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(54) WRAPPING MACHINE AND ASSOCIATED PNEUMATIC SYSTEM

(57) A wrapping machine for wrapping trayed food products includes a plurality of pneumatic components that are actuatable by delivery of pressurized air to the pneumatic components. A pneumatic arrangement produces pressurized air for actuating the pneumatic components. The pneumatic arrangement is configured to reduce moisture in the pressurized air.

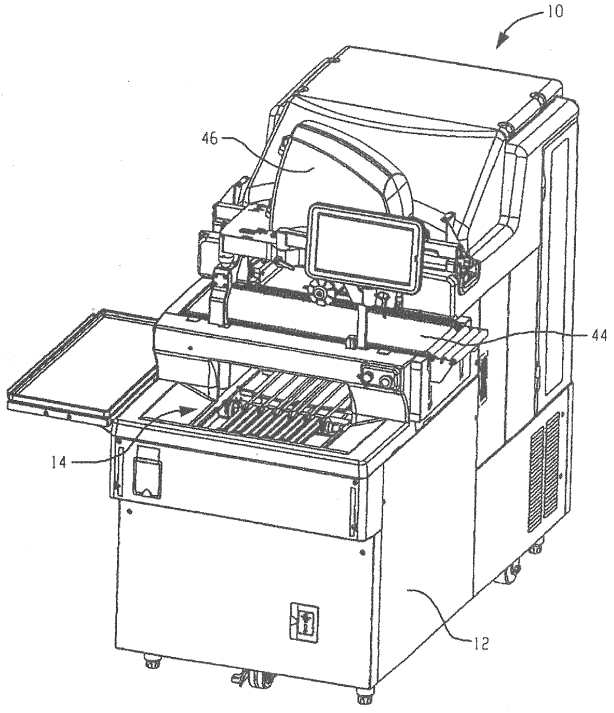

Fig. 1

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Description

TECHNICAL FIELD

[0001] This application relates generally to wrapping machines used for wrapping food items and, more specifically, to a wrapping machine and associated pneumatic system that is suited for operation in cool environments.

BACKGROUND

[0002] Pneumatic systems, such as those used to control components in a trayed item (e.g., trayed meat items) wrapping machine, require consistent response times from all of the actuation cylinders and valves in the system and therefore must maintain dry air throughout the system. Water in such a pneumatic system will cause lubricants in cylinders and valves to break down and rust to build up on surfaces not tolerant to water. The result, assuming the cylinder or valve still functions, is typically slower or less consistent response times for the cylinder or valve to move from its home point to end of travel. This scenario may jeopardize any hard deadlines of an automated system to meet specific timing requirements.

[0003] It would be desirable to provide an automated wrapping system with a pneumatic arrangement that facilitates operation in a typical 90%+ relative humidity and 40 degree Fahrenheit meat processing environment, yet can maintain a dry air actuation system to achieve consistent actuation response times.

SUMMARY

[0004] In one aspect, a wrapping machine for wrapping trayed food products includes a plurality of pneumatic components that are actuatable by delivery of pressurized air to the pneumatic components. A pneumatic arrangement produces pressurized air for actuating the pneumatic components. The pneumatic arrangement is configured to reduce moisture in the pressurized air.

[0005] In another aspect, a wrapping machine for wrapping trayed food products includes a plurality of pneumatic components that are actuatable by delivery of pressurized air to the pneumatic components. A pneumatic arrangement produces pressurized air for actuating the pneumatic components. The pneumatic arrangement includes first and second receiver tanks connected in series along a flow path from the compressor to the pneumatic components.

[0006] In a further aspect, a wrapping machine for wrapping food products includes a wrap station at which food products are wrapped and a film dispensing system for drawing out film over food products at the wrap station. A conveying system moves food products along a path to the wrap station. A plurality of pneumatic components are provided, each pneumatic component actuatable by delivery of pressurized air, and a pneumatic arrangement produces pressurized air for actuating the pneumatic components. The pneumatic arrangement includes a compressor, first receiver tank and second receiver tank. The compressor tank includes an air inlet and an air outlet. The first receiver tank includes an air inlet fluidly connected to the air outlet of the compressor to receive pressurized air, the first receiver tank is sized to enable water in the pressurized air to condense, the first receiver tank includes a drain outlet for draining condensed water, and the first receiver tank has an air outlet. An air inlet of the second receiver tank is fluidly connected to the air outlet of the first receiver tank to receive pressurized air. The second receiver tank is sized to enable water in the pressurized air that enters the second receiver tank to condense, the second receiver tank includes a drain outlet for draining condensed water, and the second receiver tank having an air outlet that is fluidly connected to a path for delivery of pressurized air to the pneumatic components.

[0007] In yet another aspect, a wrapping machine for wrapping food products includes a wrap station at which food products are wrapped and a film dispensing system for drawing out film over food products at the wrap station. A conveying system moves food products along a path to the wrap station. A plurality of pneumatic components are provided, each pneumatic component actuatable by delivery of pressurized air, and a pneumatic arrangement produces pressurized air for actuating the pneumatic components. The pneumatic arrangement includes a compressor and a receiver tank. The receiver tank includes an air inlet fluidly connected to the air outlet of the compressor to receive pressurized air, and the receiver tank is sized to enable water in the pressurized air to condense, the receiver tank includes a drain outlet for draining condensed water, and the receiver tank has an air outlet. The receiver tank also has an air outlet fluidly connected to a path for delivery of pressurized air to the pneumatic components. A drain valve is associated with the drain outlet (e.g., downsteam along a drain path that is connected to the drain outlet). A controller is configured for controlling wrap operations of the wrapping machine, including controlling the conveying system, the pneumatic components and the compressor. The controller is also configured to selectively open the drain valve (i) upon completion of a wrap sequence and/or (ii) upon start-up of a wrap sequence.

[0008] In still another aspect, a wrapping machine includes wrap station at which food products are wrapped and a film dispensing system for drawing out film over food products at the wrap station. A conveying system moves food products along a path to the wrap station. A plurality of pneumatic components are provided, each pneumatic component actuatable by delivery of pressurized air. A pneumatic arrangement produces pressurized air for actuating the pneumatic components. The pneumatic arrangement includes a compressor with an air inlet and an air outlet, the outlet fluidly connected to a path for delivery of pressurized air to the pneumatic

components. A pressurized air wand is connected to an outlet of the path such that pressurized air produced onboard of the wrapping machine can be selectively output by the pressurized air wand under manual control.

[0009] The details of one or more embodiments are set forth in the accompanying drawings and the description below. Other features, objects, and advantages will be apparent from the description and drawings, and from the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

Fig. 1 is a perspective front view of a wrapping machine;

Fig. 2 is a side elevation of the wrapping machine;

Fig. 3 is a schematic side view showing product movement through the machine during wrapping;

Fig. 4 is a schematic depiction of wrapping machine components and a pneumatic arrangement of the machine; and

Figs. 5 and 6 are perspective rear views of the wrapping machine.

DETAILED DESCRIPTION

[0011] Referring to Figs. 1-3, a food product wrapping machine 10 includes an inner frame and outer housing 12. An inlet area 14 provides a location at which products to be wrapped (e.g., food items 16, such as meats in trays) are input to the machine for wrapping in plastic film. The inlet area 14 is part of a conveying system 18 that carries packages into the machine (right to left in Figs. 2 and 3) and then up into a wrap station 20 at which the food products are wrapped. Here the conveying system includes one or more horizontal conveyors 18A that feed from the front of the machine back to an elevator mechanism 18B. A film dispensing system 22 is provided for drawing out film over food products at the wrap station 20 (e.g., under control of a film gripper 24 that moves left to right in Fig. 3 in order to draw off film from one or more film rolls 26). Where more than one film roll is provided (e.g., of differing film widths), an actuatable film selector 28 provides the ability to select the desired film for a given wrap operation (e.g., depending upon size of the food product). An actuatable film knife 30 is provided to cut the film at the appropriate time to enable the wrap operation to be completed. The wrap station may include side clamps 32A, 32B to grip the lateral sides of the film, as well as side underfolders and a rear underfolder (not shown).

[0012] A weighing mechanism 34 is located at the inlet area for weighing the food product as it is placed into the machine. Once a stable weight is determined, the food product 16 is moved laterally into the machine through a light curtain imaging system 38 and past a height sensor array 40 for determining size of the food product and location of the food product on the conveyor. Part of the horizontal conveying system 18A may shift be shifted (e.g., into or out of the page in Fig. 3) as necessary to assure that the food product is properly centered when it is transferred onto the elevator mechanism 18B. After the food product is moved up into the wrap station 20 and wrapped, the wrapped food product is conveyed by a conveyor 42 back toward the front of the machine and deposited onto another horizontal conveyor 44, which here moves left or right (into or out of the page in Fig. 3). The conveyor 42 includes an associated sealer belt that heats the bottom of the wrapped food product to seal the film, and a label printing mechanism 46 prints and applies a pricing label to the wrapped food product. An exemplary controller 50 is shown for controlling machine operation. As used herein, the term controller is intended to broadly encompass any circuit (e.g., solid state, application specific integrated circuit (ASIC), an electronic circuit, a combinational logic circuit, a field programmable gate array (FPGA)), processor(s) (e.g., shared, dedicated, or group - including hardware or software that executes code), software, firmware and/or other components, or a combination of some or all of the above, that carries out the control functions of the machine or the control functions of any component thereof.

[0013] Various motors M are shown and are used primarily for movement of the conveyor components, gripper components and underfolders. However, a plurality of pneumatic components are also provided for control of components, where each pneumatic component is actuatable by delivery of pressurized air.

[0014] In this regard, Fig. 4 shows an exemplary pneumatic arrangement 60 for the wrapping machine. The illustrated system employs pneumatics to perform actuation of various components and utilizes a design that can remove the heat and humidity from the compressor and the environment from which the compressor is pulling air. This design solves the problem of maintaining a dew point within the pneumatic system that is below the ambient temperature of the environment (in this case the environment is typically the meat processing environment, which may be 50°F or less, such as less than 46°F).

[0015] The exemplary automated wrapping system includes a pair of pneumatic cylinders 62A, 62B to actuate the side clamps 32A, 32B, a set of pneumatic gripper cylinders 64A, 64B, 64C to actuate the gripping operation of the film gripper 24 (which has a center grip and two side grips), a pneumatic cylinder 66 to actuate the film knife assembly 30 to cut the film, a pair of film selector pneumatic cylinders 68A, 68B to select from the two film rolls, and a pneumatic cylinder 70 to actuate a label applier. All of these actuation points should be free from any material amount of water in the pressurized air system to operate at specific response rates required to wrap

product in trays at desired speeds (e.g., 30 Packages Per Minute (PPM) or more). The system components described below help to develop pressure in the system and maintain a dew point in the system that is below the ambient temperature, even in low temperature environments.

[0016] The air flow of the system starts at the compressor 100 with arrows indicating the flow through all key components. The compressor 100 includes an air inlet and an air outlet and generates a high pressure (e.g., at least 120 PSI, such at least 130 PSI (e.g., a 135 PSI target)) as it moves air from the walk-in cooler environment into a closed pressure system. To reduce overall noise, the compressor 100 may be sized that is only needs to be operated at no more than a 50% duty cycle, such as at most a 40% duty cycle or at most a 35% duty cycle to provide adequate air pressure even when the wrapping machine is wrapping at a rated high speed of 25 or more PPM. However, even at a 30% duty cycle the negative by product of the compression is heat that will affect the dew point and should be removed, and a fan may be provided for this purpose. The compressor 100 is also pulling in high humidity air in the walk-in cooler environment, making it more difficult to create a dry pressurized air flow to the components.

[0017] The illustrated fluid connections between components may be formed of suitable tubing (e.g., copper and/or flexible). Tubing in the system between the compressor and a receiver tank 102 may be of a specified length and diameter (e.g., 1/2 " OD) to provide an adequate amount of flow of the 135 PSI system as well as a suitable surface area for the compressed air to cool as it travels to the air inlet of a receiver tank 102. An unloader valve 104 with associated pressure sensor is provided between the compressor 100 and receiver tank 102 to remove pressure in the supply line between the compressor 100 and the receiver tank 102 to allow the compressor to start without back pressure. The air outlet of receiver tank 102 feeds to an air inlet of a receiver tank 108. Receiver tank 102 includes a drain outlet 110 and receiver tank 108 includes a drain outlet 112.

[0018] Drain outlet 110 feeds to a controllable drain valve 114. Here, the drain outlet 112 feeds along a path 116 into receiver tank 102 for eventual draining through drain outlet 110. However, alternatively drain outlet 112 could feed along a separate external path 118 to the input side of the drain valve 114.

[0019] The air outlet of receiver tank 108 feeds to path that leads to an air inlet of an auto drain trap 120, which in turn has an air outlet that feeds to an air inlet of another auto drain trap 122. A pressure regulator 124 is positioned between the two auto drain traps and reduces the pressure to a desired set level for component operation. The air outlet of auto drain trap 122 feeds to a low pressure dump valve 126, which in turn feeds to a valve manifold 128 with a plurality of controllable valves that enable controlled and selective delivery of pressurized air to the various pneumatic components.

[0020] Another valve manifold 130 selectively connects the high pressure air flow to the label applier cylinder, at either side according actuation desired. A vacuum pump 132 creates a vacuum pull along path 134 that also feeds through the valve manifold 130 for selectively controlling application of the vacuum to an label application wand 136 to hold a label at the end of the wand.

[0021] Notably, the receiver tanks 102 and 108 are positioned, sized and configured such that the hot, humid, high pressure air (e.g., at least 100 PSI) expands and cools since the surface of the tanks are cooled by the meat processing environment. In one example, each receiver tank may be cylindrical in configuration having a capacity of between about one and about three gallons. The expansion and cooling process forces moisture out of the compressed air through condensation, thereby lowering the moisture level in the pressurized air. The cool surface area of the first tank 102 causes condensation of the water as it passes thru the tank inlet, which condensation falls to the bottom of the tank 102. The air is subsequently cooled further within the tank during this first stage of condensation and cooling. Water can collect on the bottom of the tank 102. The water is expelled on a selective basis under control of the drain valve 114. Alternatively, the water in tank 108 drains along path 118. By using two receiver tanks instead of one, the likelihood of blow through of condensed water is reduced, and the overall tank surface area is increased and/or more effectively utilized. A pressure relief valve 115 may be provided on one or both of the receiver tanks to limit pressure within the tanks, and a pressure gauge 117 may also be provided for visual inspection by operators.

[0022] The high pressure air then enters the second receiver tank 108 for subsequent further cooling of the pressurized air and further condensation of remaining water in the pressurized air. Tank 108 is located above tank 102, and this condensed water is freely drained by gravity into the bottom receiver tank 102 for subsequent removal under control of the drain valve. The combined cooled surface area of the two receiver tanks 102 and 108, the volume of the tanks to handle water condensation and drain the water, and the high pressure force water droplets to separate from the pressurized air. The two downstream auto drain traps 120 and 122 provide a final filtering of the air in the system and expel any remaining condensed water particulates outside of the closed air system. The pressure reduction between traps 120 and 122 and resulting expansion of the air results in a lower dew point of the pressurized air at the downstream side of regulator 124. The result is a pressurized air flow from drain trap 122 having a dew point below the temperature of the ambient working environment of the machine (e.g., below 50°F), which pressurized air is made available to the downstream components through the valve manifold 128. Because the dew point of the pressurized air is lower than the relatively cool temperature of the ambient environment, moisture condensation on the downstream side

of the regulator 124 is significantly reduced and/or substantially eliminated from the system. The controller 50 is connected for selective control of each valve.

[0023] The drain valve 114 may be opened on a predefined basis for draining of condensed water. By way of example, in one implementation the drain valve 114 may be momentarily opened (e.g., for less than one second) to permit draining each time the wrapping machine is started to initiate a wrap sequence or operation (e.g., when a start button 160 (Fig. 2) is pushed, or as part of an machine initialization sequence carried out responsive to pushing of the start button 160). In another example, the draining may take place each time a wrap sequence or operation is stopped (e.g., when the machine is turned off). Periodic draining (e.g., every X minutes) or draining based upon operating time (e.g., after Y minutes of compressor operation) could also be implemented.

[0024] The compressor 100 and receiver tank volume can be collectively sized such that adequate air pressure is made available for all pneumatic components to operate properly as necessary for sequential wrapping operations at a rated high speed of at least 25 PPM (such as at least 30 PPM), while at the same time requiring the compressor to be operated at no more than a 50% duty cycle (e.g., at most a 40% duty cycle or at most a 35% duty cycle). This reduces overall heat production by the compressor and also enables overall quieter operation of the machine. A pressure sensor may be used to control when the compressor is turned ON/OFF.

[0025] As seen in the rear perspectives of Figs. 5 and 6, the compressor 100 and vacuum pump 132 may be located in a rear compartment 170 of the machine 10, where the rear compartment includes one or more louvered cover panels 172 that enable ventilation of the compartment. A fan may be provided for moving air through the compartment if needed for heat reduction.

[0026] The heat by product of the compressor 100 and/or vacuum pump 132 may also be put to use to warm film and the sealer belt by heat capture and flow along paths 140, 142 (Fig. 4). Due to the cold environment of the walk-in cooler film can be cold and will stretch less than desired during wrap of a product. Ideal wraps occur when the film temperature is maintained at or above sixty degrees Fahrenheit. The sealer belt of the system also requires a substantial amount of heat (upwards of 300 degrees Fahrenheit) to be applied to the bottom of a wrapped product tray to seal the film. The compressor 100 and the vacuum pump 132 generate heat that may be captured and output (e.g., as a heated air flow) to the film and/or sealer belt areas of the machine to passively heat these areas.

[0027] Notably, and referring again to Fig. 4, the pressure regulator 124 provides a higher pressure zone upstream of the pressure regulator 124 and a lower pressure zone downstream of the pressure regulator 124. By way of example, a pressure in the higher pressure zone may be at least 120 PSI (per above), and a pressure in the lower pressure zone may no more than 75 PSI (e.g., no more than 60 PSI, such as a 50 PSI target).

[0028] As shown, a pressurized air cleaning/drying wand 150 may be connected to a high pressure outlet 152 of the higher pressure zone. The high pressure outlet 152 may include a quick disconnect coupler to which a flexible feed tube 154 of the pressurized air cleaning/drying wand is connected for this purpose. The operator may selectively use the wand 150 for cleaning of the wrapping machine and/or the area around the wrapping machine. An openable/closeable valve 106 (e.g., manual lever valve or electrically/electronically controllable valve) may be provided along the flow path to the high pressure outlet 152 for controlling whether high pressure air is present at the outlet 152. The operator opens the valve when there is desire to use the wand 150.

[0029] It is to be clearly understood that the above description is intended by way of illustration and example only, is not intended to be taken by way of limitation, and that other changes and modifications are possible.

Claims

1. A wrapping machine for wrapping food products, comprising:

- a wrap station at which food products are wrapped;
- a film dispensing system for drawing out film over food products at the wrap station;
- a conveying system for moving food products along a path to the wrap station;
- a plurality of pneumatic components, each pneumatic component actuatable by delivery of pressurized air;
- a pneumatic arrangement for producing pressurized air for actuating the pneumatic components, the pneumatic arrangement including:

  - a compressor including an air inlet and an air outlet;
  - a first receiver tank having an air inlet fluidly connected to the air outlet of the compressor to receive pressurized air, the first receiver tank sized to enable water in the pressurized air to condense, the first receiver tank including a drain outlet for draining condensed water, the first receiver tank having an air outlet;
  - a second receiver tank having an air inlet fluidly connected to the air outlet of the first receiver tank to receive pressurized air, the second receiver tank sized to enable water in the pressurized air that enters the second receiver tank to condense, the second receiver tank including a drain outlet for draining condensed water, the second receiver

tank having an air outlet that is fluidly connected to a path for delivery of pressurized air to the pneumatic components.

2. The machine of claim 1, wherein the second receiver tank is positioned above the first receiver tank.

3. The machine of claim 1 or 2, wherein the drain outlet of the second receiver tank is connected to a drain inlet of the second receiver tank such that water drained from the firt receiver tank passes through the first receiver tank.

4. The machine of one of the preceding claims, wherein the drain outlet of the first receiver tank is spaced from the air outlet of the first receiver tank to limit moisture blow through to the second receiver tank, and the drain outlet of the second receiver tank is spaced from the air outlet of the first receiver tank to limit moisture blow through to the path.

5. The machine of one of the preceding claims, further comprising:

- a first auto drain trap along the path and having an air inlet fluidly connected to the air outlet of the second receiver tank, the first auto drain trap configured for capturing water and particulate in the pressurized air, the first auto drain trap having an air outlet,
- a second auto drain trap having an air inlet fluidly connected to the air outlet of the first auto drain trap, the second auto drain trap configured for capturing water and particulate in the pressurized air, the second auto drain trap having an air outlet,

wherein the air outlet of the second auto drain trap is fluidly connected to the plurality of pneumatic components.

6. The machine of one of the preceding claims, wherein one or more controllable air valves fluidly connect the air outlet of the second receiver tank to the plurality of pneumatic components to enable selective delivery of pressurized air from the second receiver tank to the pneumatic components, wherein the drain outlet of the first receiver tank and the drain outlet of the second receiver tank feed to a common and controllable drain valve.

7. The machine of claim 6, wherein a controller is connected for selective control of each of the air valves, selective control of the drain valve, and selective operation of the compressor.

8. The machine of claim 6 or 7, wherein a pressure regulator is positioned between the air outlet of the second receiver tank and the controllable air valves to provide a higher pressure zone upstream of the pressure regulator and a lower pressure zone downstream of the pressure regulator.

9. The machine of claim 8, wherein a pressure in the higher pressure zone is at least 120 psi and a pressure in the lower pressure zone is no more than 75 psi.

10. The machine of any preceding claim, wherein a first heat transfer arrangement is configured to transfer waste heat of the compressor to one or both of a sealer belt film seal zone and/or a film roll supply location.

11. The machine of claim 10, wherein a vacuum pump is fluidly connected for control of a vacuum actuated component, wherein a second heat transfer arrangement is configured to transfer waste heat of the vacuum pump to one or both of the sealer belt film seal zone and/or the film roll supply location.

12. The machine of one of the preceding claims, wherein the drain outlet of the first receiver tank and the drain outlet of the second receiver tank feed to a common and controllable drain valve, a controller is connected for selective control of the drain valve and selective operation of the compressor, the controller configured to selectively open the drain valve.

13. The machine of one of the preceding claims, wherein the compressor and total volume of the first and second receiver tanks are collectively sized such that sufficient air pressure is made available for all pneumatic components top operate properly as necessary for sequential wrapping operations at a rated high speed of at least 25 packages per minute, while at the same time requiring the compressor to be operated at no more than a 50% duty cycle.

14. The machine of one of the preceding claims, the pneumatic arrangement including:

- a compressor including an air inlet and an air outlet, the outlet fluidly connected to a path for delivery of pressurized air to the pneumatic components; and
- a pressurized air wand connected to an outlet of the path such that pressurized air produced on-board of the wrapping machine can be selectively output by the pressurized air wand under manual control.

15. The machine of claim 14, wherein the high pressure outlet includes a quick

disconnect coupler to which a feed tube of the pressurized air wand is connected

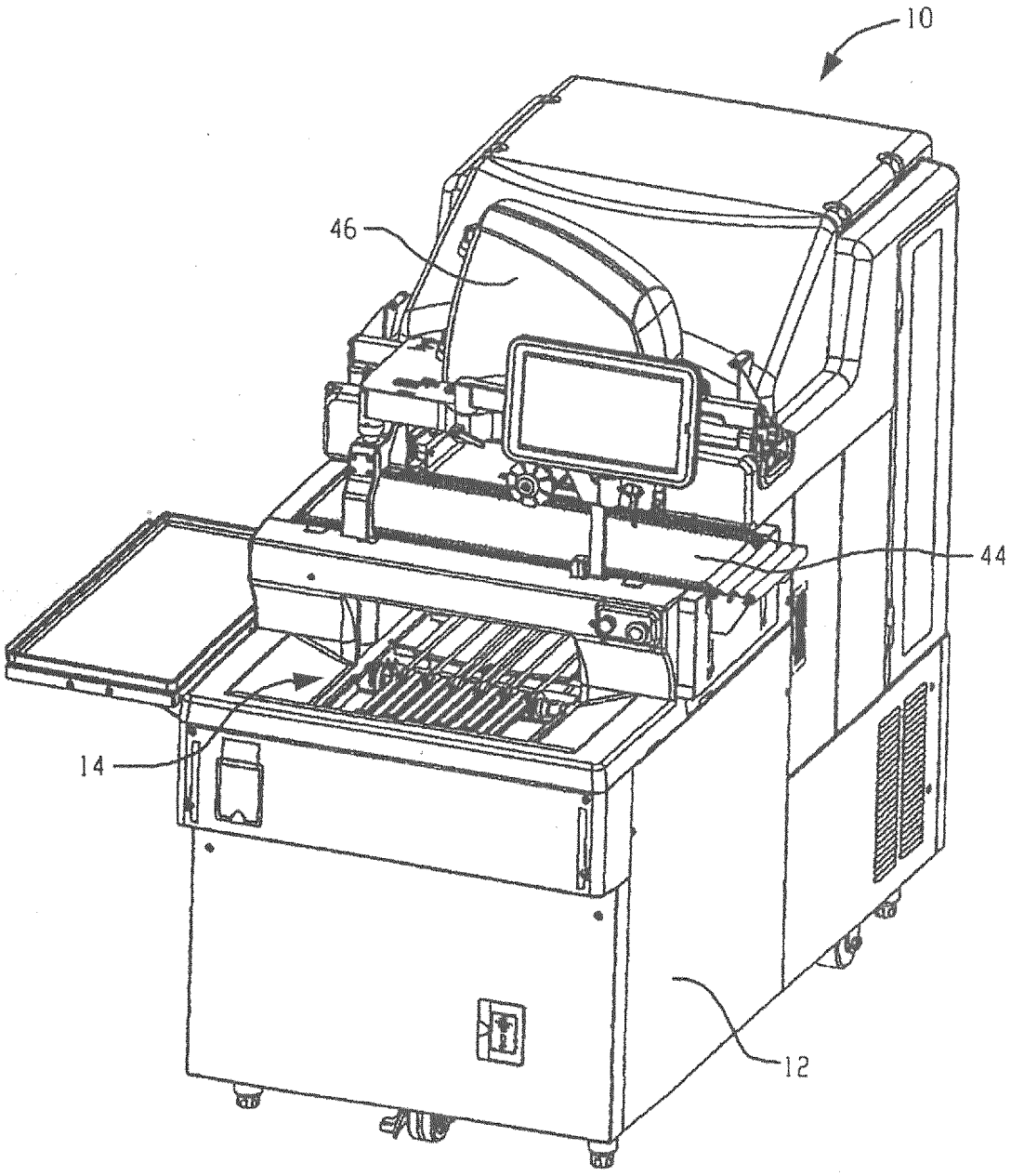

Fig. 1

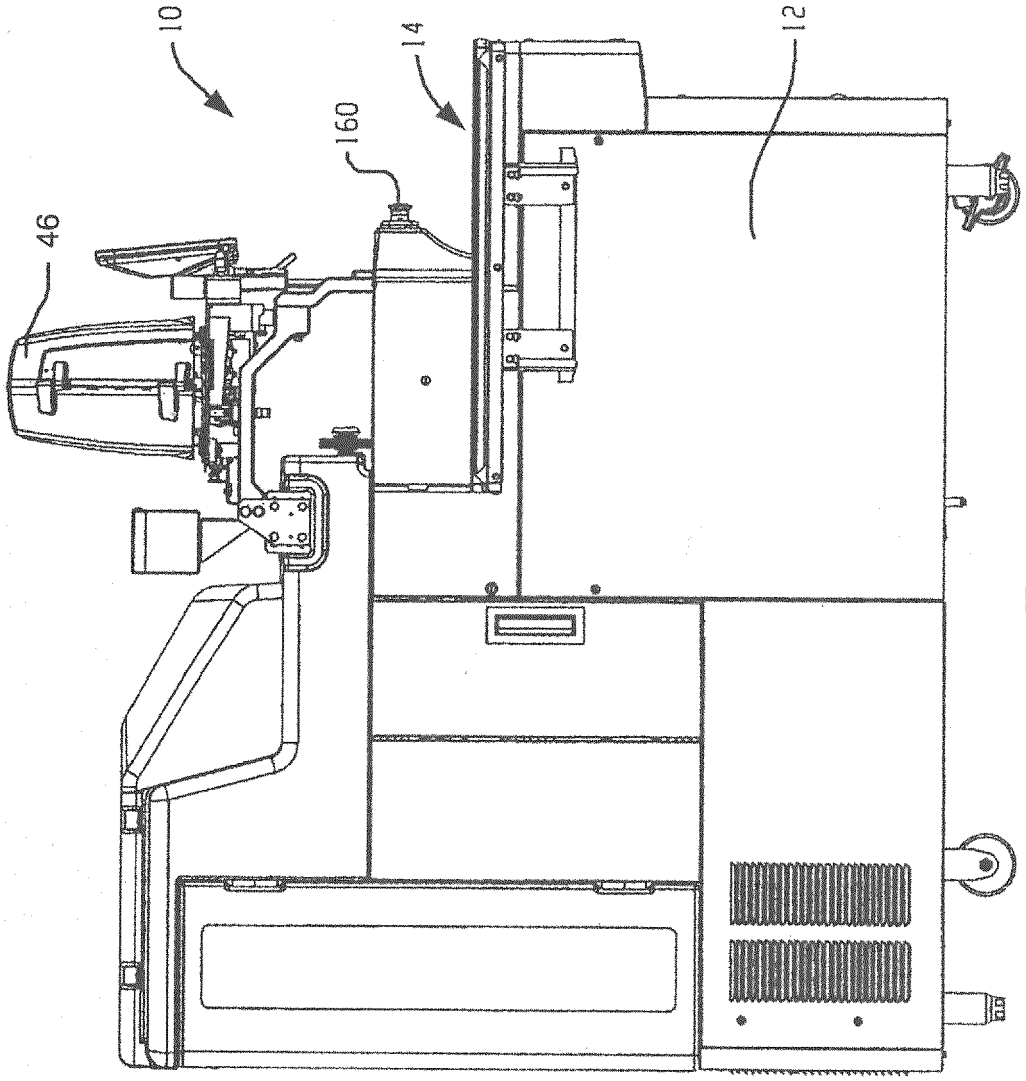

Fig. 2

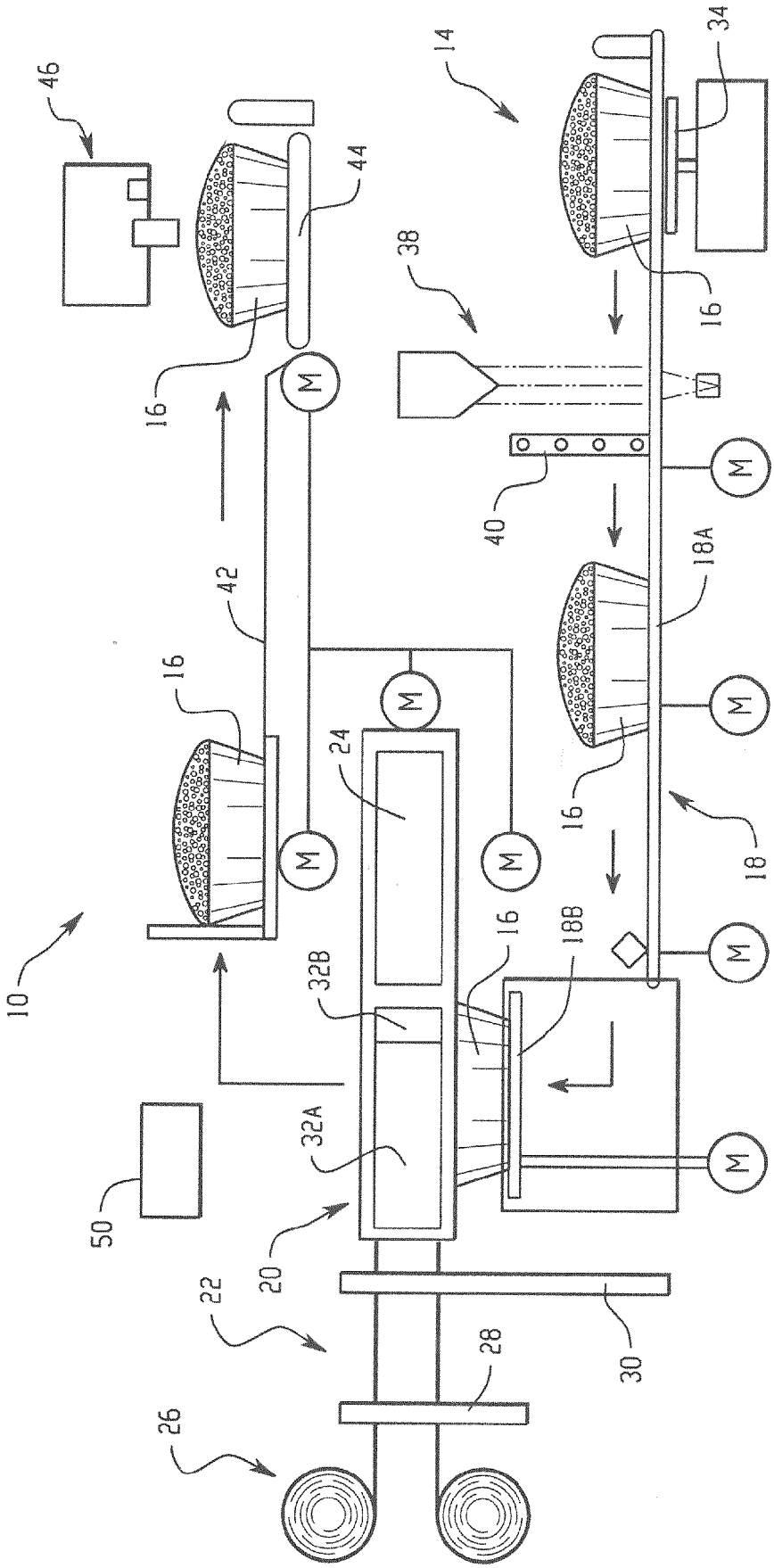

Fig. 3

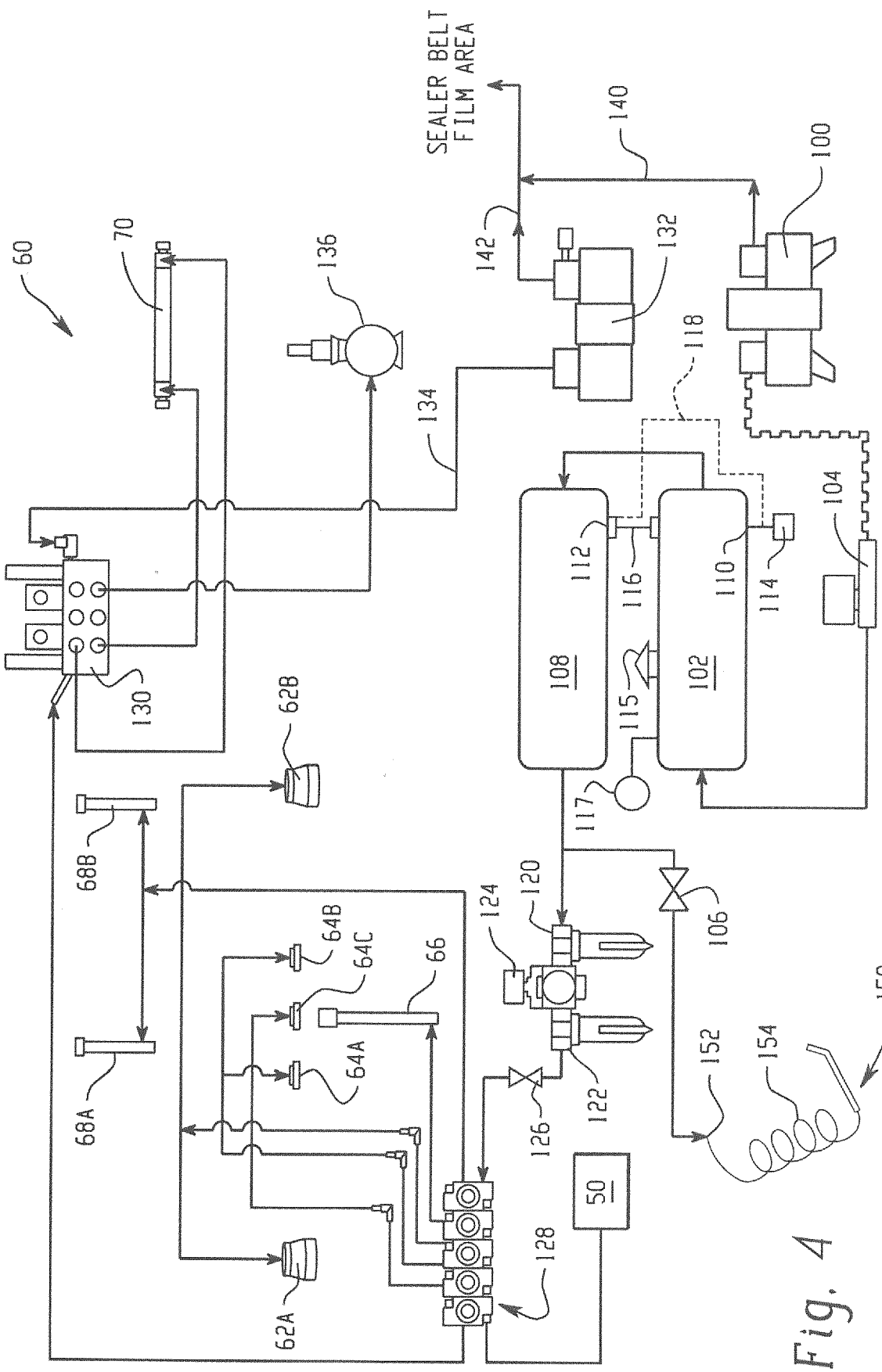
SEALER BELT FILM AREA
60
70
136
142
140
100
132
118
134
104
112
116
110
114
108
102
115
117
130
62B
68B
64B
64C
66
124
120
106
150
68A
64A
152
154
126
122
50
128
62A

Fig. 4

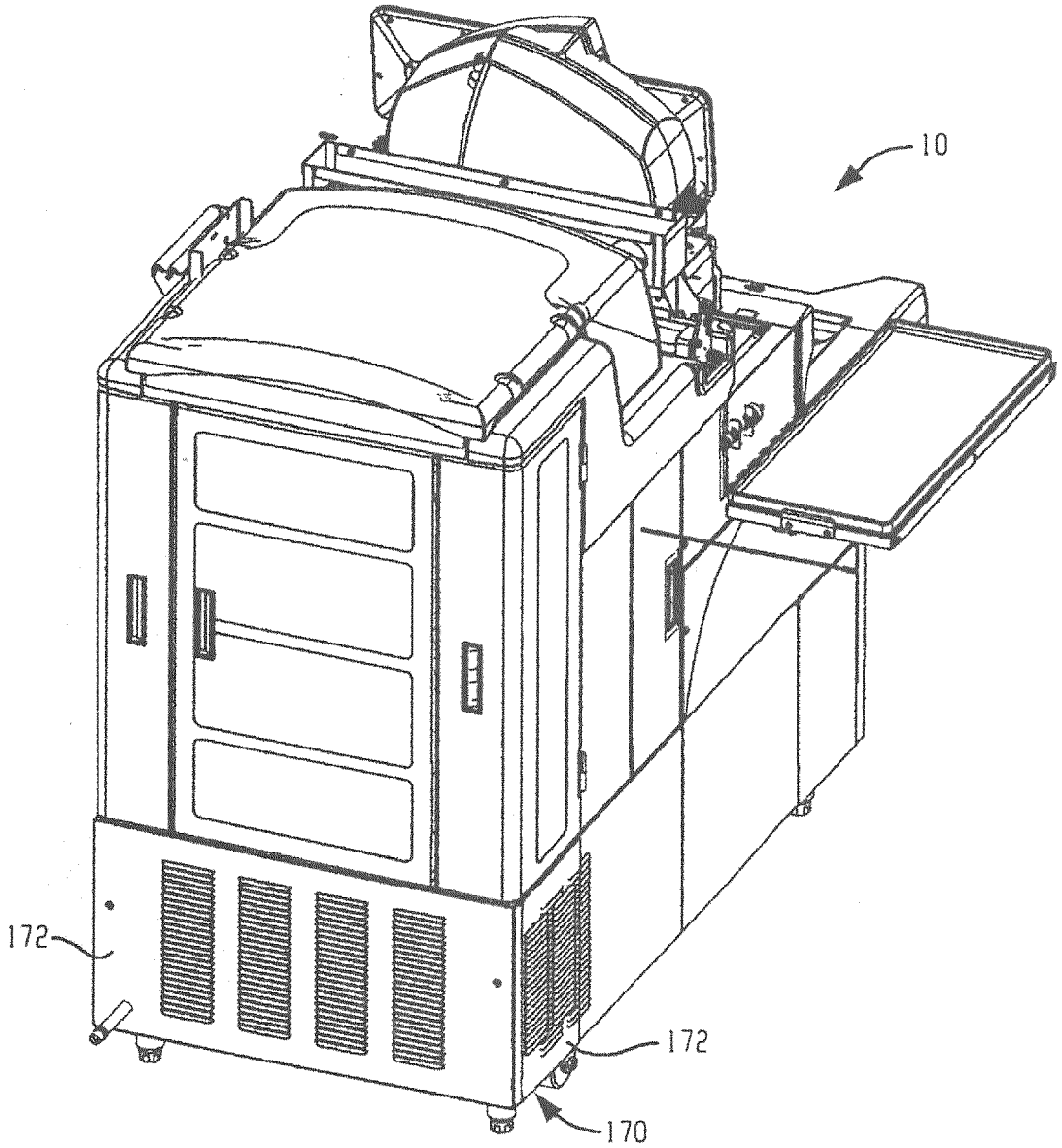

Fig. 5

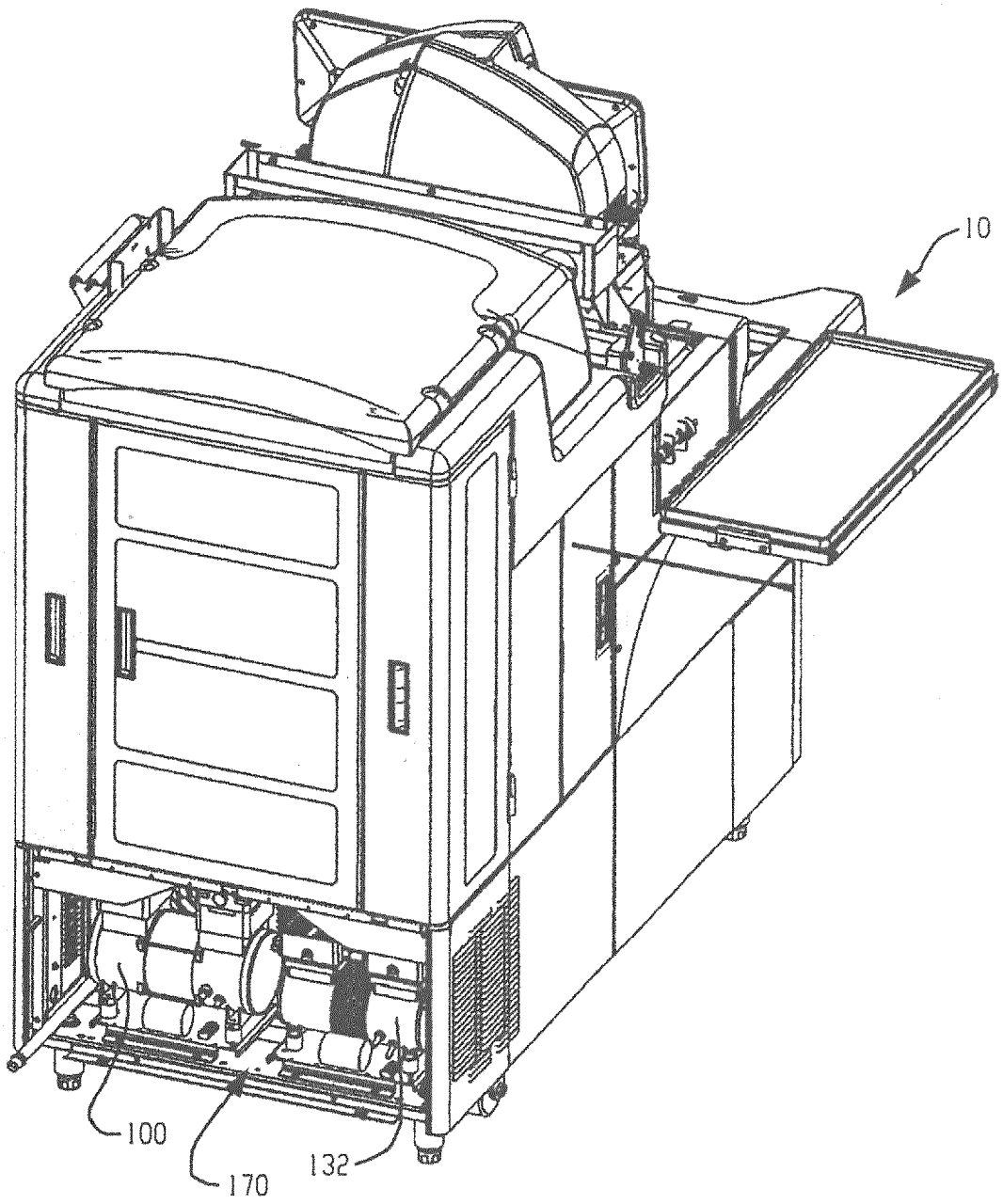

Fig. 6