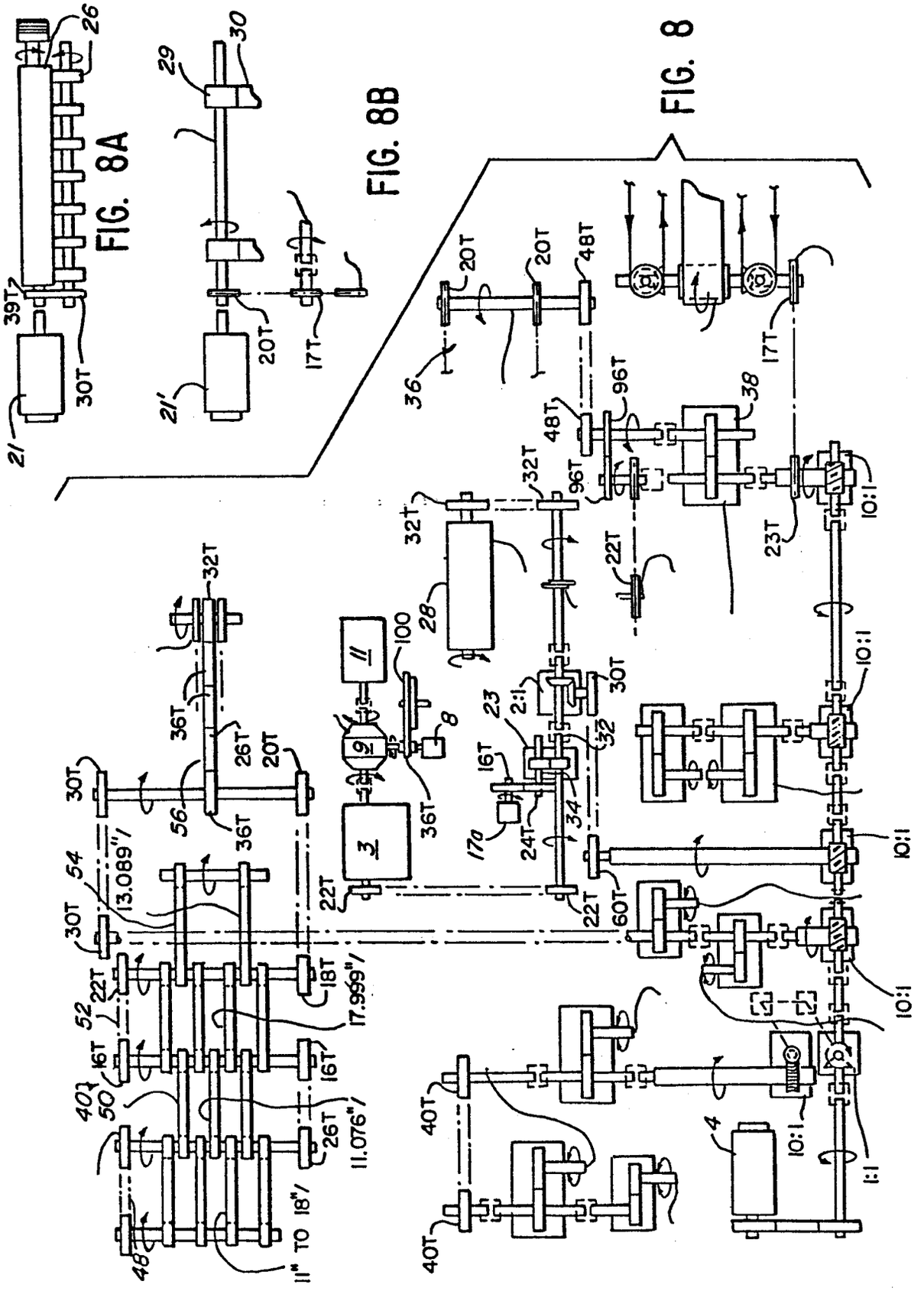


FIG. 8A
FIG. 8B
FIG. 8
26
39T
30T
21
29
30
20T
17T
21'
36
20T
20T
48T
96T
38
48T
32T
32T
28
22T
23T
10:1
100
11
9
8
3
36T
30T
23
2:1
32
16T
17a
24T
34
22T
60T
36T
56
26T
20T
32T
30T
54
13.089"/
52
22T
16T
40
50
26T
11.076"/
18T
17.999"/
16T
11" TO 18"/
48
40T
40T
4
10:1
1:1

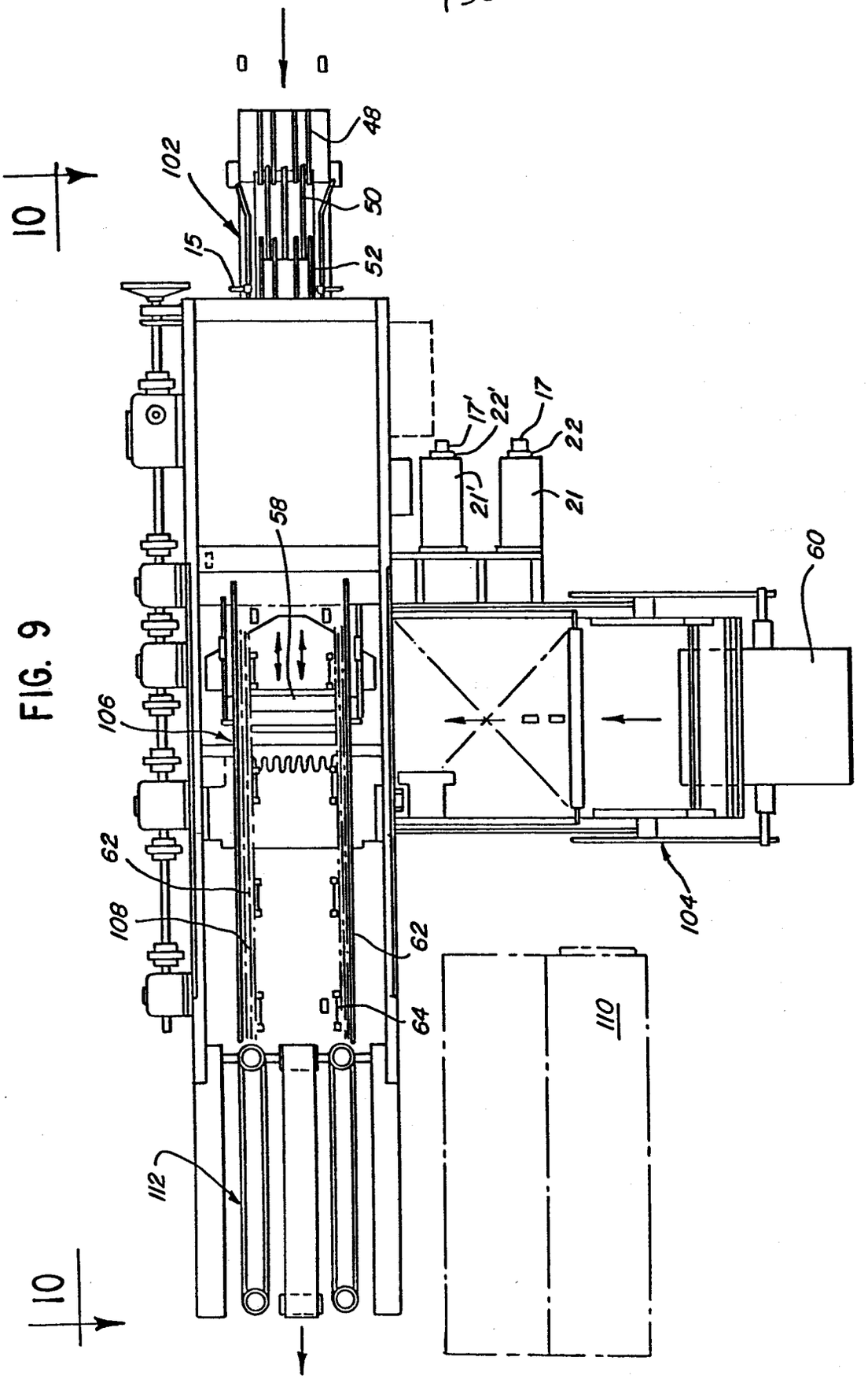

10
10
48
102
50
15
52
17'
22'
17
22
21'
21
58
60
106
62
108
62
64
104
110
112

FIG. 9

FIG. 10

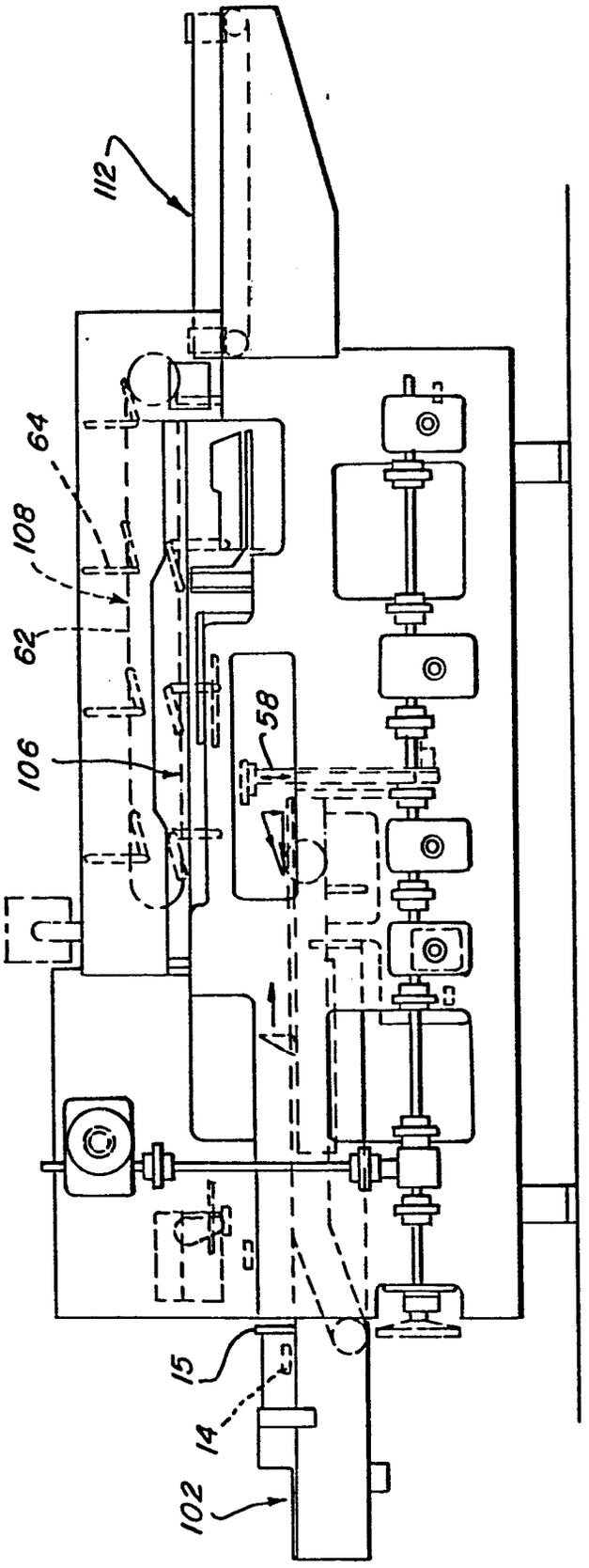


FIG. 11

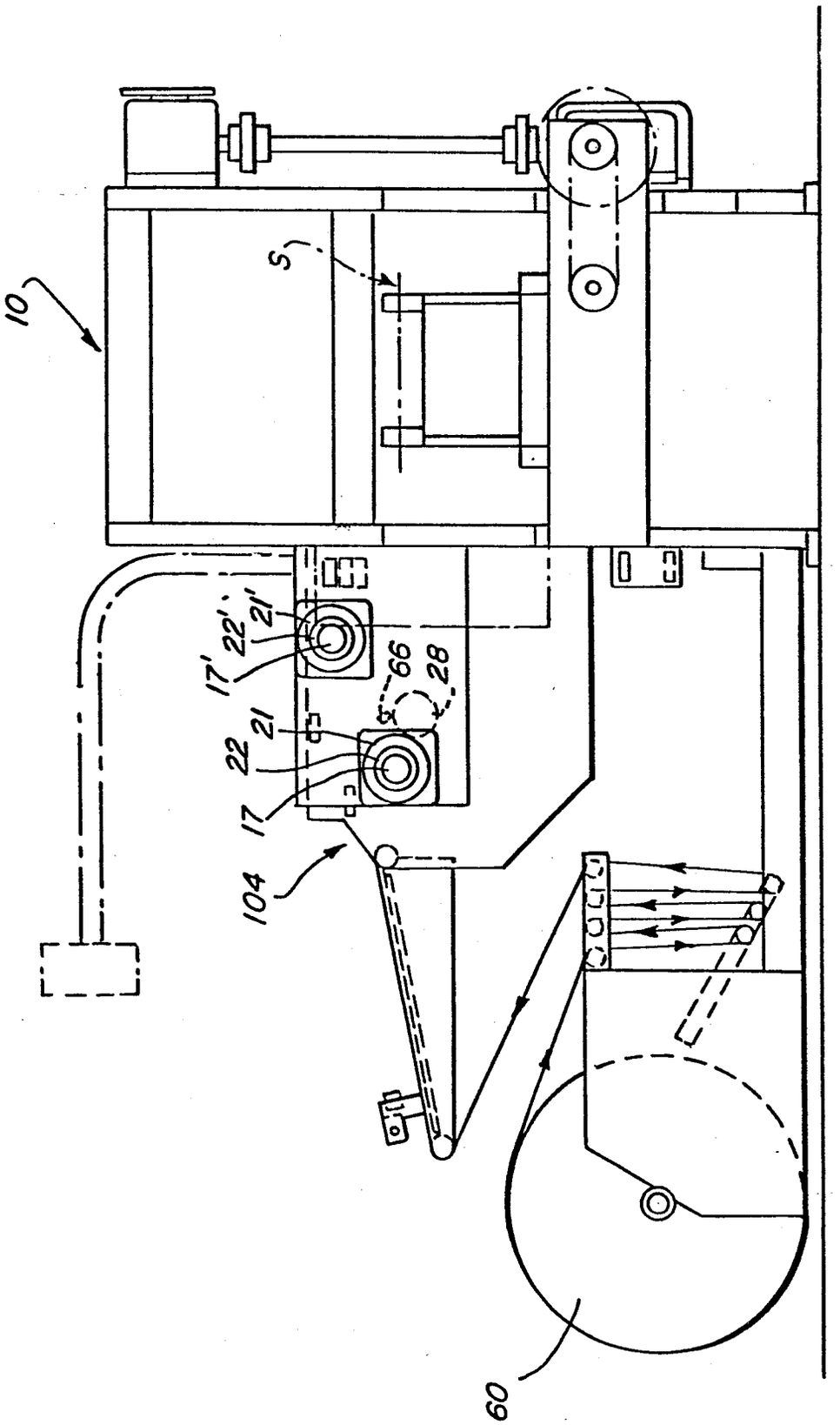


FIG. 12

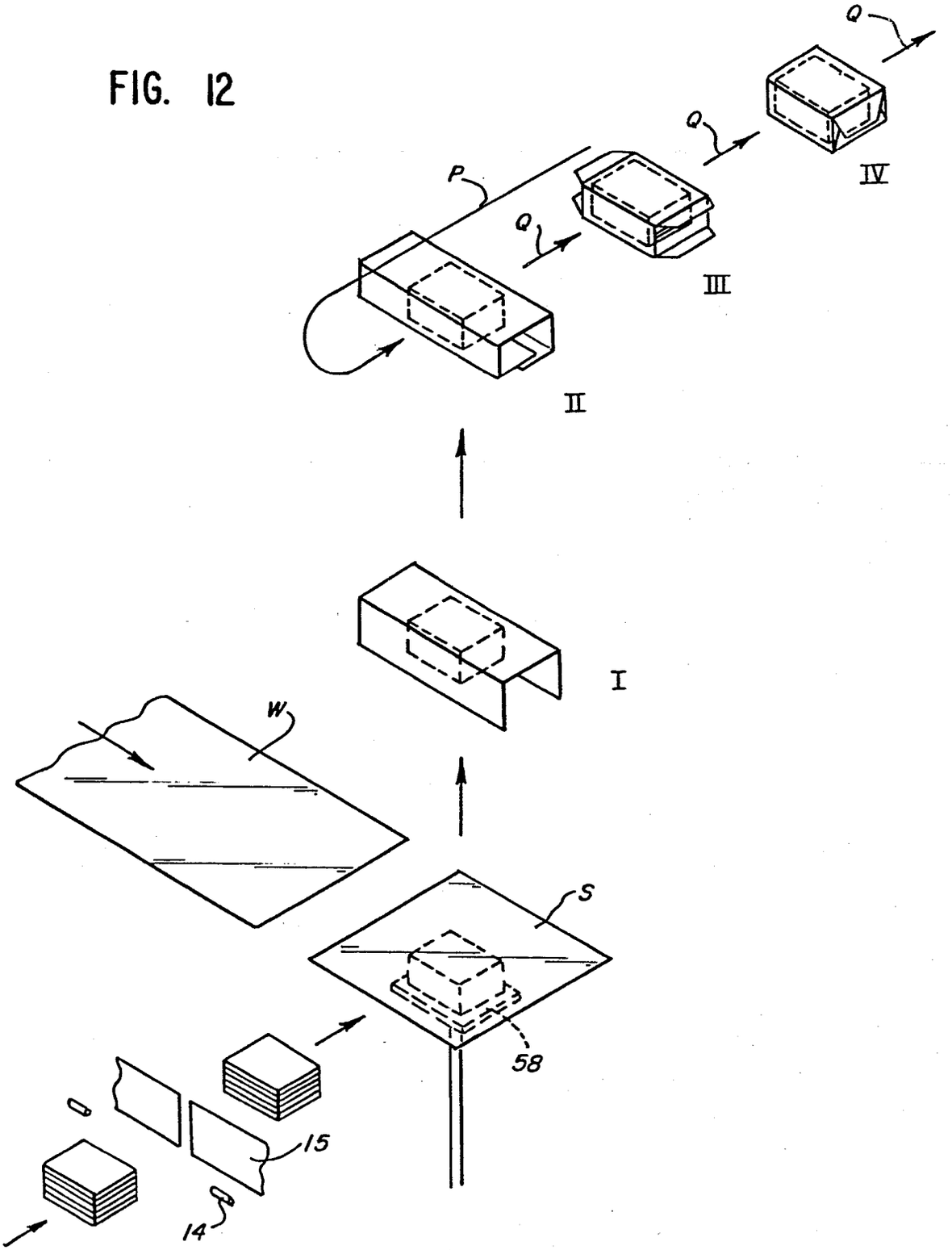
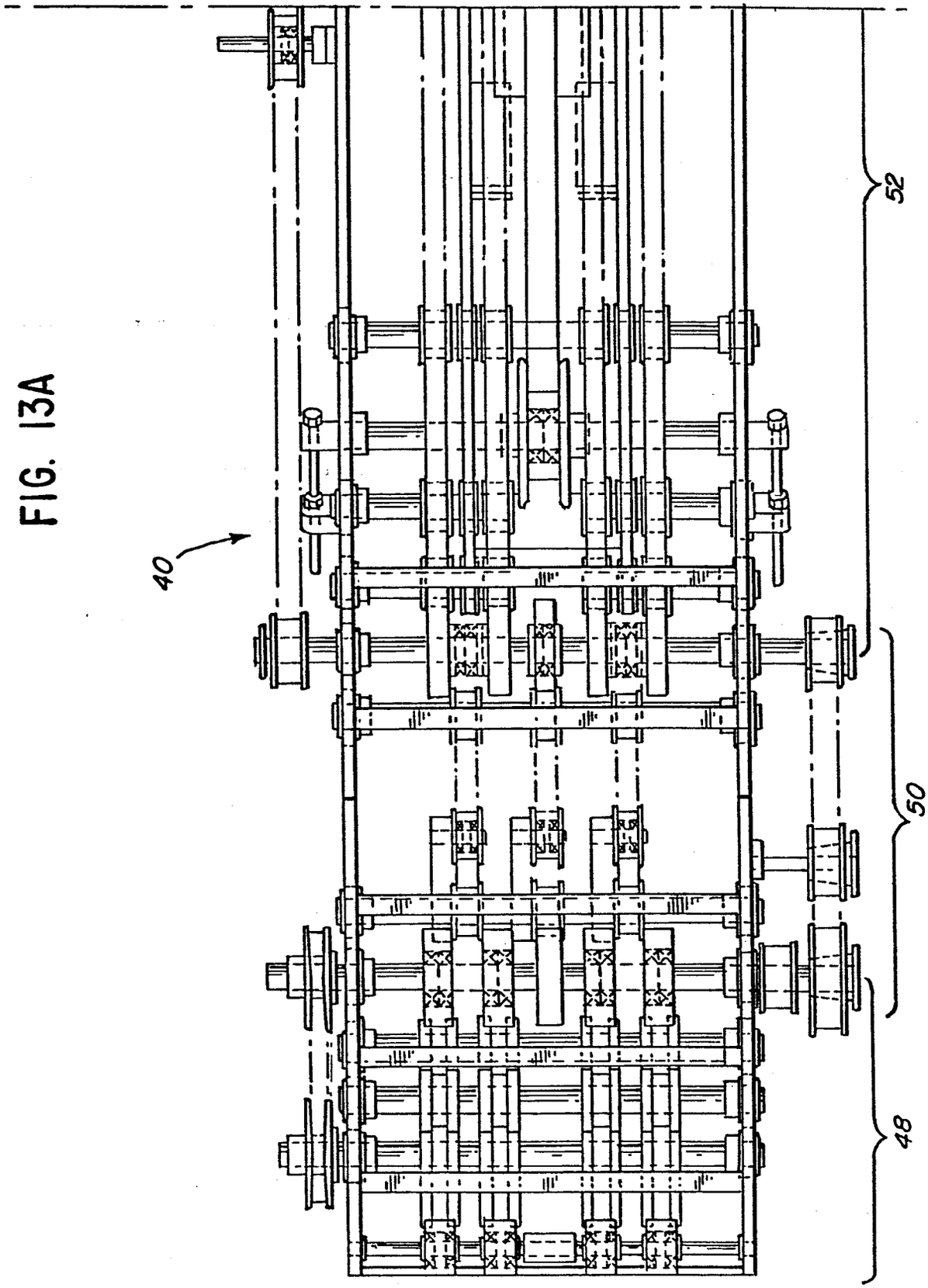


FIG. 13A



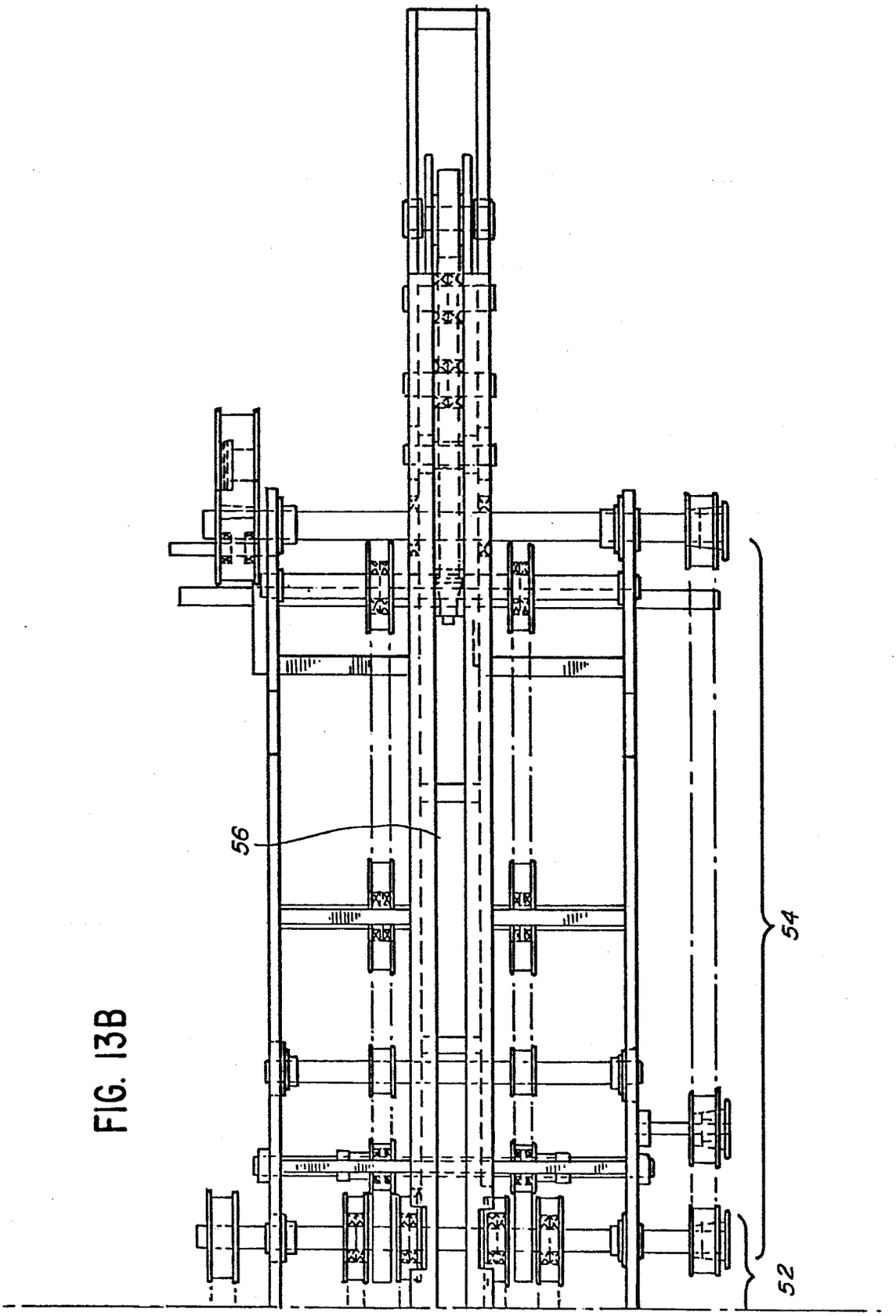
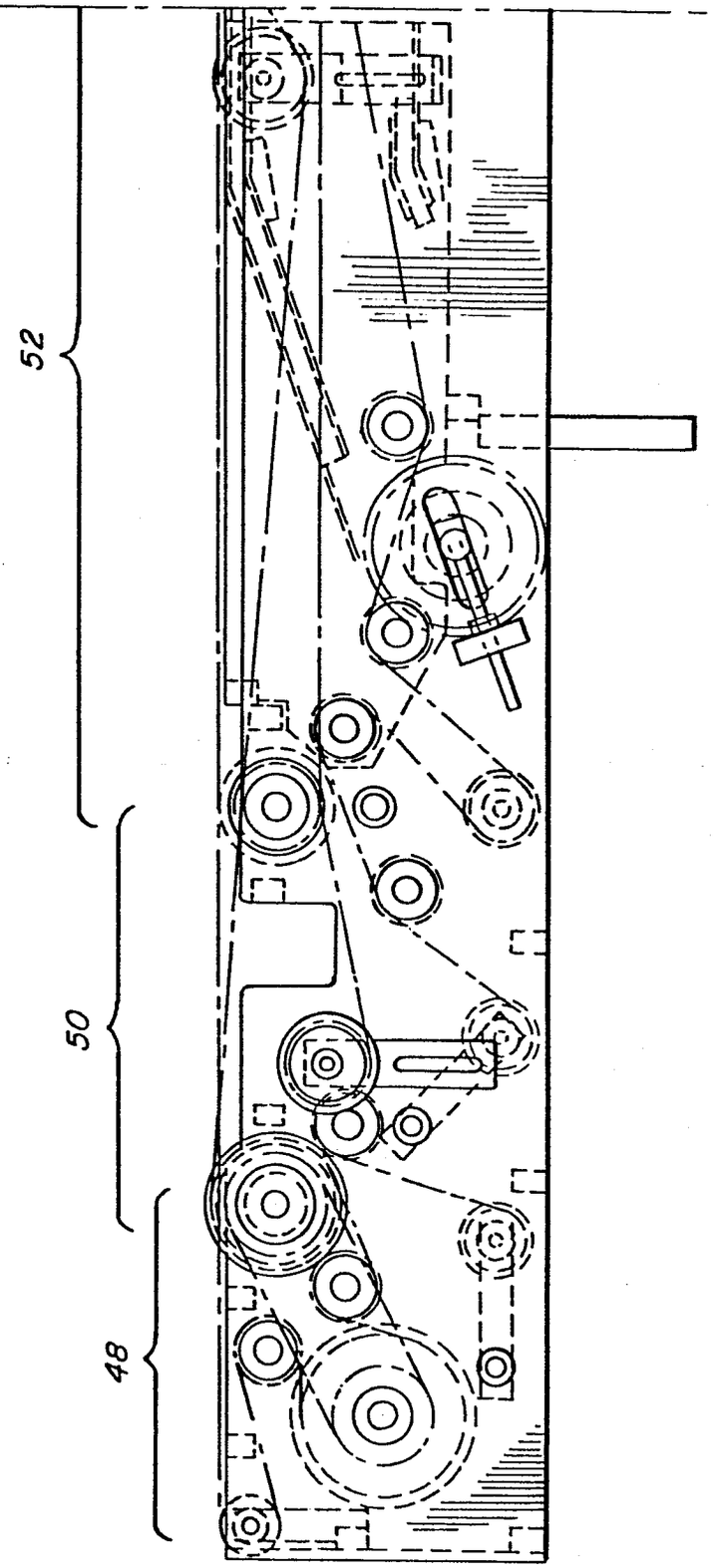


FIG. 13B

FIG. 14A



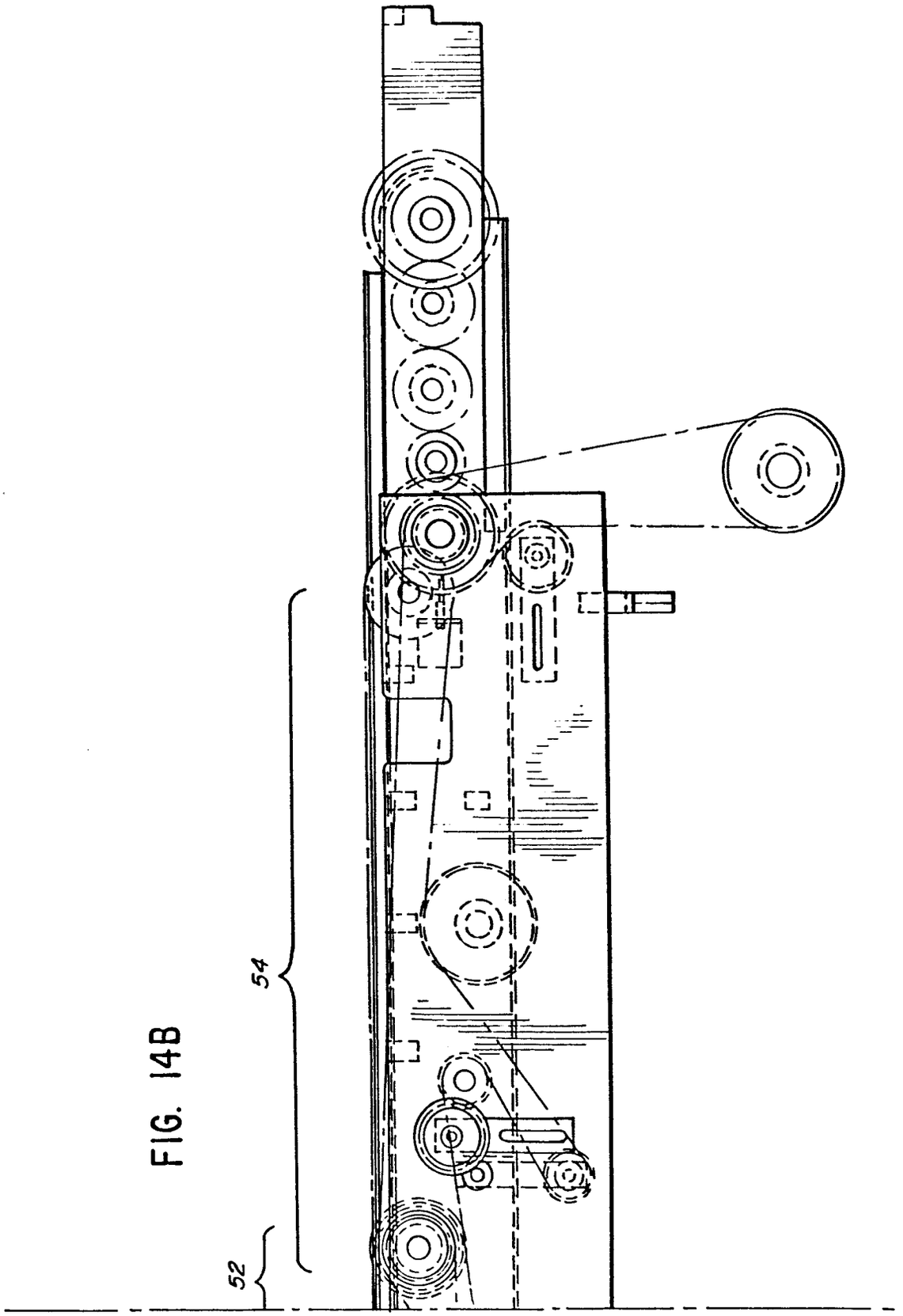
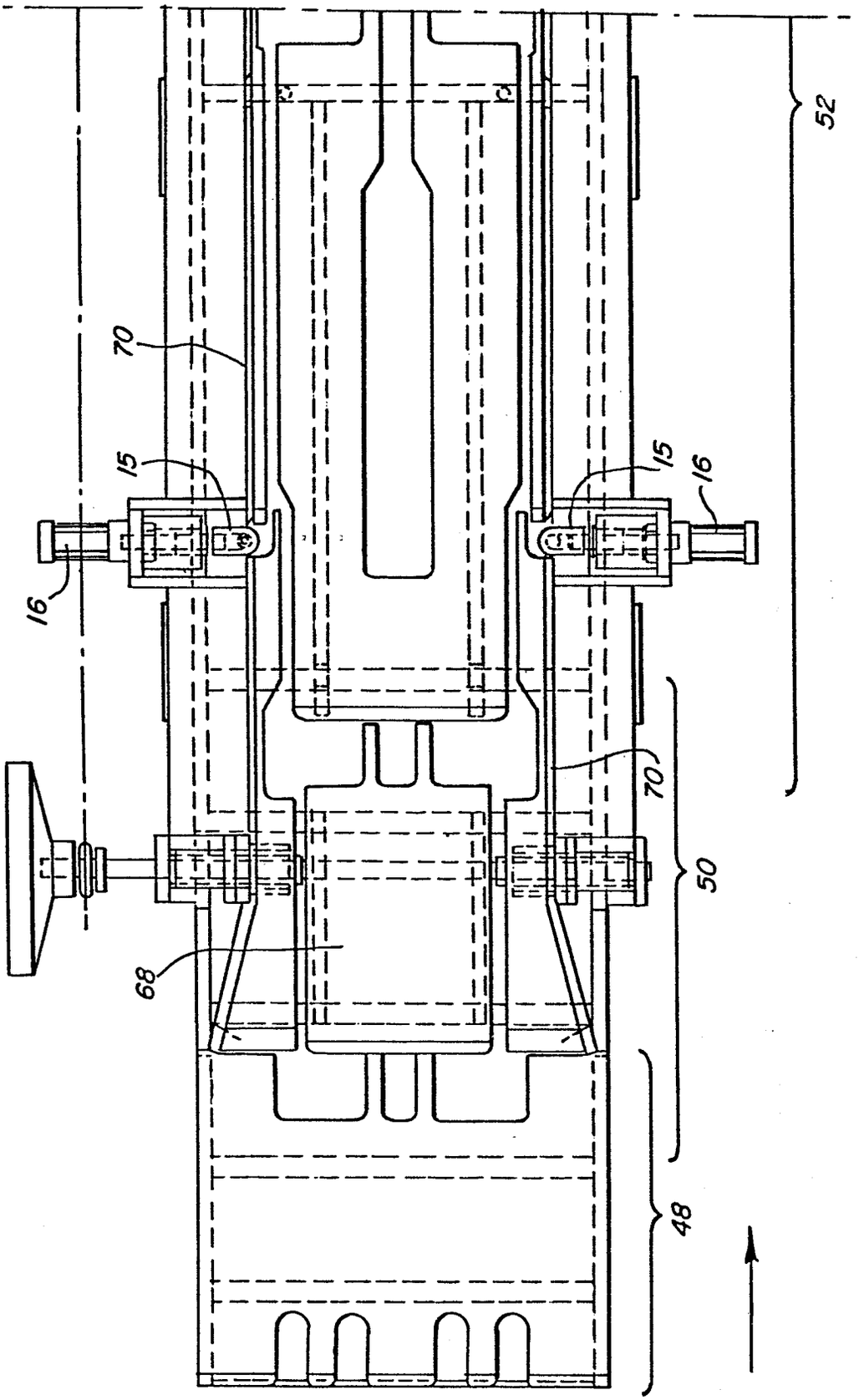


FIG. 14B

FIG. 15A



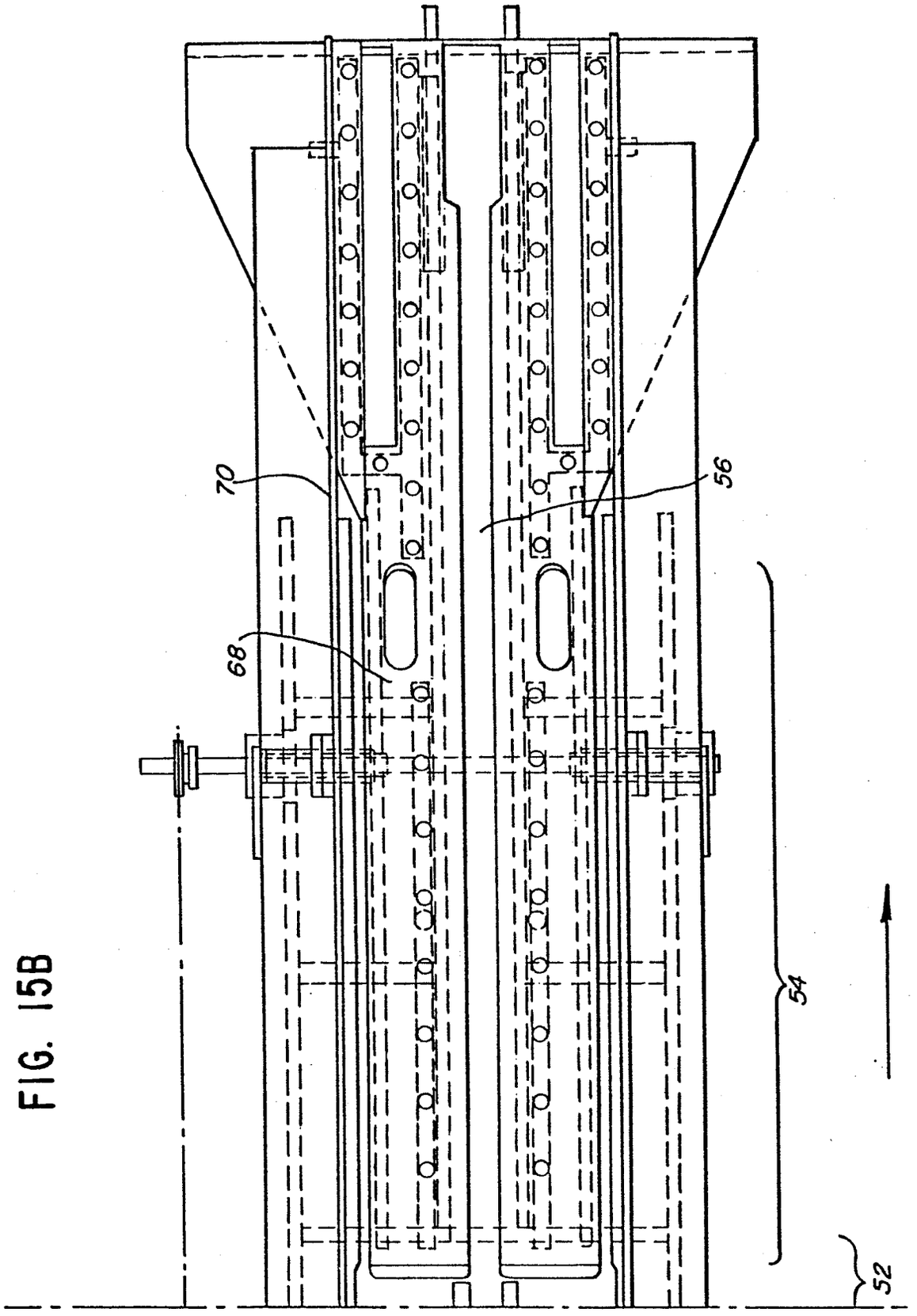
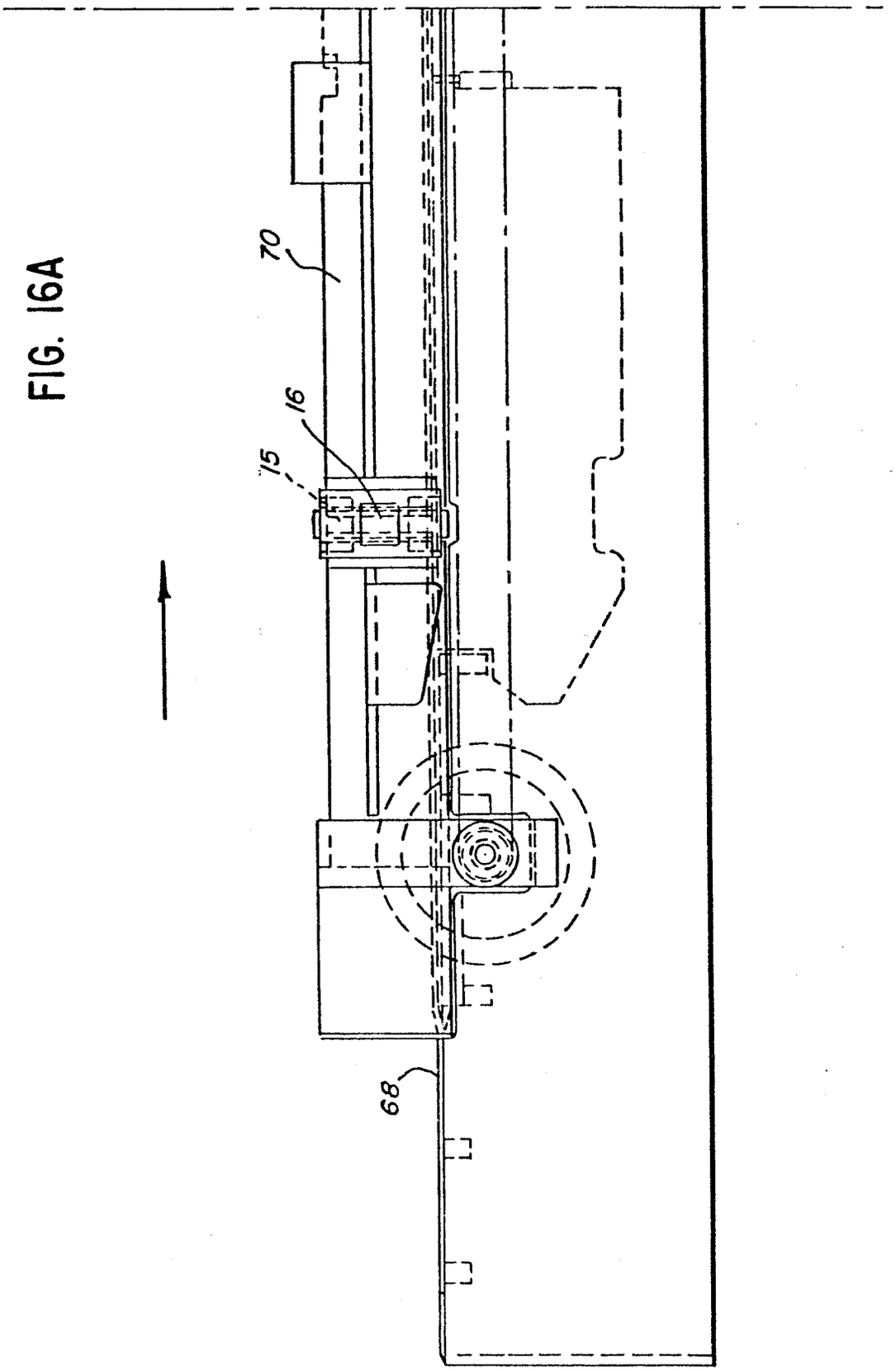


FIG. 15B

FIG. 16A



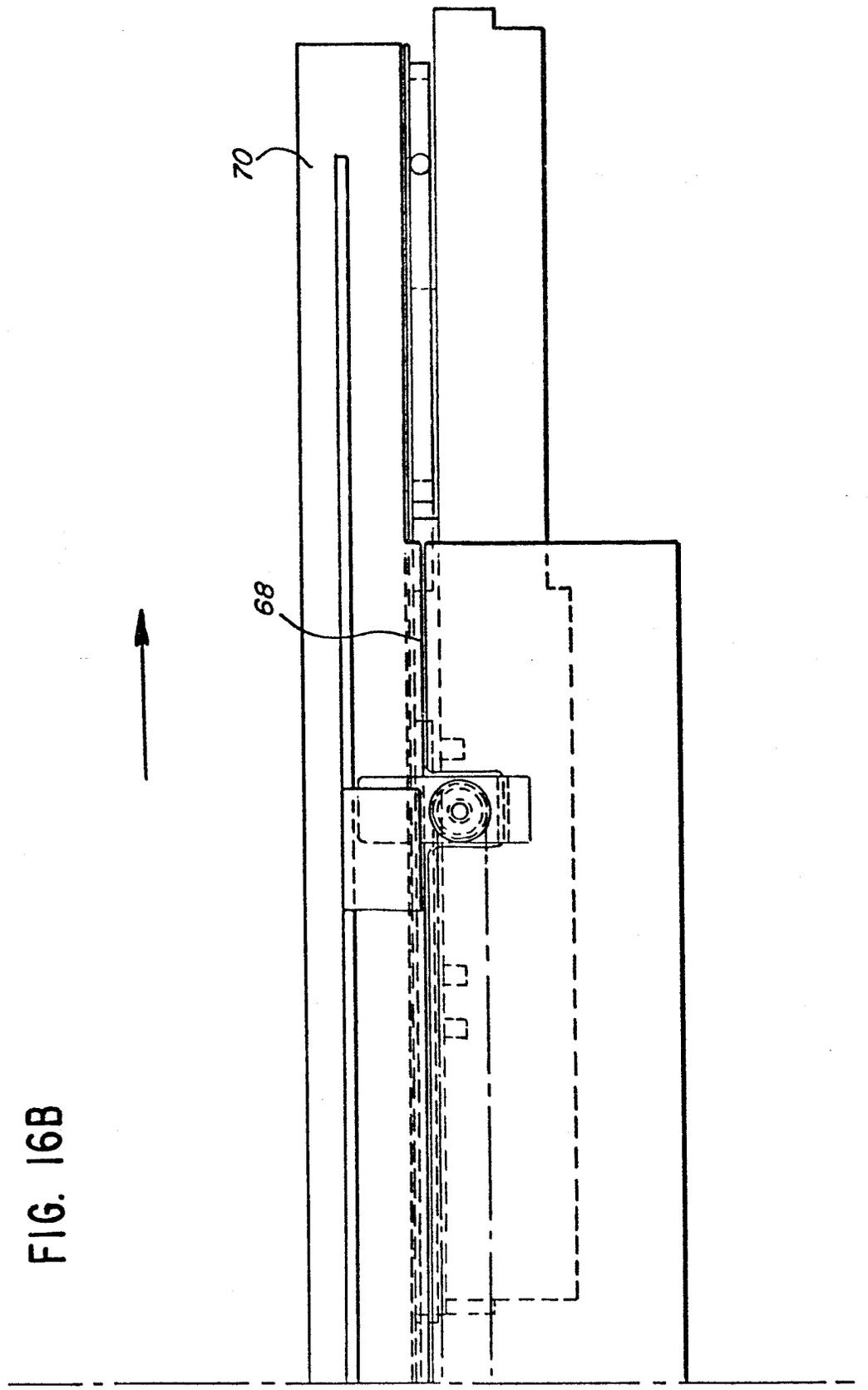
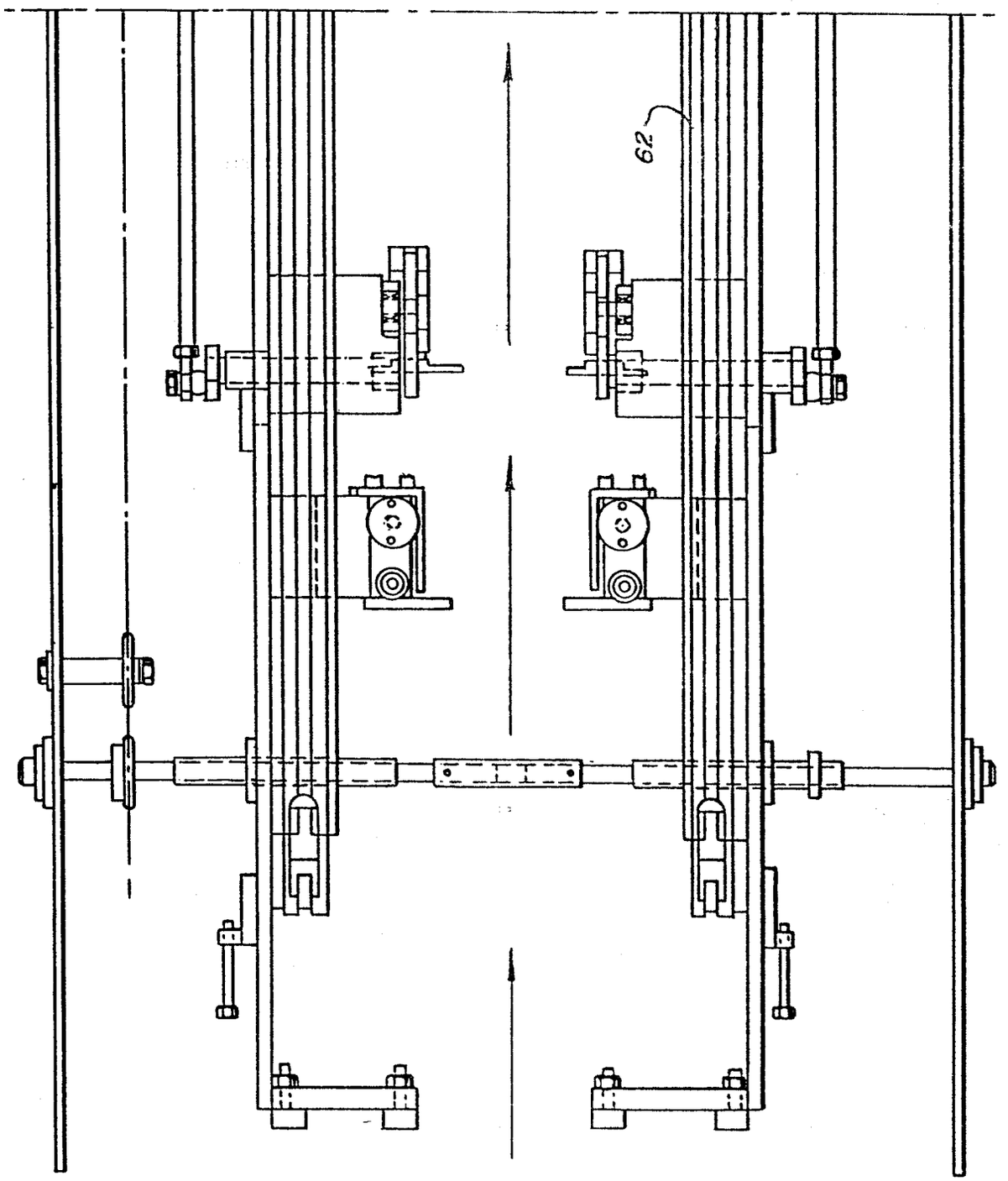


FIG. 16B

FIG. 17A



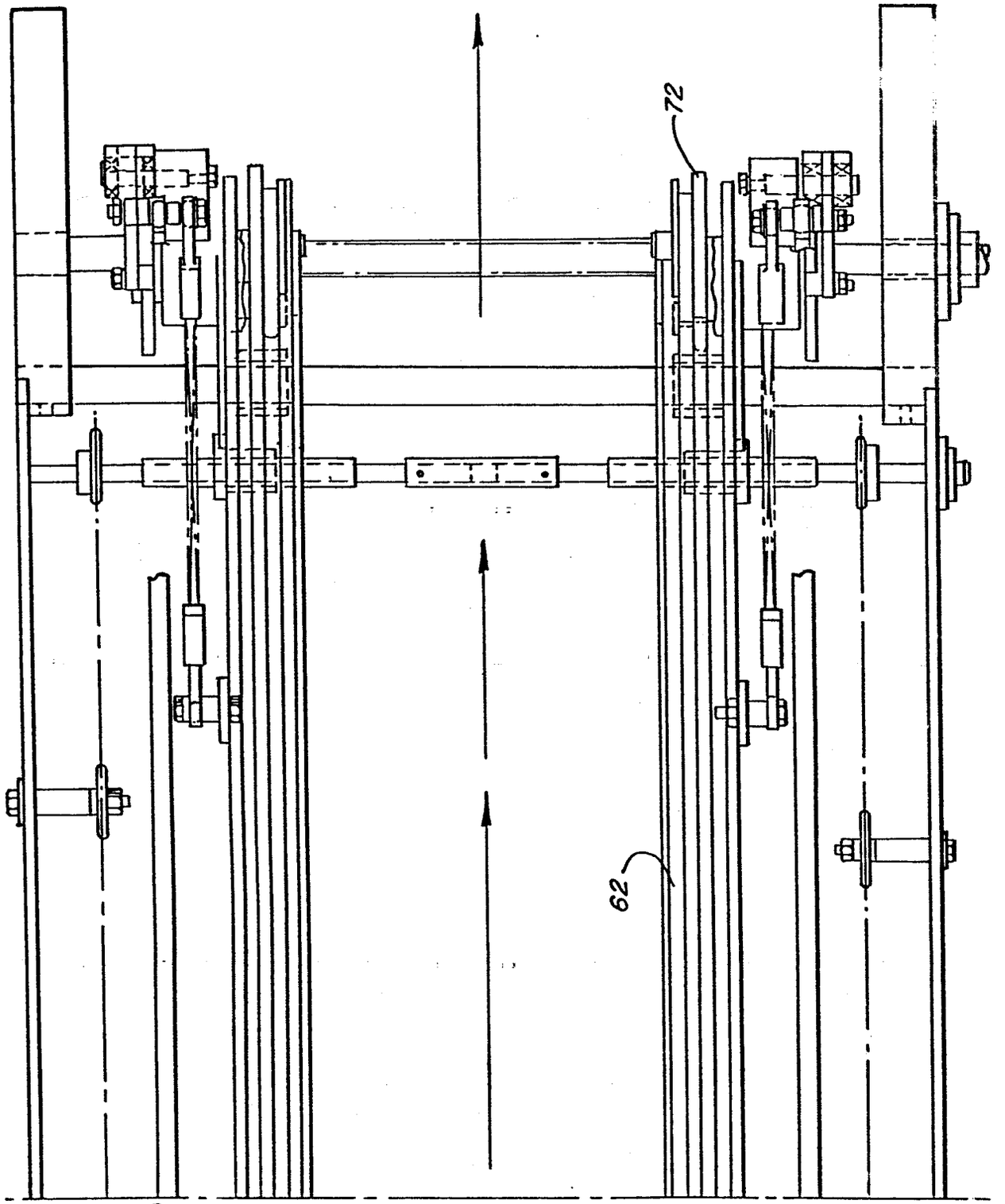


FIG. 17B

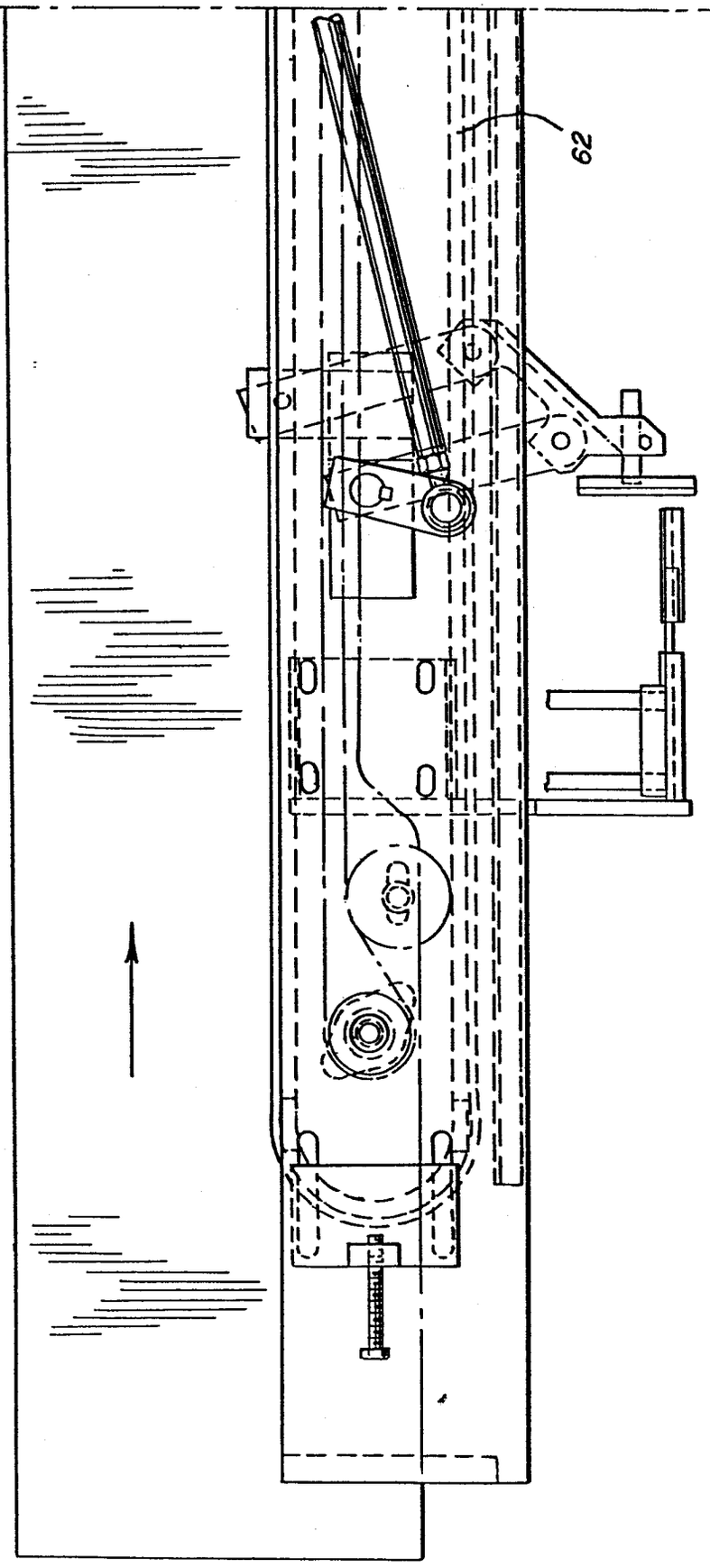


FIG. 18A

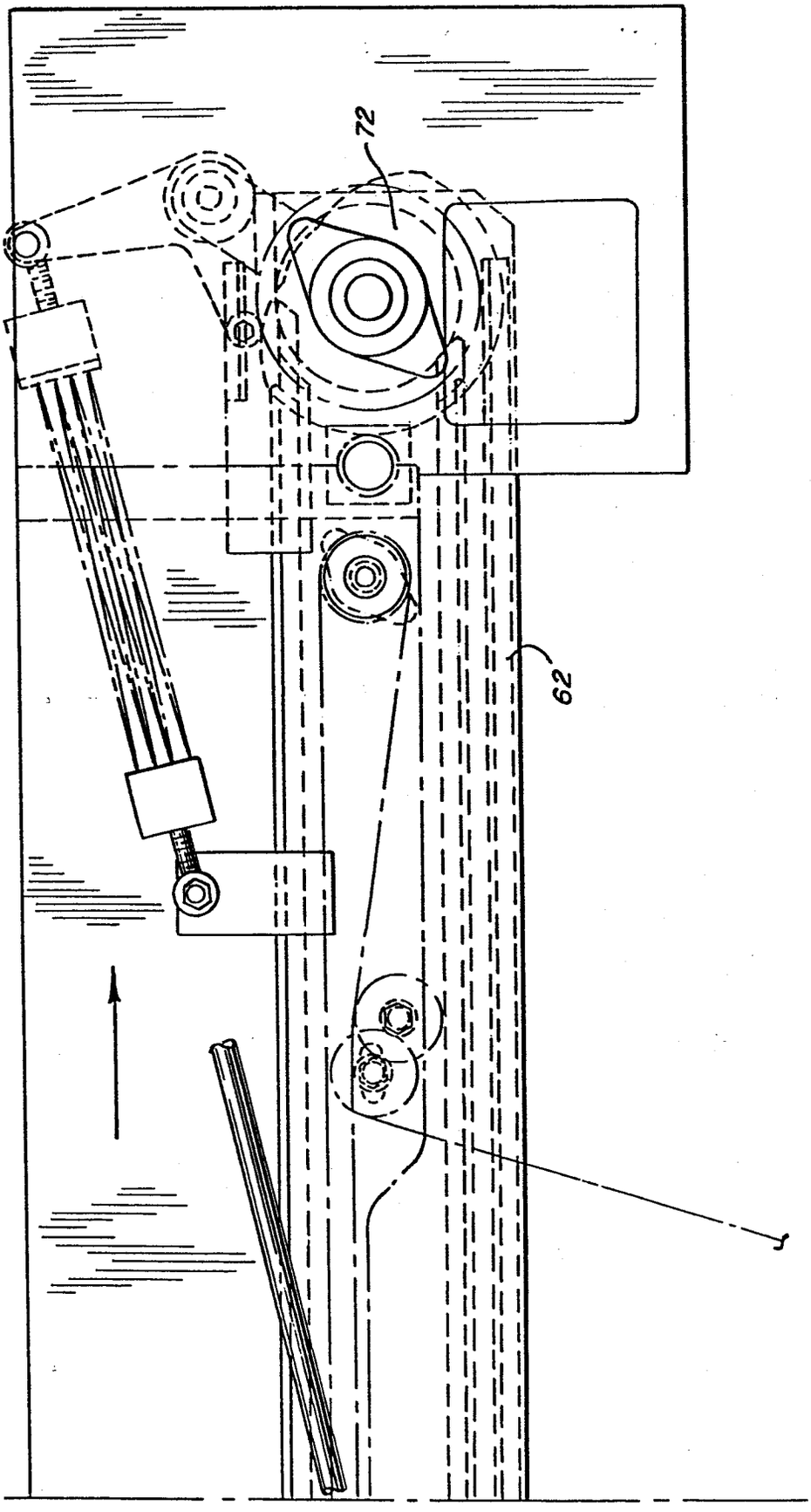
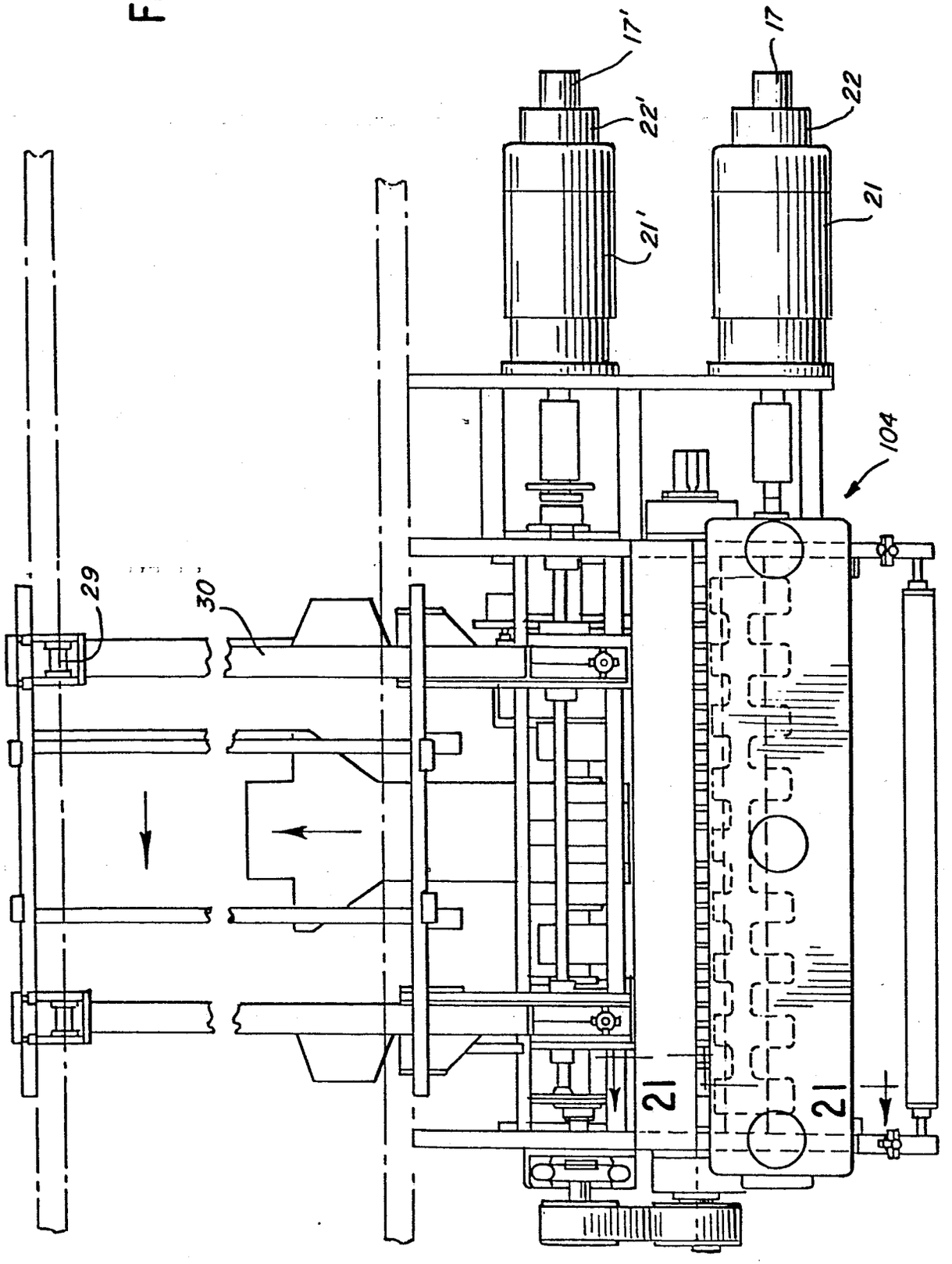


FIG. 18B

FIG. 19



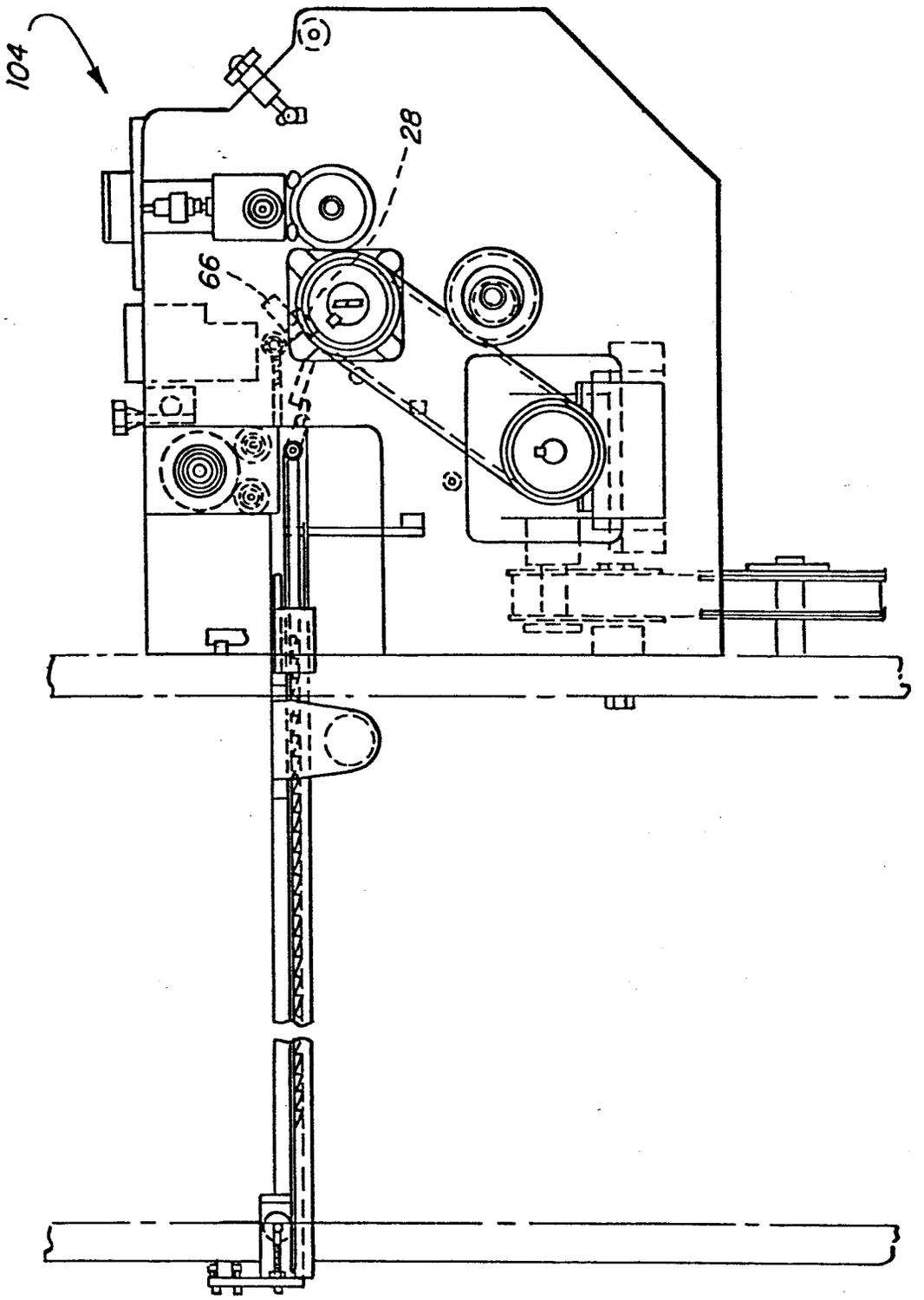


FIG. 20

FIG. 21

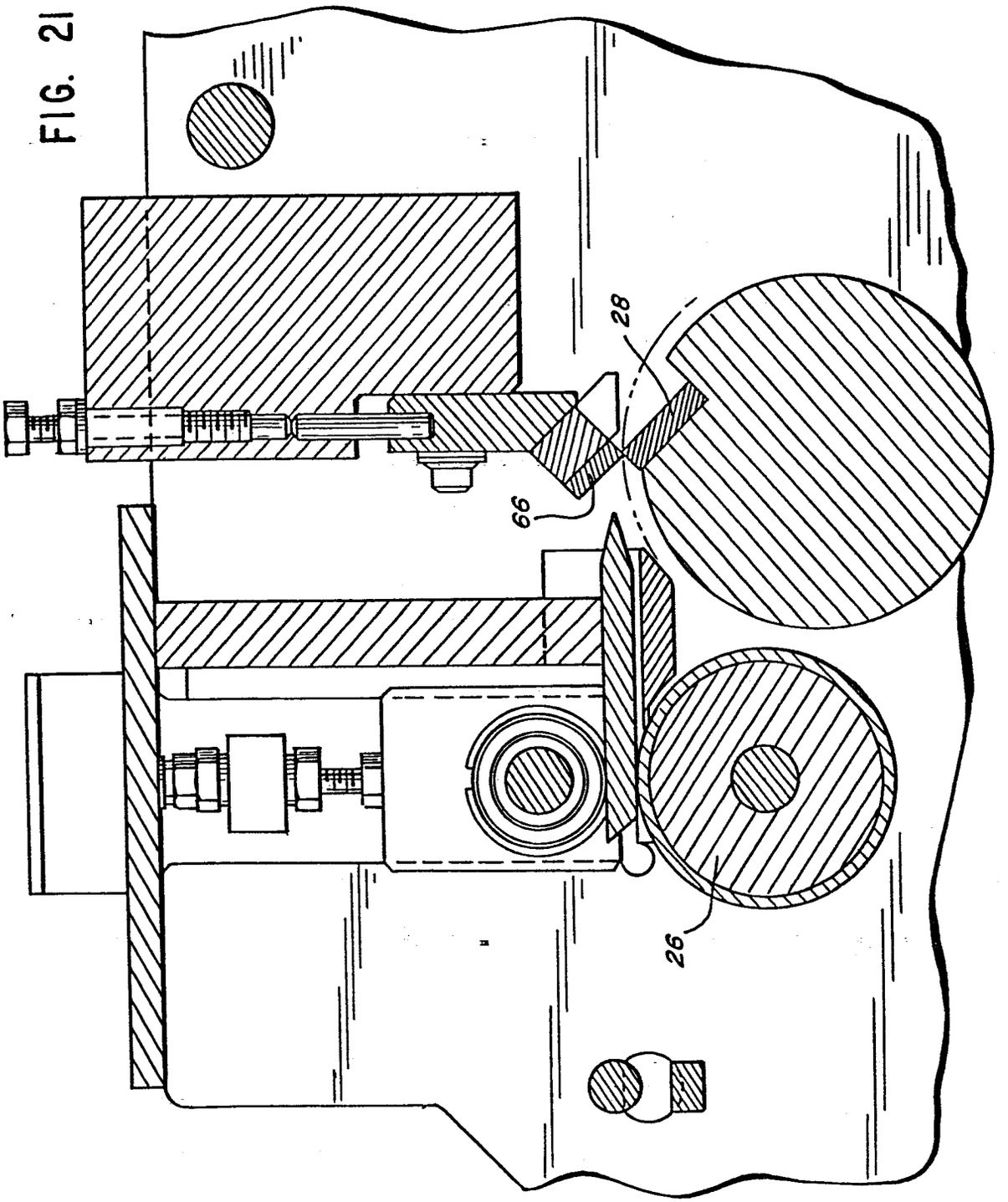


FIG. 22

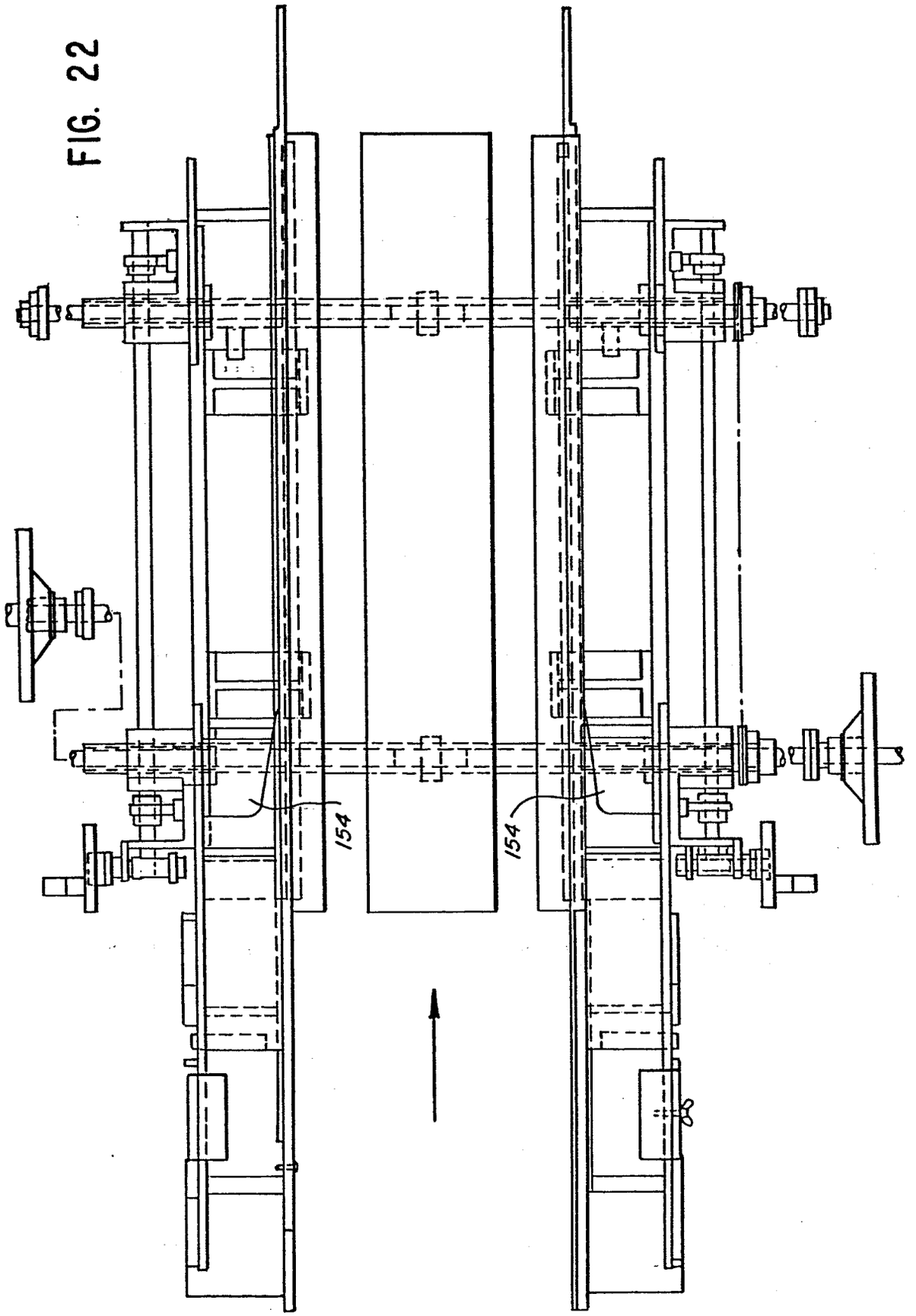


FIG. 23

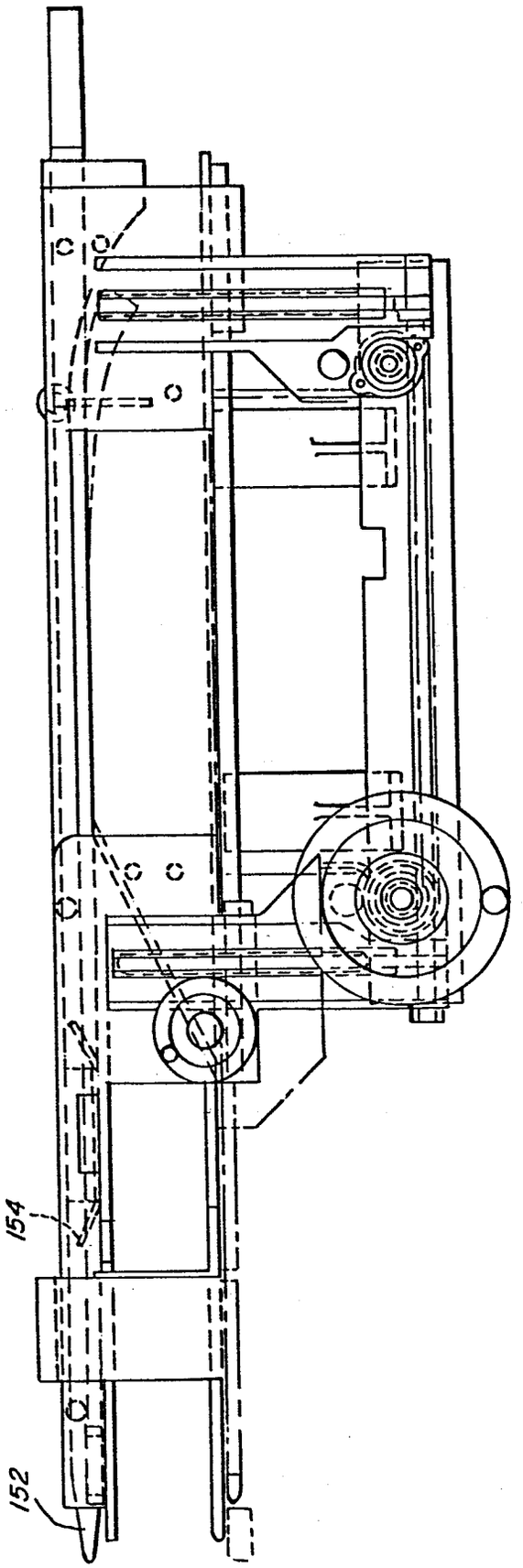
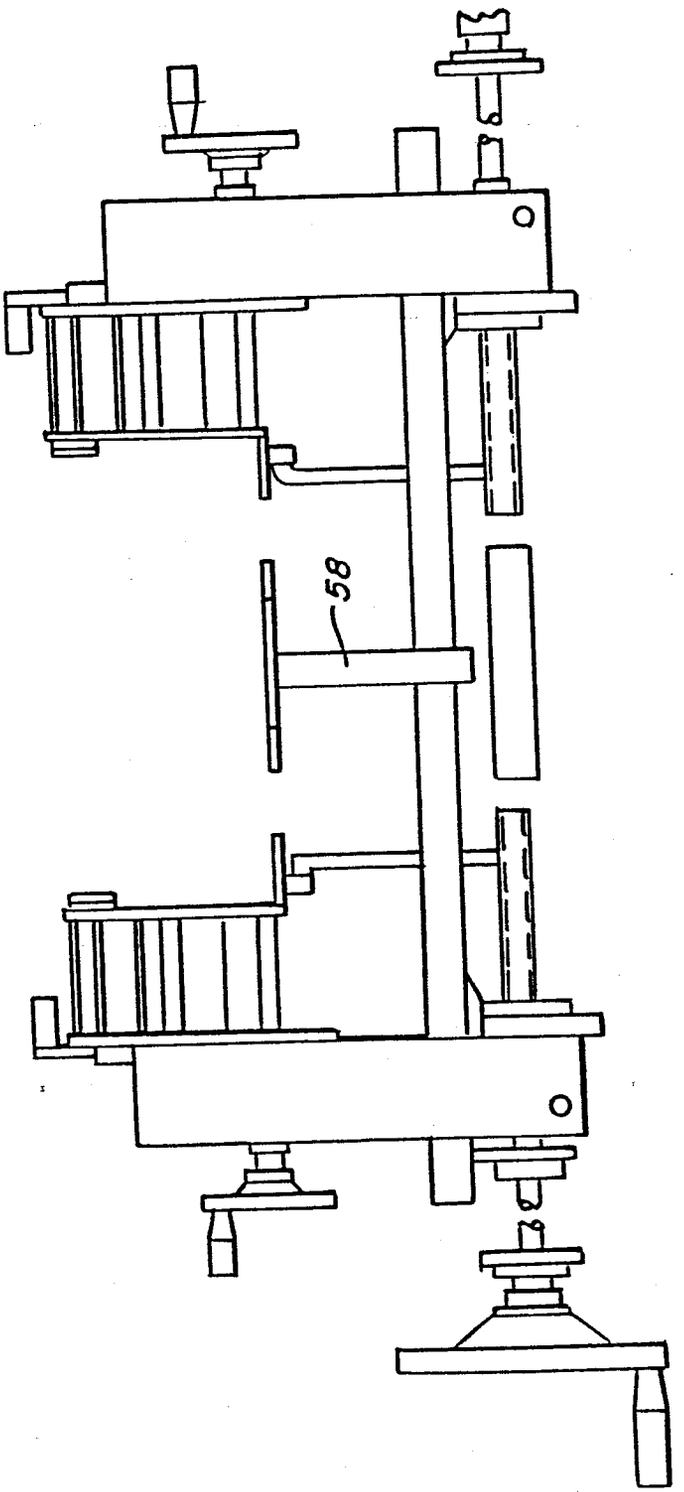


FIG. 24



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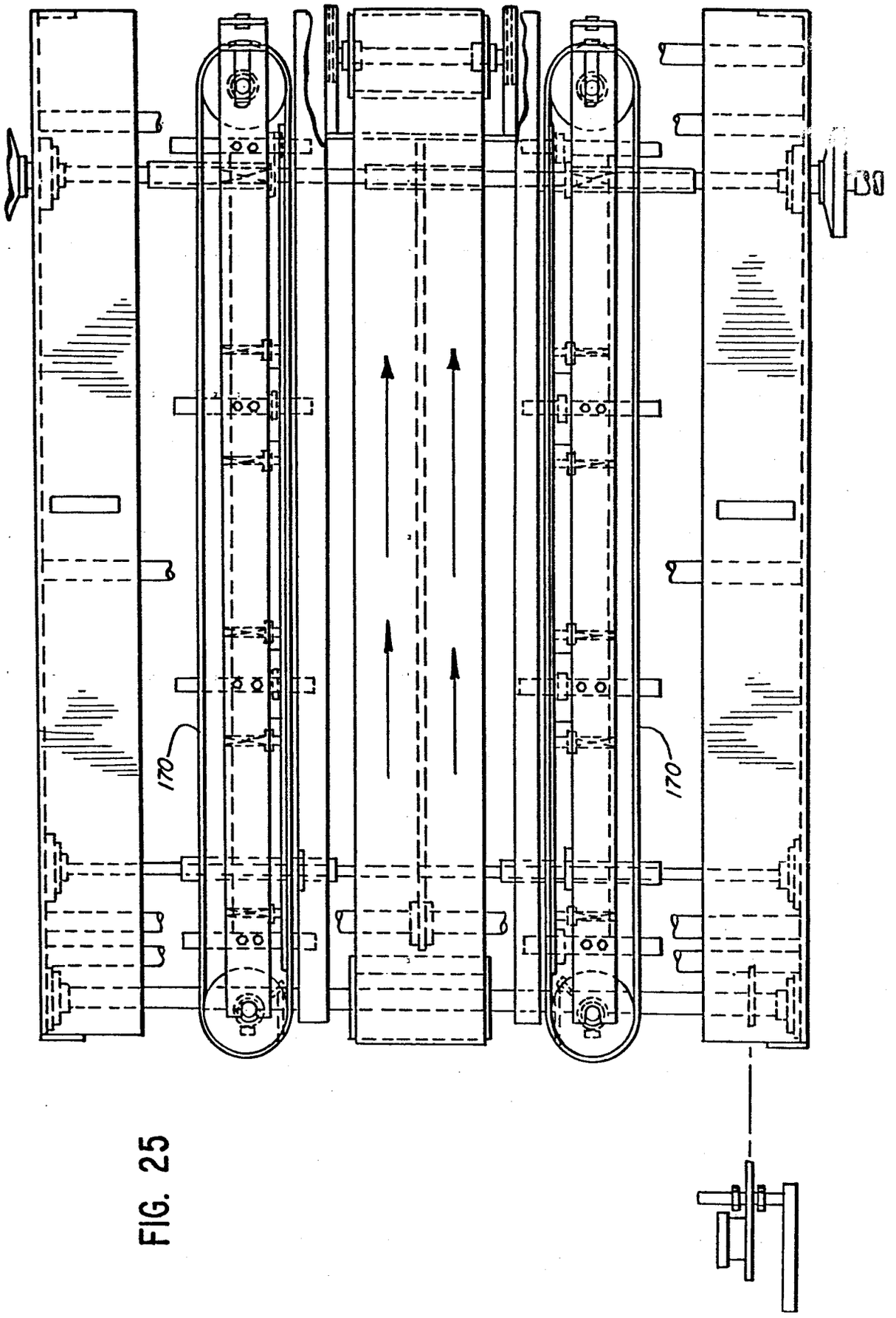

FIG. 25

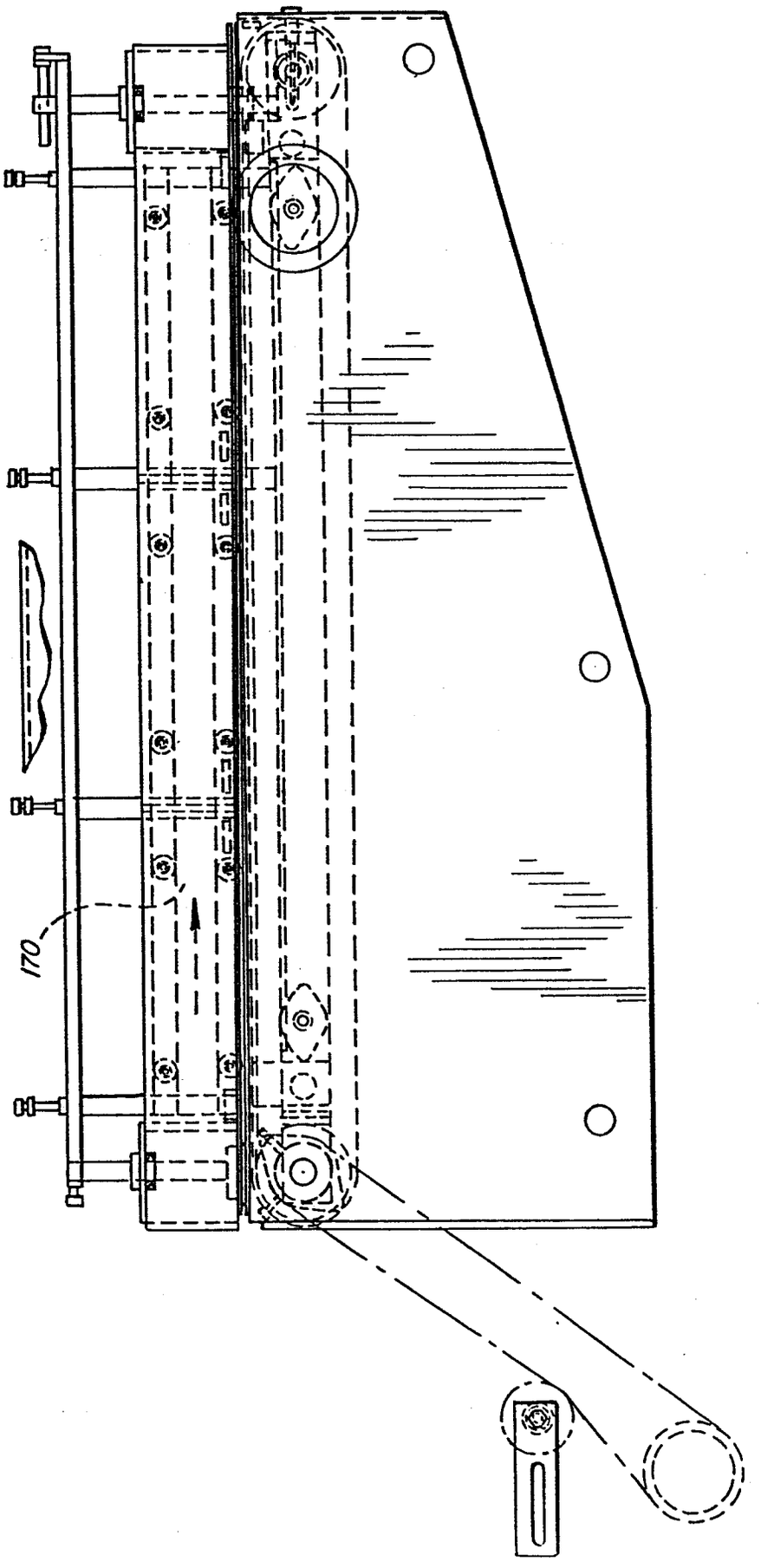

FIG. 26