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(54) **Title:** INFEED SYSTEMS FOR CHIPPERS OR GRINDERS, AND CHIPPERS AND GRINDERS HAVING SAME

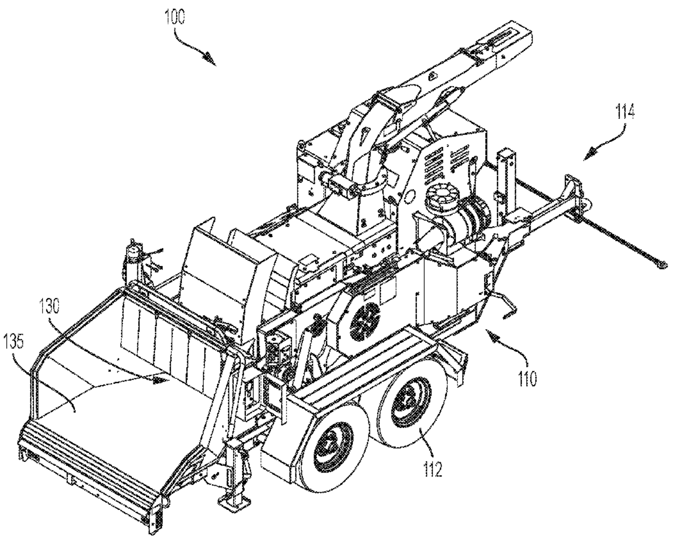

FIG. 1

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(57) **Abstract:** An infeed system is provided for a chipper or grinder having a processing portion wherein an item is processed into smaller pieces. The infeed system is upstream of the processing portion and includes a feed roller, a first hydraulic motor in communication with the feed roller for selectively actuating the feed roller, a second hydraulic motor in communication with the feed roller for selectively actuating the feed roller, and a hydraulic pump for providing hydraulic fluid to the first and second motors. A directional control valve and a relational control valve are between the pump and the motors. The directional control valve allows the hydraulic fluid to operate the first and second motors in a forward direction and in a reverse direction, and the relational control valve allows the hydraulic fluid to operate the first and second motors in series and in parallel.

[Continued on next page]

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INFEED SYSTEMS FOR CHIPPERS OR GRINDERS, AND CHIPPERS AND GRINDERS HAVING SAME

Cross-Reference to Related Applications

[0001] This application claims priority to U.S. Patent Application No. 15/145,653, filed May 3, 2016, which is currently pending, and which is incorporated herein by reference in its entirety.

Background

[0002] The current invention relates generally to chippers and grinders, which are devices used to process items into smaller pieces. Chippers typically contain sharp knives that cut items such as whole trees and branches into smaller woodchips. Grinders, on the other hand, typically contain hammers which crush aggregate material into smaller pieces through repeated blows. Example prior art chippers are shown in U.S. Pat. Nos. 8,684,291; 7,637,444; 7,546,964; 7,011,258; 6,138,932; 5,692,549; 5,692,548; 5,088,532; and 4,442,877; and US 2014/0031185, each owned by Vermeer Manufacturing Company; these documents are each incorporated herein by reference in their entirety and form part of the current disclosure. Example grinders are disclosed in U.S. Pat. Nos. 7,441,719; 7,213,779; 7,077,345; and 6,840,471, each owned by Vermeer Manufacturing Company; these patents are each incorporated herein by reference in their entirety and form part of the current disclosure as well.

[0003] Chippers and grinders often include in-feed systems for moving items to the knives or hammers to be processed. Some embodiments of the current invention relate particularly to improved infeed systems for chippers and grinders, to chippers and grinders having such improved in-feed systems, and to methods of operation.

Summary

[0004] The following presents a simplified summary of the invention in order to provide a basic understanding of some aspects of the invention. This summary is not an extensive overview of the invention. It is not intended to identify critical elements of the invention or to delineate the scope of the invention. Its sole purpose is to present some concepts of the invention in a simplified form as a prelude to the more detailed description that is presented elsewhere.

[0005] According to one embodiment, an infeed system is provided for a chipper or grinder having a processing portion wherein an item is processed into smaller pieces. The infeed system is upstream of the processing portion and includes a feed roller, a first hydraulic motor in communication with the feed roller for selectively actuating the feed roller, a second hydraulic motor in communication with the feed roller for selectively actuating the feed roller, and a control system for selectively providing hydraulic fluid to the first and second hydraulic motors in series and in parallel.

[0006] According to another embodiment, an infeed system is provided for a chipper or grinder having a processing portion wherein an item is processed into smaller pieces. The infeed system is upstream of the processing portion and includes a feed roller, a first hydraulic motor in communication with the feed roller for selectively actuating the feed roller, a second hydraulic motor in communication with the feed roller for selectively actuating the feed roller, and a hydraulic pump for providing hydraulic fluid to the first and second hydraulic motors. A directional control valve and a relational control valve are between the hydraulic pump and the first and second hydraulic motors. The directional control valve allows the hydraulic fluid to operate the first and second hydraulic motors in a forward direction and in a reverse direction, and the relational control valve allows the hydraulic fluid to operate the first and second hydraulic motors in series and in parallel.

[0007] According to still another embodiment, a chipper or grinder includes a processing portion wherein an item is processed into smaller pieces and an infeed system upstream of the processing portion. The infeed system includes a feed roller, a first hydraulic motor in communication with the feed roller for selectively actuating the feed roller, a second hydraulic motor in communication with the feed roller for selectively actuating the feed roller, and a hydraulic pump for providing hydraulic fluid to the first and second hydraulic motors. A directional control valve and a relational control valve are between the hydraulic pump and the first and second hydraulic motors. The directional control valve allows the hydraulic fluid to operate the first and second hydraulic motors in a forward direction and in a reverse direction, and the relational control valve allows the hydraulic fluid to operate the first and second hydraulic motors in series and in parallel.

[0008] According to yet another embodiment, an infeed system is provided for a chipper or grinder having a processing portion wherein an item is processed into smaller pieces. The infeed system is upstream of the processing portion and includes a feed roller, a hydraulic motor in communication with the feed roller for selectively actuating the feed roller, and a control system. The control system selectively actuates the motor at a first operational mode and a second operational mode. The motor has an increased speed output when at the first operational mode relative to when at the second operational mode, and the motor has a decreased torque output when at the first operational mode relative to when at the second operational mode. The control system automatically switches from the first operational mode to the second operational mode when an amount of down pressure applied on the feed roller is increased.

Brief Description of the Drawings

[0009] FIG. 1 is a perspective view of a chipper according to one embodiment of the current invention.

[0010] FIG. 2 is a side view of the chipper of FIG. 1, with portions removed for illustration.

[0011] FIG. 3 is a rear view of the chipper of FIG. 1.

[0012] FIG. 4 is a side view of the chipper of FIG. 1, in use with a log and with a cutaway for illustration.

[0013] FIG. 5a is a perspective view of part of an infeed system from the chipper of FIG. 1.

[0014] FIG. 5b is another perspective view of part of the infeed system from the chipper of FIG. 1.

[0015] FIG. 6 shows the view of FIG. 5a, with covering removed for illustration.

[0016] FIG. 7 shows the view of FIG. 6, with portions removed for illustration.

[0017] FIG. 8a is a schematic view of part of the infeed system from the chipper of FIG. 1.

[0018] FIG. 8b is a schematic view of part of the infeed system from an alternate embodiment of the chipper of FIG. 1.

[0019] FIGs. 9a through 9c show example logic used by the processor in the chipper of FIG. 1.

[0020] FIG. 10 is a perspective view of a grinder according to one embodiment of the current invention.

[0021] FIG. 11 is a schematic view of part of the infeed system from the grinder of

FIG. 10.

[0022] FIG. 12 is a schematic view of part of the infeed system from an alternate embodiment of the chipper of FIG. 1 or the grinder of FIG. 10.

Detailed Description

[0023] FIGs. 1 through 9c illustrate a chipper 100, according to one embodiment. The chipper 100 includes a processing portion 120 for processing an item into smaller pieces and an infeed portion 130 for feeding the item to the processing portion 120. A frame 110 supports (and may form part of) the processing portion 120 and the infeed portion 130, and the frame 110 may further include wheels 112 and a hitch 114 to allow travel and transport of the chipper 100. Mobility may not be desirable in all cases, however, and stationary embodiments are clearly contemplated herein.

[0024] The processing portion 120 (FIG. 2) includes a cutting mechanism such as a chipping or cutting drum or a disk cutter. Cutting mechanisms are well known, and any appropriate cutting mechanism (whether now known or later developed) may be used to process an item into smaller pieces.

[0025] The infeed portion 130 is upstream of the processing portion 120 and includes a feed roller 132 (FIGs. 3-7). First and second hydraulic motors 140, 150 (FIGs. 6-8) are each in communication with the feed roller 132 for selectively actuating the feed roller 132, and a control system 160 selectively provides hydraulic fluid to the motors 140, 150 in series and in parallel. More particularly, the control system 160, best shown in FIG. 8a, includes a hydraulic pump 162, a directional control valve 164, and a relational control valve 166. The pump 162 provides hydraulic fluid to the motors 140, 150, and the directional control valve 164 and the relational control valve 166 are each positioned between the hydraulic pump 162 and the motors

140, 150, such that fluid from the pump 162 passes the valves 164, 166 before reaching the motors 140, 150. The directional control valve 164 allows the hydraulic fluid to operate the first and second hydraulic motors 140, 150 in a forward direction and in a reverse direction; and the relational control valve 166 allows the hydraulic fluid to operate the first and second hydraulic motors 140, 150 in series and in parallel. The directional control valve 164, the relational control valve 166, and/or another valve may selectively prevent the hydraulic fluid from operating the motors 140, 150 as well. It may be particularly desirable for the motors 140, 150 to be fixed displacement motors, as fixed displacement motors may be cost effective and operating the feed roller 132 at a constant speed may typically be desirable for producing a consistent chip output from the chipper 100.

[0026] A processor (or “controller”) 170 may operate the pump 162 and the valving (e.g., the directional control valve 164 and the relational control valve 166) to provide the hydraulic fluid to the motors 140, 150 in series; to provide the hydraulic fluid to the motors 140, 150 in parallel; and to prevent the hydraulic fluid from operating the motors 140, 150. Operating the motors 140, 150 in series may cause the feed roller 132 to rotate at roughly twice the speed at which the feed roller 132 rotates when the motors 140, 150 are operated in parallel. But torque of the feed roller 132 when the motors 140, 150 are operated in series may be roughly one half the torque of the feed roller 132 when the motors 140, 150 are operated in parallel. Thus, by altering the motors 140, 150 from operating in series and in parallel, the speed and torque of the feed roller 132 may be adjusted.

[0027] Attention is now directed to FIGs. 1, 3, and 4, which show that the infeed portion 130 may further include an infeed floor 135. In some embodiments, the feed roller 132 is movable toward and away from the infeed floor 135, and output from a sensor 172 indicates the position of the feed roller 132. In embodiment 100, hydraulic cylinders 175 raise and lower the feed roller 132 relative to the infeed floor 135.

[0028] Another pump 182 (FIG. 8a) is shown providing hydraulic fluid to the hydraulic cylinders 175 (though the pump 162 could be used in some embodiments), and height control valving 184 changes direction of fluid flow to the cylinders 175 to selectively extend and contract the cylinders 175—and thus alter the height of the feed roller 132. The height control valving 184 may also sufficiently depressurize the cylinders 175 to allow the cylinders 175 (and thus the feed roller 132) to float. The processor 170 may operate the pump 182 and the valving 184 to control the height of the feed roller 132 relative to the infeed floor 135, such as discussed in further detail below. One of ordinary skill in the art will appreciate that many of the various electrical and mechanical parts discussed herein can be combined together or further separated apart. As a further example, the processor 170 may be separated into a plurality of discrete processors which jointly perform the processes and functions described herein, and which jointly form the processor 170.

[0029] Still referring to FIG. 8a, various operator controls 174, 176, 178 may additionally be in data communication with the processor 170. The operator controls 174, 176, 178 may, for example, be levers, switches, dials, buttons, or any other appropriate controls, whether now existing or later developed. In some embodiments, at least one of the operator controls 174, 176, 178 is not in direct physical communication with the processor 170, and instead communicates with the processor 170 wirelessly, such as through one or more of near-field, radio, or cellular communication technology.

[0030] The operator control 174 may cause the processor 170 to adjust the height of the feed roller 132 by extending or contracting the cylinders 175 (via the pump 182 and the height control valving 184), or may cause the processor 170 to allow the height of the feed roller 132 to float (via the valving 184). When chipping items such as trees and branches, it can be important for the feed roller 132 to apply a sufficient crush force (or "down pressure") on the tree or branch such that the tree or branch is moved toward the processing portion 120. Moving the feed roller 132 toward the infeed floor 135 may increase the amount of crush force applied, while moving the feed roller 132 away from the infeed floor 135 may decrease the crush force.

[0031] In some embodiments, the processor 170 allows the cylinders 175 and the feed roller 132 to float only within certain parameters, and automatically alters the valving 184 to move the roller 132 toward the infeed floor 135 when those parameters are not met as desired. FIG. 9a shows example logic used by the processor 170, with process S100 starting at step S102, where the processor 170 uses position information from the sensor 172 to determine if the feed roller 132 is positioned outside of preset float parameters. This may occur, for example, if a branch extending from a tree being input through the infeed portion 130 sticks out and is sufficiently immovable to cause the feed roller 132 to raise. If the feed roller 132 is not positioned outside of the preset float parameters at step S102, the process S100 returns to step S102 to check again. If the feed roller 132 is positioned outside of the preset parameters at step S102, the process S100 continues to step S104.

[0032] At step S104, the processor 170 again uses position information from the sensor 172 to determine if the feed roller 132 is still positioned outside the preset float parameters. While step S104 may be omitted, it may be beneficial for filtering out brief jumps by the feed roller 132 for which the feed roller 132 does not need to be lowered. Additional filtering logic may also be employed at step S104, such as determining how many times the feed roller 132 is outside the preset float parameters in a given amount of time, determining how far the feed roller

132 moves outside the preset float parameters, et cetera. If the feed roller 132 is not undesirably outside the preset float parameters at step S104, the process S100 returns to step S102. If the feed roller 132 is undesirably outside the preset float parameters at step S104, the process S100 continues to step S106.

[0033] At step S106, the processor 170 adjusts the valving 184 to move the feed roller 132 toward the infeed floor 135 by actuating the cylinders 175. The process S100 then waits a predetermined amount of time at step S108 and continues to step S110. At step S110, the processor 170 adjusts the valving 184 to again allow the feed roller 132 to float, and the process S100 returns to step S102. Because the process S100 occurs when the user has chosen (e.g., through the operator control 174) to allow the feed roller 132 to float, steps S108, S110 return the feed roller 132 to the float condition. If the user desires to maintain the feed roller 132 at a locked position at any particular height, that may be accomplished by inputting a lowering command or a raising command to the processor 170 (e.g., through output of the operator control 174).

[0034] Focusing now on controlling the direction of the feed roller 132, the operator control 176 may be a control bar as shown in FIG. 2, and may have four angular positions. In order, a first position may be a stop position at which the processor 170 does not operate the feed roller 132, a second position may cause the processor 170 to operate the feed roller 132 in a forward direction (via the directional control valve 164 and the motors 140, 150), a third position may be another stop position at which the processor 170 does not operate the feed roller 132, and the fourth position may cause the processor 170 to operate the feed roller 132 in a reverse direction (via the directional control valve 164 and the motors 140, 150). Other operator control devices 176 (e.g., levers, switches, dials, buttons, etc.) and positional configurations may of course be used, however.

[0035] While not required, it may be desirable for the processor 170 to default to operating the motors 140, 150 in series through the relational control valve 166. When additional torque is needed for the feed roller 132, operation of the motors 140, 150 may be manually or automatically adjusted such that the motors 140, 150 are powered in parallel. For manual adjustment, the user may instruct the processor 170 through the operator control 178 to actuate the motors 140, 150 in parallel (via the relational control valve 166). Once the additional torque is no longer desired, the user may instruct the processor 170 through the operator control 178 to actuate the motors 140, 150 in series (again, via the relational control valve 166). In some embodiments, the processor 170 may automatically return the motors 140, 150 to operating in series after a predetermined amount of time operating in parallel.

[0036] FIG. 9b shows example logic used by the processor 170 for adjusting operation of the motors 140, 150 from series to parallel operation, with process S200 starting at step S202. At step S202, the processor 170 determines if a triggering event S203 is present. If so, process S200 continues to step S204, where the processor 170 actuates the relational control valve 166 to provide hydraulic fluid to the motors 140, 150 in parallel. If not, the process S200 returns to step S202. FIG. 9b illustrates various triggering events S203a, S203b, S203c, S203d, and those skilled in the art will appreciate that other triggering events S203 may also be used. Further, an individual triggering event S203 may require multiple conditions to be present, such as each of: (a) the sensor 172 indicating that the feed roller 132 is raised due to material passing through the infeed portion 130, (b) the operator control 176 causing the feed roller 132 to operate in the forward direction, and (c) the processing portion 120 not engaging material as shown by a cutter speed sensor.

[0037] Triggering event S203a relates to manual control as discussed above. More particularly, the operator control 178 instructs the processor 170 to alter from series to parallel operation. Triggering event S203b occurs when the feed roller 132 is forced to move toward the infeed floor 135 by the cylinders 175, as discussed above. Triggering event 203c occurs when an infeed passageway area 139 (FIG. 3), defined between the feed roller 132 and the infeed floor 135, is less than a predetermined threshold. Triggering event 203d occurs when the sensor 172 indicates that more torque is needed for the feed roller 132. For example, the sensor 172 may detect that the feed roller 132 has been undesirably raised by the object being chipped.

[0038] FIG. 9c shows example logic used by the processor 170 for adjusting operation of the motors 140, 150 from parallel to series operation, with process S300 starting at step S302. At step S302, the processor 170 determines if a triggering event S303 is present. If so, process S300 continues to step S304, where the processor 170 actuates the relational control valve 166 to provide hydraulic fluid to the motors 140, 150 in series. If not, the process S300 returns to step S302. FIG. 9c illustrates various triggering events S303a, S303b, S304c, S304d, and those skilled in the art will appreciate that other triggering events S303 may also be used.

[0039] Triggering event S303a again relates to manual control as discussed above. More particularly, the operator control 178 instructs the processor 170 to alter from parallel to series operation. Triggering event S303b occurs when the motors have operated in parallel for a predetermined amount of time. Triggering event 303c occurs when the motors 140, 150 are operated in the reverse direction; it may be desired to clear out any item in the infeed portion 130 as quickly as possible when operating in the reverse direction. Triggering event 303d occurs when the sensor 172 indicates that increased torque is not needed. Here, the sensor 172 may be a load sensor, a speed sensor, a pressure sensor, a current sensor, or a combination of multiple sensors, for example.

[0040] An alternate control system 160' is shown in FIG. 8b. The primary difference between the control system 160 and the control system 160' is that the control system 160' does not include the processor 170. Instead, the directional control valve 164 and the relational control valve 166 are controlled by the operator controls 174, 176 either directly or via solenoids. So if the control system 160' is used, the operator may simply control the directional control valve 164 and the relational control valve 166 manually through at least one lever, switch, dial, button, or other operator control. The height control for the feed roller 132 is not shown in FIG. 8b for simplicity, but height control may similarly be included in the control system 160'. For example, the operator control 174 may simultaneously actuate the relational control valve 166 and the valving 184; or the operator control 178 may actuate the valving 184.

[0041] FIG. 4 shows the chipper 100 in use with a tree 10. The tree 10 is moved along the infeed floor 135 to the feed roller 132, which moves the tree 10 to the processing portion 120. Operation of the chipper 100, including adjustment of the height, speed, and torque of the feed roller 132, is discussed above. In some embodiments, another feed roller is provided generally at the infeed floor 135 such that the tree or debris passes between two feed rollers before reaching the processing portion 120.

[0042] FIGs. 10 and 11 show a grinder 1000 having a processing portion for crushing aggregate material into smaller pieces through repeated blows, and an infeed portion 1130 upstream that is substantially similar to the infeed portion 130 described above, except as specifically noted and/or shown, or as would be inherent. For uniformity and brevity, corresponding reference numbers may be used to indicate corresponding parts, though with any noted deviations.

[0043] The apparatus infeed portion 1130 primarily differs from the infeed portion 130 shown in FIGs. 1 through 9c by having a powered conveyor 1132' (i.e., another feed roller) at the infeed floor 1135 such that the aggregate material passes between the two feed rollers 1132, 1132' before reaching the processing portion. As shown in FIG. 11, the second feed roller 1132' may be operated in the same manner as the feed roller 1132 (e.g., by processor 1170 interacting with pumps 1162, 1162', directional control valves 1164, 1164,' and relational control valves 1166, 1166'), and the processor 1170 may adjust the valves 1164, 1164' in concert (i.e., together) and may adjust the valves 1166, 1166' in concert (i.e., together).

[0044] FIG. 12 schematically shows part of an infeed portion from an alternate embodiment of the chipper of FIG. 1 or an alternate embodiment of the grinder of FIG. 10. This infeed portion is substantially similar to the infeed portions 130, 1130 described above, except as specifically noted and/or shown, or as would be inherent. For uniformity and brevity, corresponding reference numbers may be used to indicate corresponding parts, though with any noted deviations.

[0045] Instead of having multiple motors 140, 150 which operate in parallel or series, the embodiment of FIG. 12 utilizes a variable displacement motor 140' which may be responsive to manual control and operating conditions similar to discussed above. For example, the discussion above teaches automatically reducing the rotational speed of the feed roller 132 and increasing the torque of the feed roller 132 when, among other things, there is an adjustment in an amount of down pressure applied on the feed roller 132. The embodiments discussed above arrive at the reduced rotational speed and increased torque by switching from series operation of the motors

140, 150 to parallel operation of the motors 140, 150. In the embodiment of FIG. 12, the processor 170 causes the displacement of the motor 140' to change when the down pressure on the feed roller 132 is increased, such that the motor 140' operates at a reduced RPM and an increased torque.

[0046] Many different arrangements of the various components depicted, as well as components not shown, are possible without departing from the spirit and scope of the present invention. Embodiments of the present invention have been described with the intent to be illustrative rather than restrictive. Alternative embodiments will become apparent to those skilled in the art that do not depart from its scope. A skilled artisan may develop alternative means of implementing the aforementioned improvements without departing from the scope of the present invention. It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations and are contemplated within the scope of the claims. The specific configurations and contours set forth in the accompanying drawings are illustrative and not limiting.

Claims

1. An infeed system for a chipper or grinder, the chipper or grinder having a processing portion wherein an item is processed into smaller pieces, the infeed system being upstream of the processing portion and comprising:

a feed roller;

a first hydraulic motor in communication with the feed roller for selectively actuating the feed roller;

a second hydraulic motor in communication with the feed roller for selectively actuating the feed roller; and

a control system for selectively providing hydraulic fluid to the first and second hydraulic motors in series and in parallel.

2. The infeed system of claim 1, wherein:

the control system includes a processor, at least one pump, and at least one valve; the at least one valve being controlled by the processor to selectively:

(a) provide the hydraulic fluid to the first and second hydraulic motors in series;

(b) provide the hydraulic fluid to the first and second hydraulic motors in parallel; and

(c) prevent the hydraulic fluid from operating the first and second hydraulic motors.

3. The infeed system of claim 2, wherein:

the feed roller is movable to adjust an infeed passageway area; and

the control system automatically switches from providing the hydraulic fluid to the first and second hydraulic motors in series to providing the hydraulic fluid to the first and second hydraulic motors in parallel when the infeed passageway area is less than a predetermined threshold.

4. The infeed system of claim 2, wherein:

the infeed system includes an infeed floor;

the feed roller is movable toward and away from the infeed floor;

output from a sensor indicates position of the feed roller;

the feed roller is forced to move toward the infeed floor when a distance between the feed roller and the infeed floor exceeds a predetermined distance for a predetermined amount of time.

5. The infeed system of claim 4, wherein the processor is in communication with the sensor and determines when the distance between the feed roller and the infeed floor exceeds the predetermined distance for the predetermined amount of time.

6. The infeed system of claim 4, wherein the control system automatically switches from providing the hydraulic fluid to the first and second hydraulic motors in series to providing the hydraulic fluid to the first and second hydraulic motors in parallel when the feed roller is forced to move toward the infeed floor.

7. The infeed system of claim 4, wherein a hydraulic cylinder controls positioning of the feed roller.

8. The infeed system of claim 2, wherein:

the infeed system includes an infeed floor;

the feed roller is movable toward and away from the infeed floor;

a hydraulic cylinder is operably coupled to the feed roller to selectively impart a force on the feed roller toward the infeed floor when a distance between the feed roller and the infeed floor exceeds a predetermined distance for a predetermined amount of time;

output from a sensor indicates position of the feed roller;

the processor is in communication with the sensor and determines when the distance between the feed roller and the infeed floor exceeds the predetermined distance for the predetermined amount of time; and

the control system automatically switches from providing the hydraulic fluid to the first and second hydraulic motors in series to providing the hydraulic fluid to the first and second hydraulic motors in parallel when the hydraulic cylinder imparts the force on the feed roller toward the infeed floor.

9. The infeed system of claim 8, wherein the control system switches between providing the hydraulic fluid to the first and second hydraulic motors in series and in parallel upon manipulation of at least one operator control.

10. The infeed system of claim 2, wherein the control system switches between providing the hydraulic fluid to the first and second hydraulic motors in series and in parallel upon manipulation of at least one operator control.

11. The infeed system of claim 1, wherein the control system includes at least one pump, at least one valve, and at least one operator control manually operating the at least one valve to selectively:

(a) provide the hydraulic fluid to the first and second hydraulic motors in series; and

(b) provide the hydraulic fluid to the first and second hydraulic motors in parallel.

12. An infeed system for a chipper or grinder, the chipper or grinder having a processing portion wherein an item is processed into smaller pieces, the infeed system being upstream of the processing portion and comprising:

a feed roller;

a first hydraulic motor in communication with the feed roller for selectively actuating the feed roller;

a second hydraulic motor in communication with the feed roller for selectively actuating the feed roller;

a hydraulic pump for providing hydraulic fluid to the first and second hydraulic motors;

a directional control valve between the hydraulic pump and the first and second hydraulic motors, the directional control valve allowing the hydraulic fluid to operate the first and second hydraulic motors in a forward direction and in a reverse direction; and

a relational control valve between the hydraulic pump and the first and second hydraulic motors, the relational control valve allowing the hydraulic fluid to operate the first and second hydraulic motors in series and in parallel.

13. The infeed system of claim 12, further comprising a processor in data communication with the directional control valve to selectively actuate the directional control valve, the processor being in data communication with the relational control valve to selectively actuate the relational control valve.

14. The infeed system of claim 13, wherein the processor actuates the relational control valve to change from operating the first and second hydraulic motors in series to operating the first and second hydraulic motors in parallel upon occurrence of a triggering event.

15. The infeed system of claim 14, further comprising an operator control in data communication with the processor, and wherein the triggering event is the processor receiving triggering output from the operator control.

16. The infeed system of claim 14, further comprising a sensor in data communication with the processor, and wherein the triggering event is the processor receiving triggering data from the sensor.

17. The infeed system of claim 13, wherein:

the infeed system includes an infeed floor;

the feed roller is movable toward and away from the infeed floor;

output from a sensor indicates position of the feed roller; and

when the feed roller extends outside a predetermined position for a predetermined amount of time, the processor actuates the relational control valve to change from operating the first and second hydraulic motors in series to operating the first and second hydraulic motors in parallel.

18. The infeed system of claim 13, further comprising an operator control in data communication with the processor, the processor actuating the directional control valve to operate the first and second hydraulic motors in the forward direction upon receiving forward-drive output from the operator control, the processor actuating the directional control valve to operate the first and second hydraulic motors in the reverse direction upon receiving reverse-drive output from the operator control.

19. The infeed system of claim 18, wherein the operator control is two operator controls.

20. The infeed system of claim 12, further comprising at least one operator control manually operating the directional control valve and the relational control valve.

21. A chipper or grinder, comprising:

a processing portion wherein an item is processed into smaller pieces;

an infeed system upstream of the processing portion and comprising:

a feed roller;

a first hydraulic motor in communication with the feed roller for selectively actuating the feed roller;

a second hydraulic motor in communication with the feed roller for selectively actuating the feed roller;

a hydraulic pump for providing hydraulic fluid to the first and second hydraulic motors;

a directional control valve between the hydraulic pump and the first and second hydraulic motors, the directional control valve allowing the hydraulic fluid to operate the first and second hydraulic motors in a forward direction and in a reverse direction; and

a relational control valve between the hydraulic pump and the first and second hydraulic motors, the relational control valve allowing the hydraulic fluid to operate the first and second hydraulic motors in series and in parallel.

22. The chipper or grinder of claim 21, further comprising a processor in data communication with the directional control valve to selectively actuate the directional control valve, the processor being in data communication with the relational control valve to selectively actuate the relational control valve.

23. The infeed system of claim 22, wherein the processor actuates the relational control valve to change from operating the first and second hydraulic motors in series to operating the first and second hydraulic motors in parallel upon occurrence of a triggering event.

24. An infeed system for a chipper or grinder, the chipper or grinder having a processing portion wherein an item is processed into smaller pieces, the infeed system being upstream of the processing portion and comprising:

a feed roller;

a hydraulic motor in communication with the feed roller for selectively actuating the feed roller;

a control system selectively actuating the motor at a first operational mode and a second operational mode, the motor having an increased speed output when at the first operational mode relative to when at the second operational mode, the motor having a decreased torque output when at the first operational mode relative to when at the second operational mode, the control system automatically switching from the first operational mode to the second operational mode when an amount of down pressure applied on the feed roller is increased.

25. The infeed system of claim 24, wherein the motor is selected from the group consisting of a variable displacement motor and a fixed displacement motor.

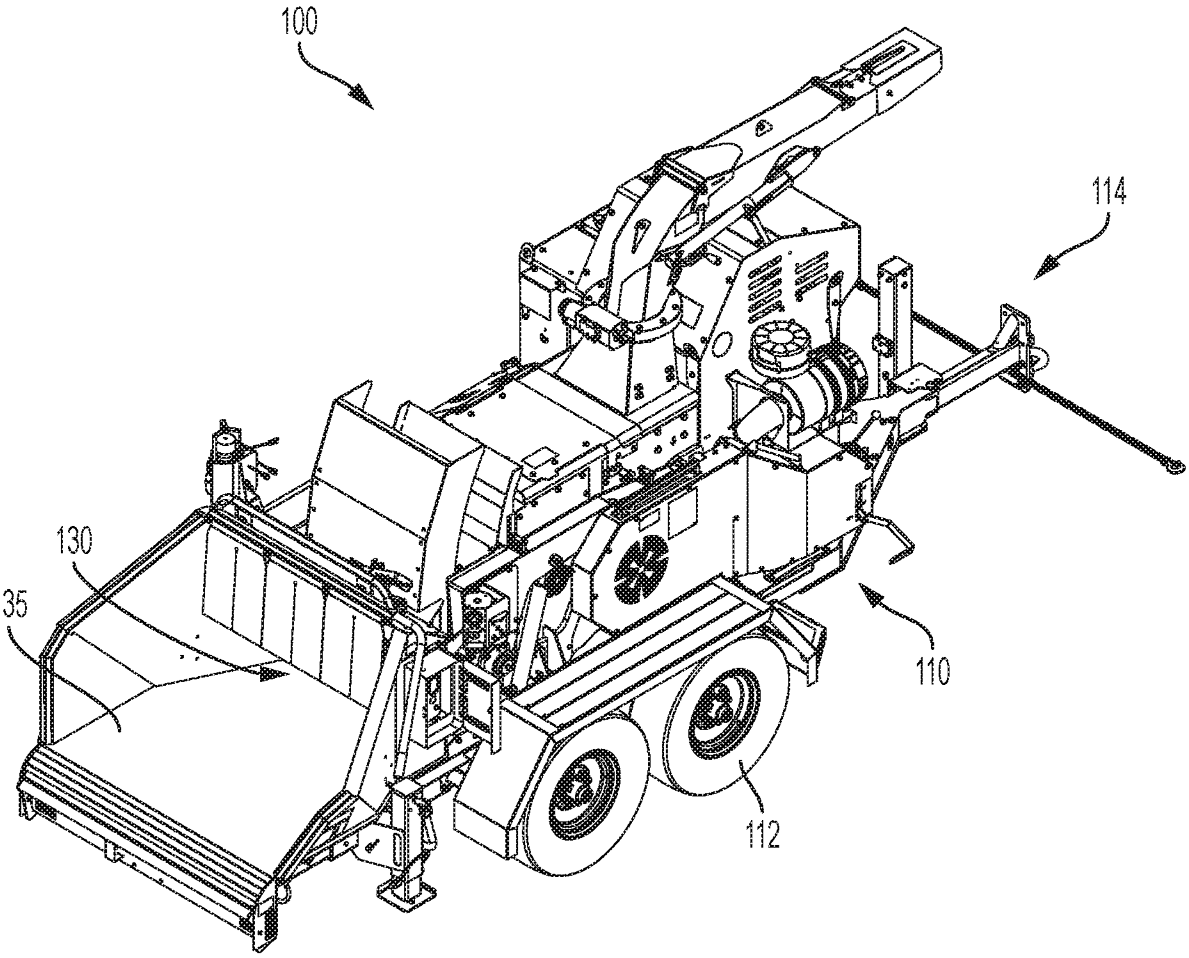

FIG. 1

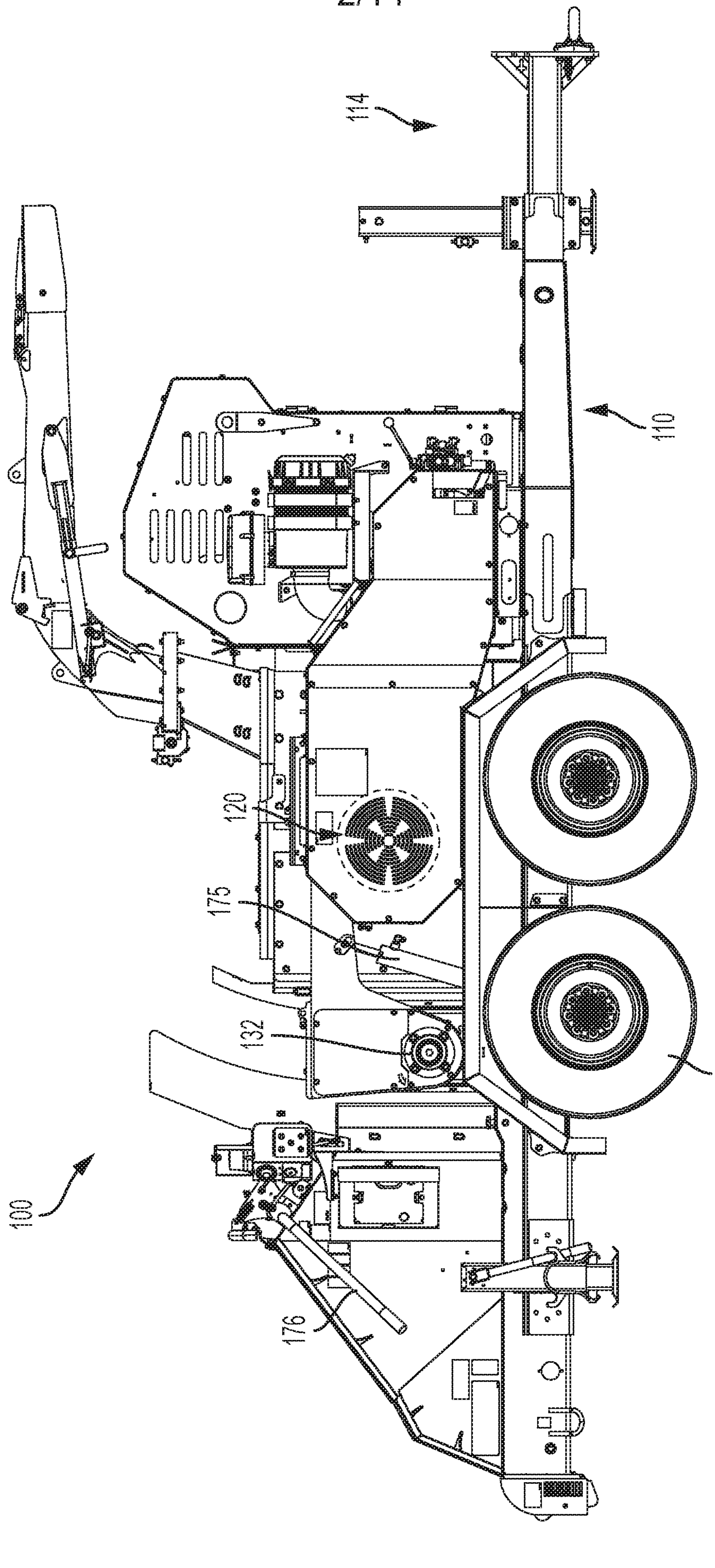

FIG. 2

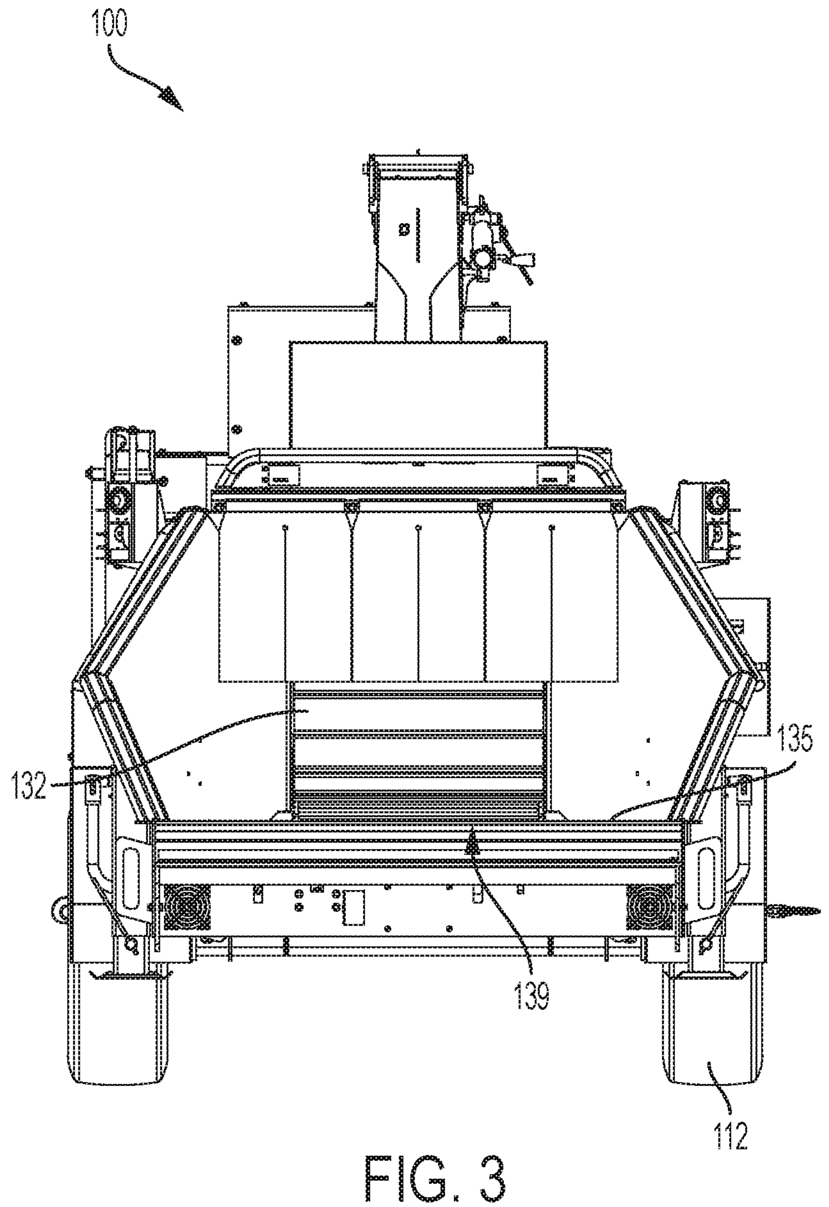

FIG. 3

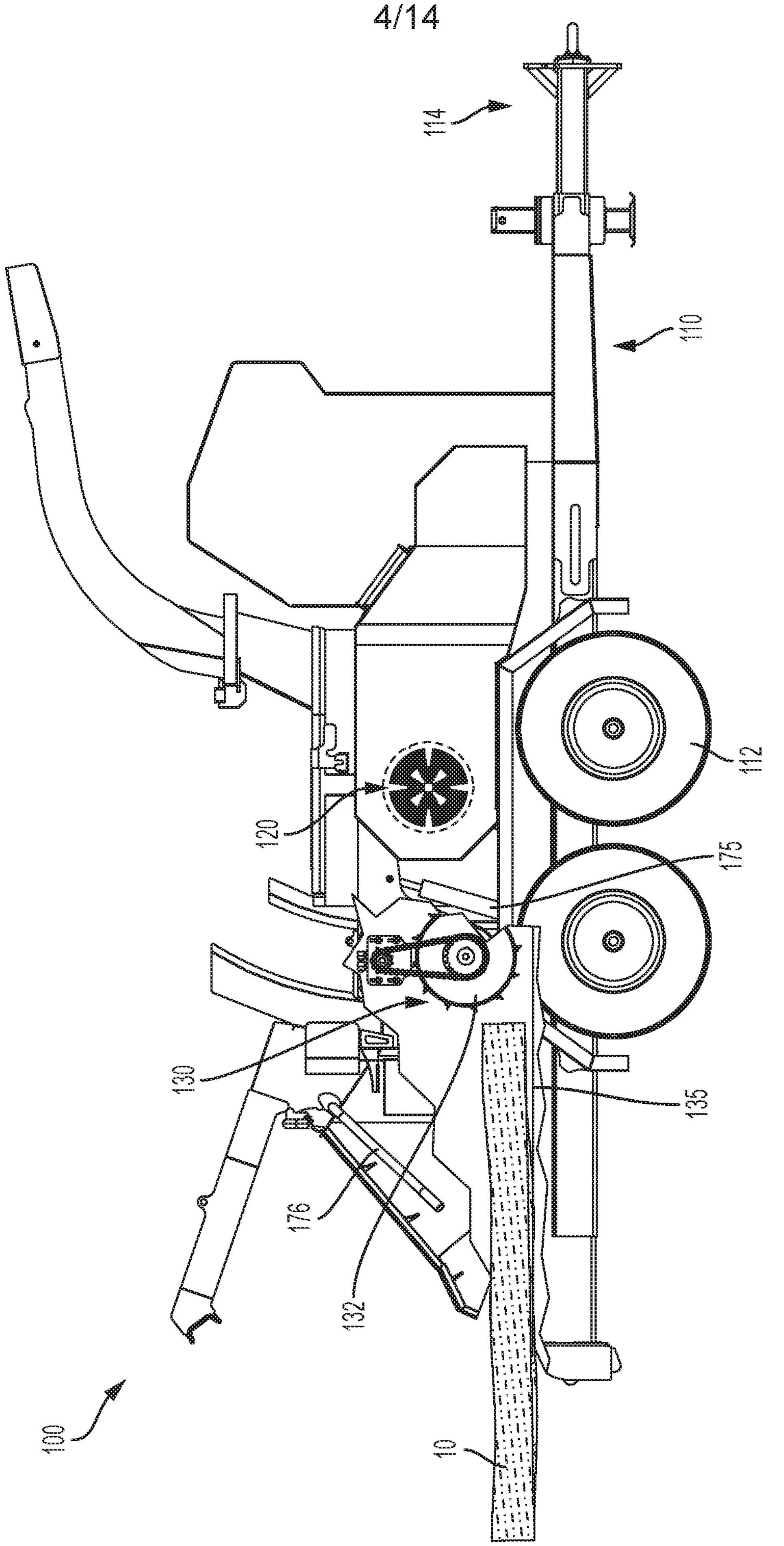

FIG. 4

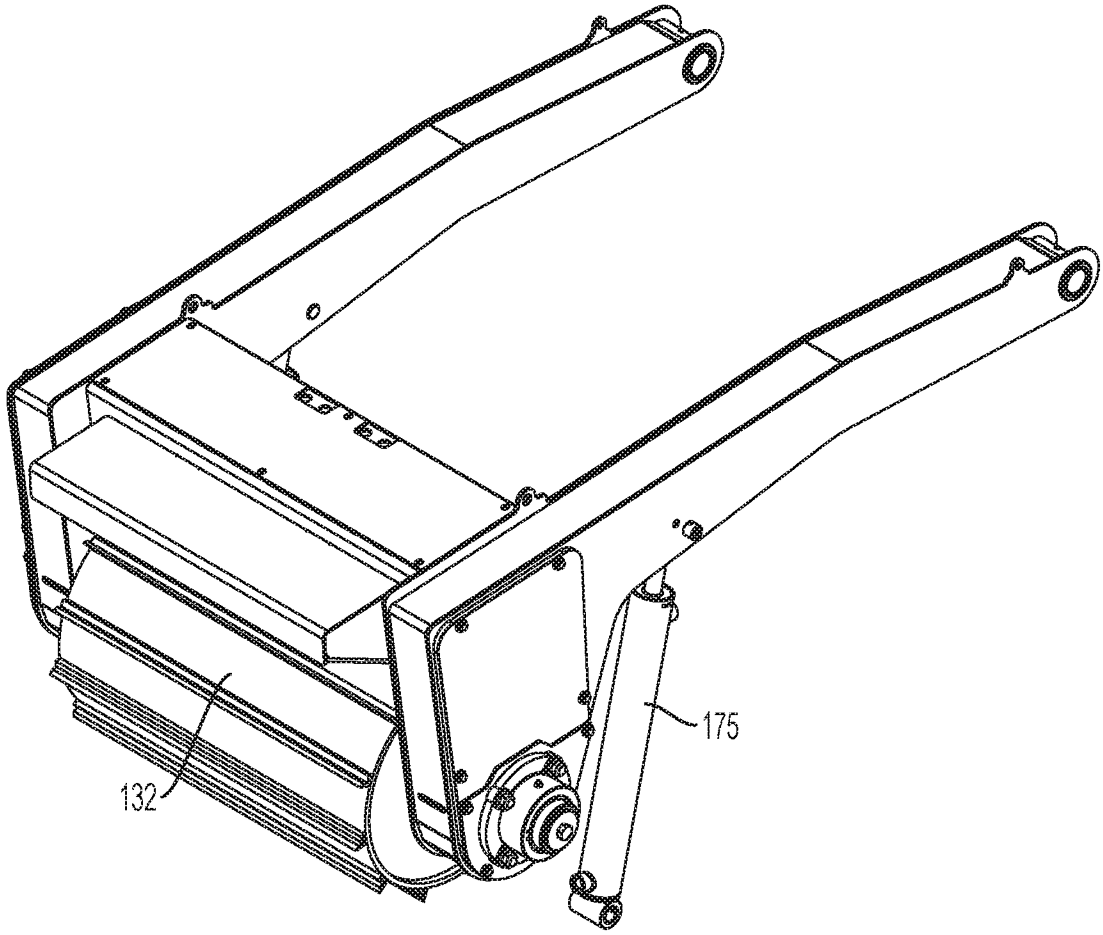

FIG. 5A

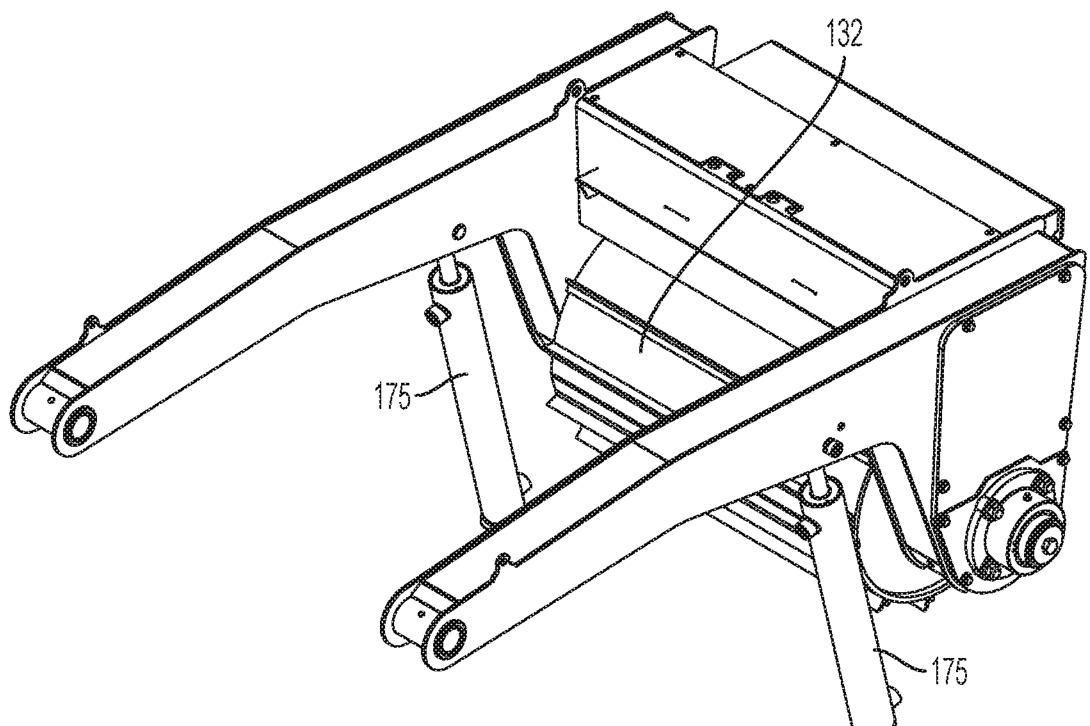

FIG. 5B

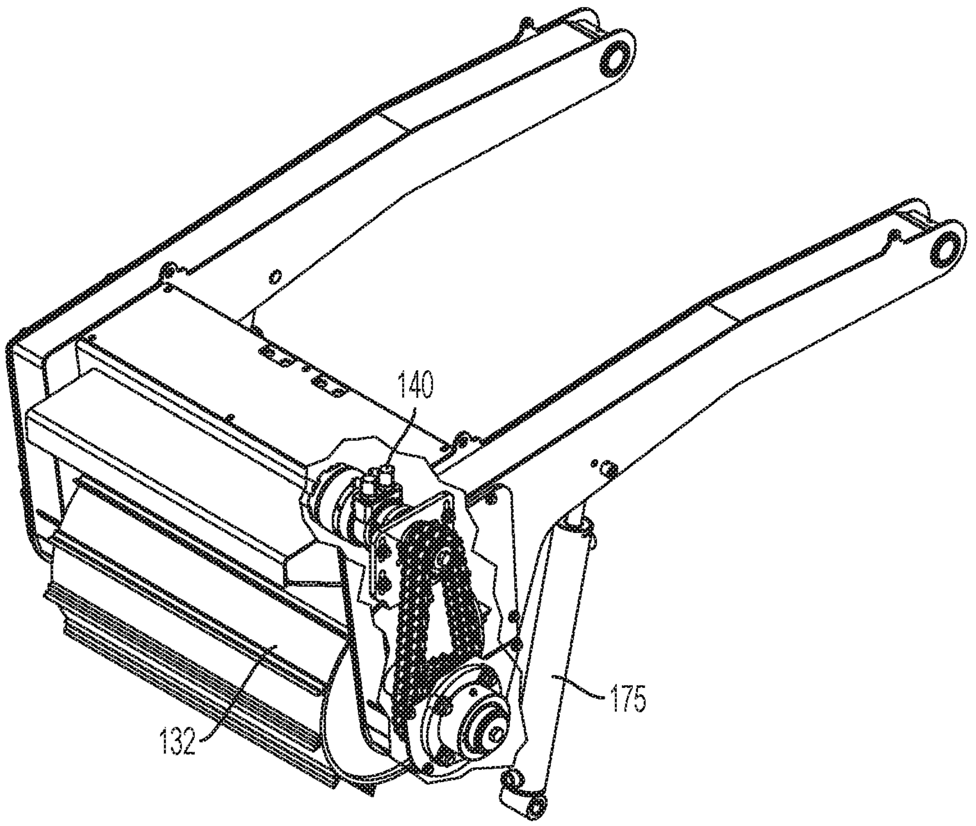

FIG. 6

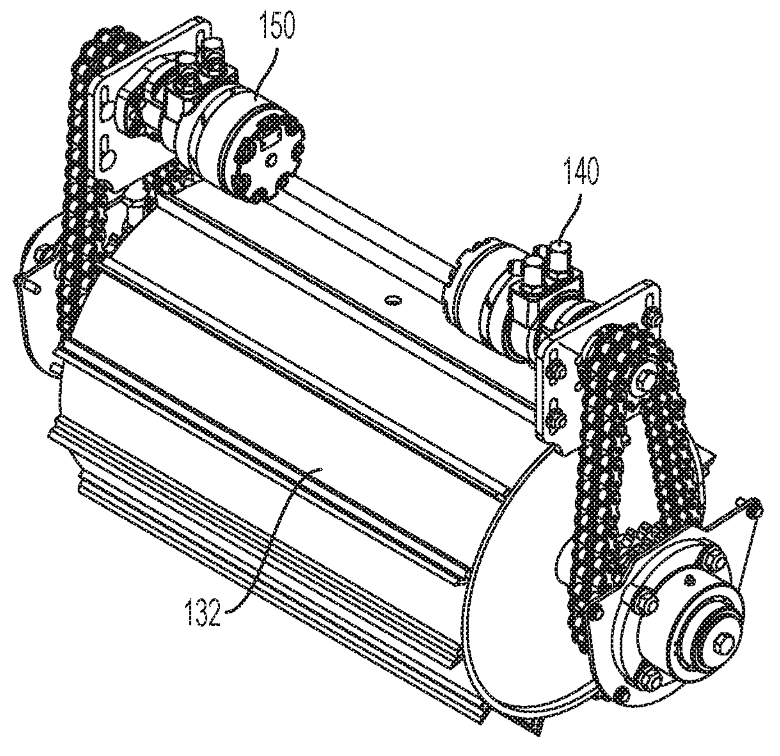

FIG. 7

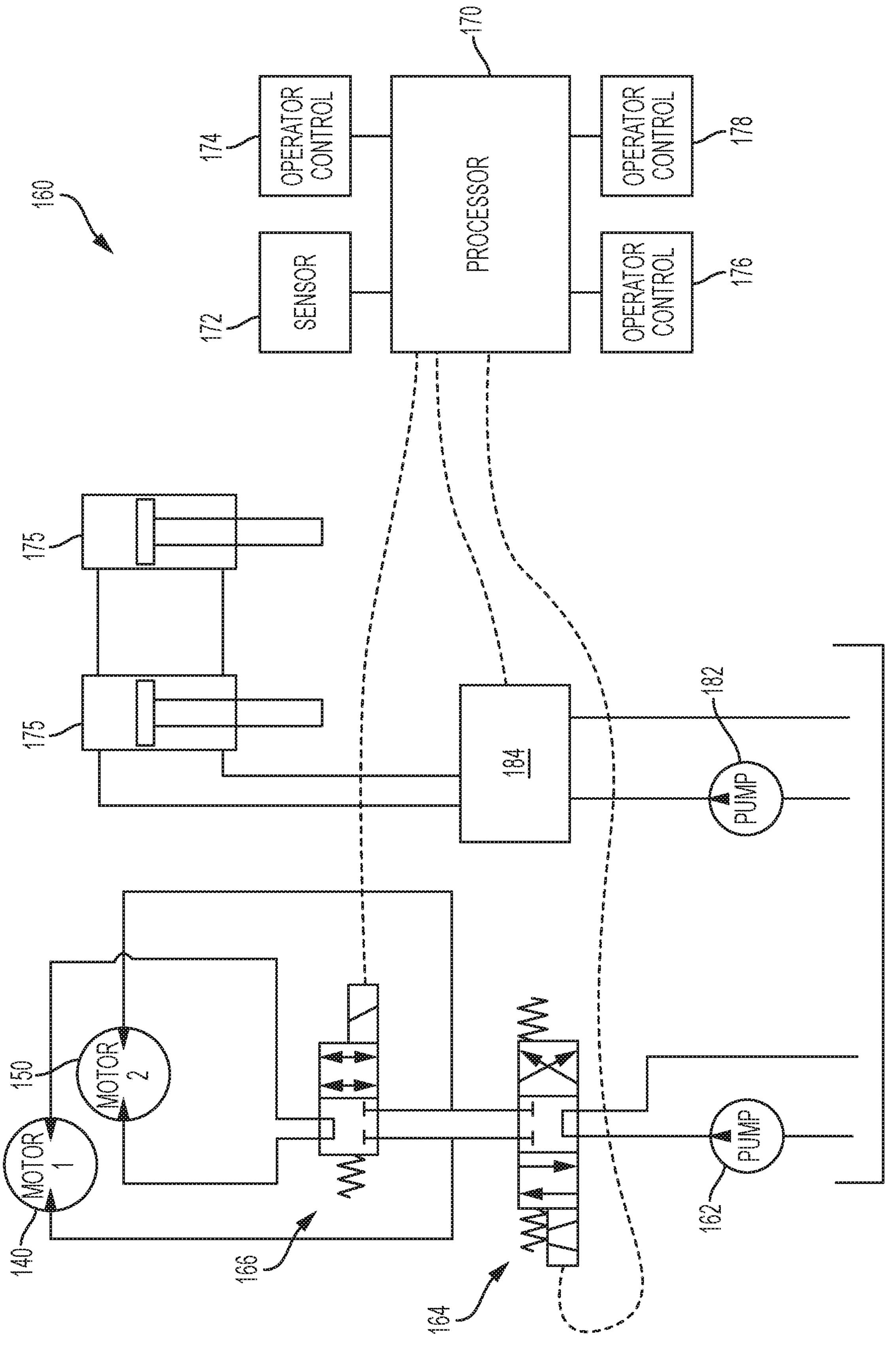
160
170
174
OPERATOR CONTROL
PROCESSOR
OPERATOR CONTROL
178
172
SENSOR
OPERATOR CONTROL
176
175
175
184
182
PUMP
150
MOTOR 2
140
MOTOR 1
166
164
PUMP
162

FIG. 8A

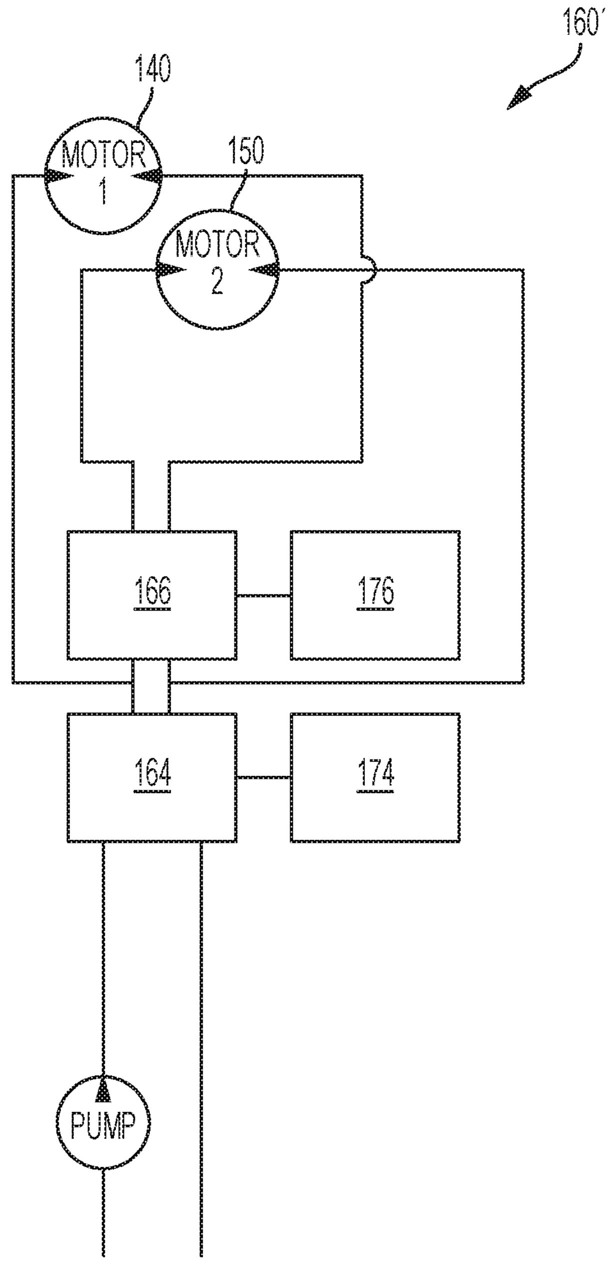

FIG. 8B

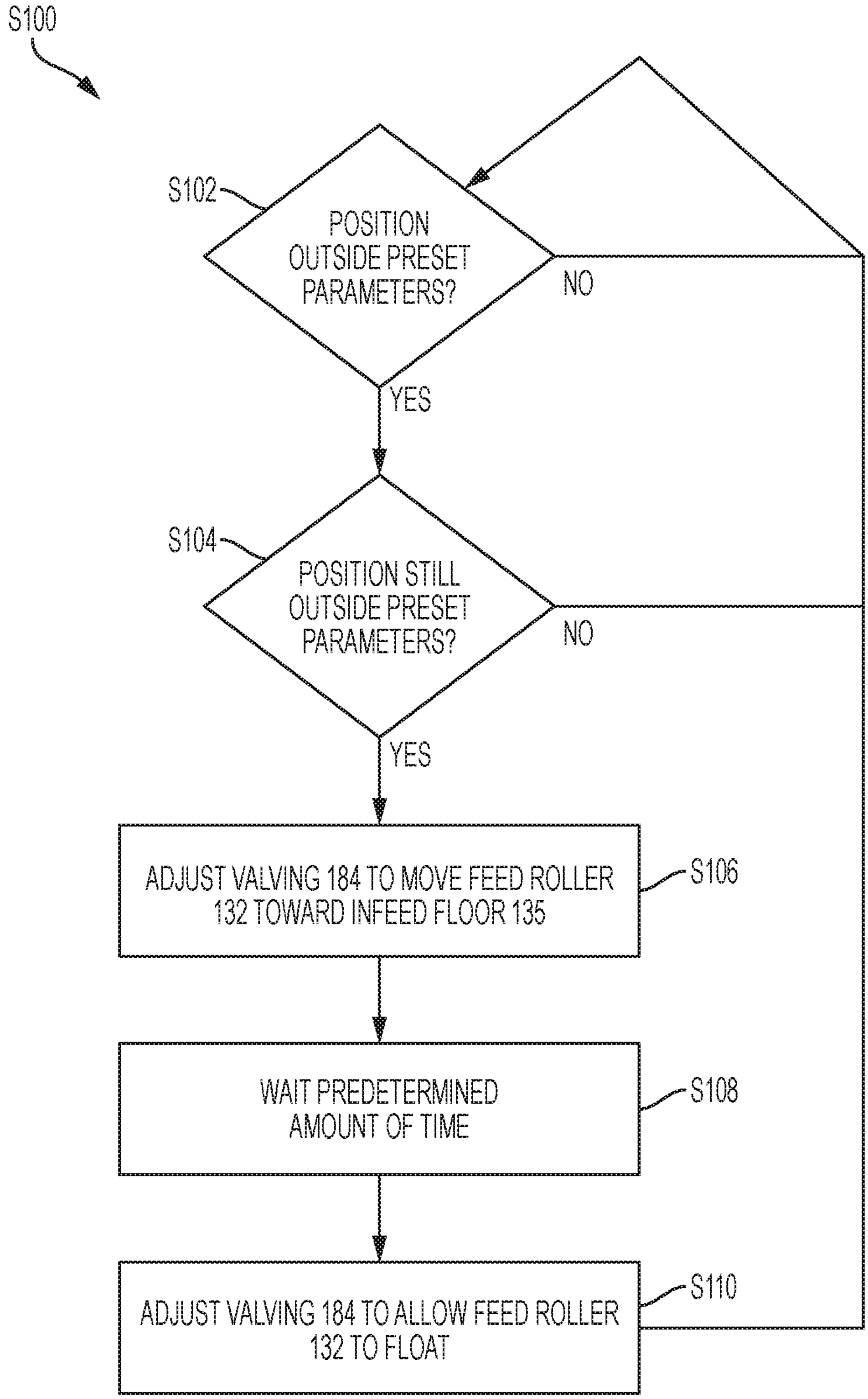
S100
S102
POSITION OUTSIDE PRESET PARAMETERS?
NO
YES
S104
POSITION STILL OUTSIDE PRESET PARAMETERS?
NO
YES
ADJUST VALVING 184 TO MOVE FEED ROLLER 132 TOWARD INFEED FLOOR 135
S106
WAIT PREDETERMINED AMOUNT OF TIME
S108
ADJUST VALVING 184 TO ALLOW FEED ROLLER 132 TO FLOAT
S110

FIG. 9A

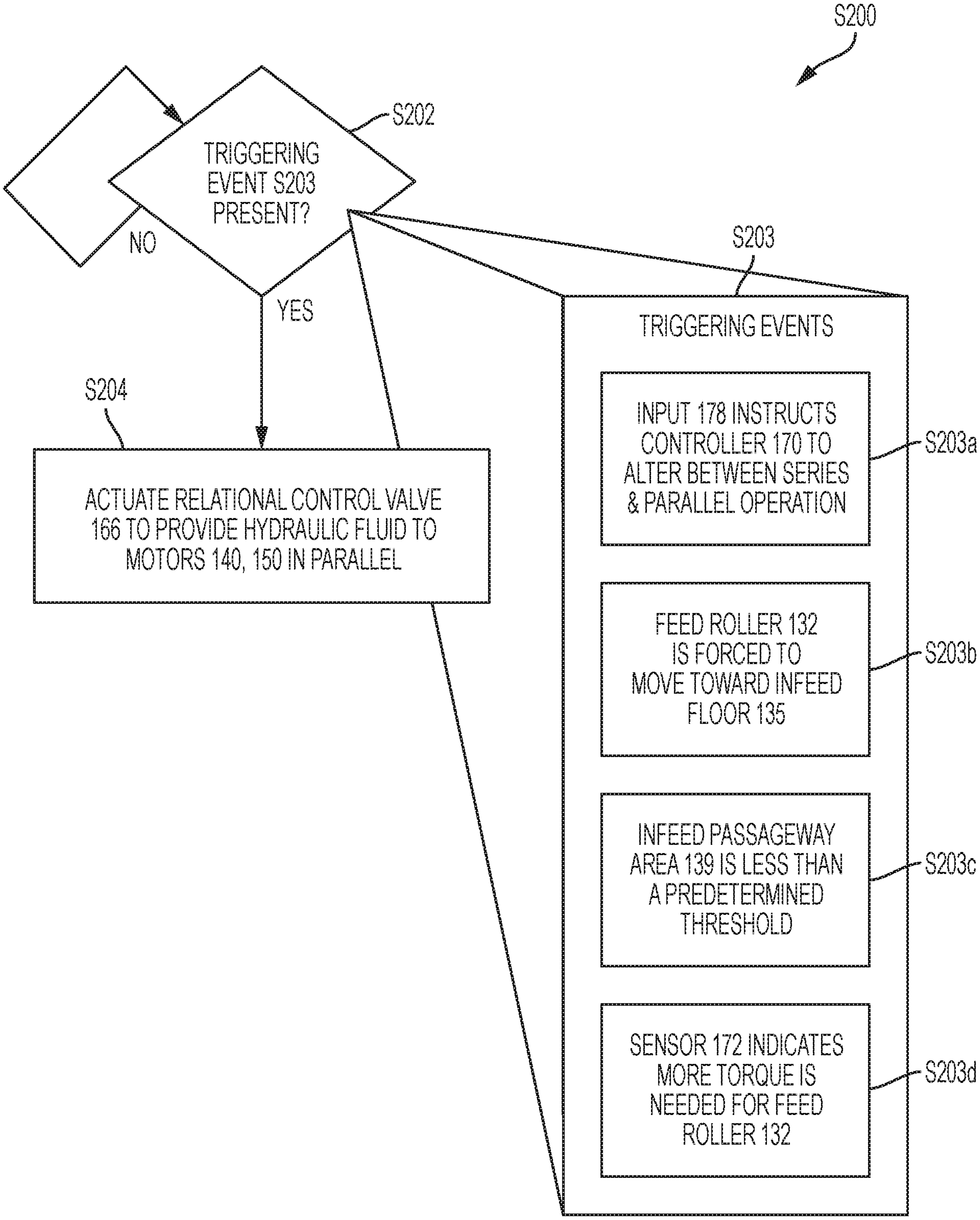
S200
TRIGGERING EVENT S203 PRESENT?
S202
NO
YES
S204
ACTUATE RELATIONAL CONTROL VALVE 166 TO PROVIDE HYDRAULIC FLUID TO MOTORS 140, 150 IN PARALLEL
S203
TRIGGERING EVENTS
INPUT 178 INSTRUCTS CONTROLLER 170 TO ALTER BETWEEN SERIES & PARALLEL OPERATION
S203a
FEED ROLLER 132 IS FORCED TO MOVE TOWARD INFEED FLOOR 135
S203b
INFEED PASSAGEWAY AREA 139 IS LESS THAN A PREDETERMINED THRESHOLD
S203c
SENSOR 172 INDICATES MORE TORQUE IS NEEDED FOR FEED ROLLER 132
S203d

FIG. 9B

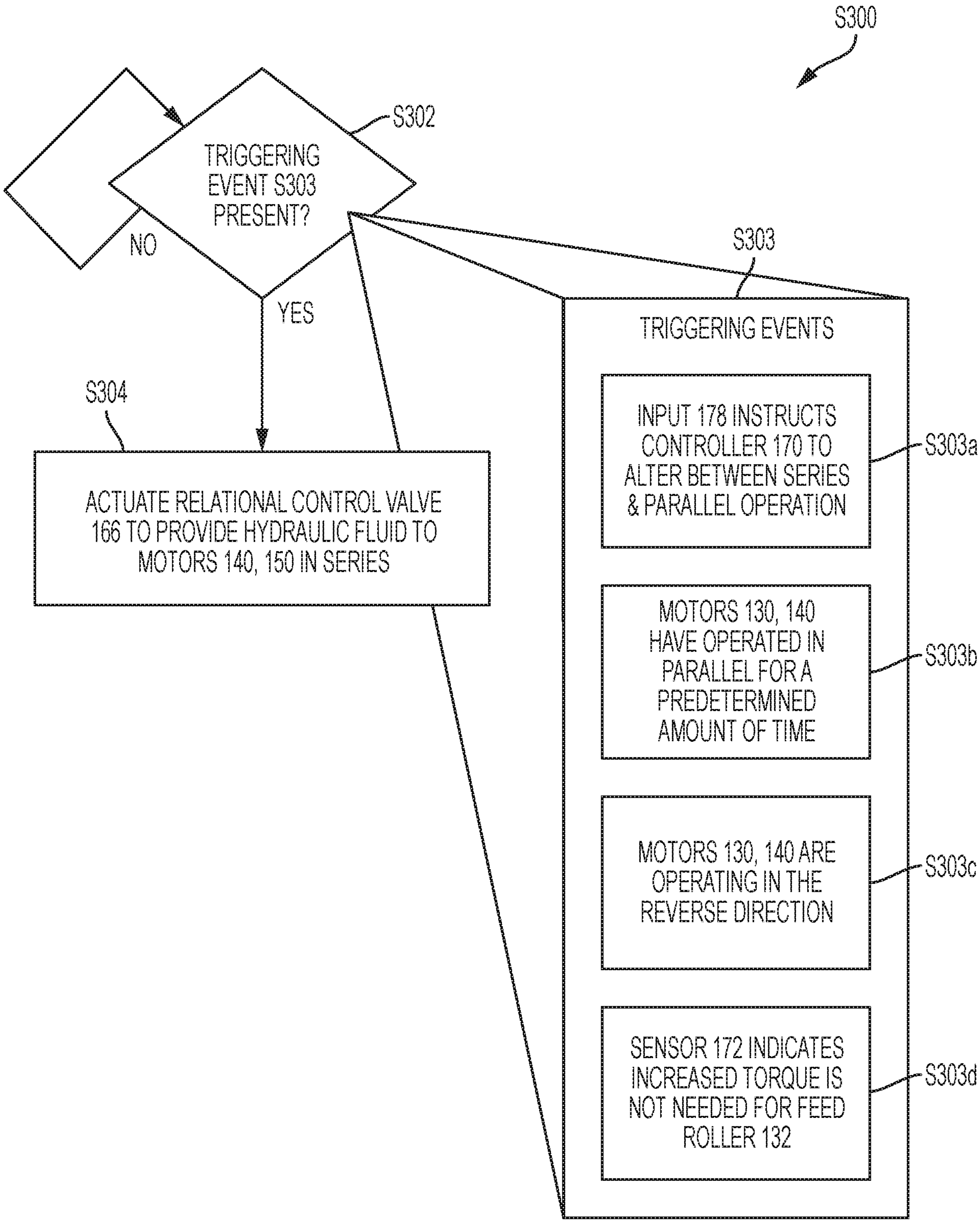
S300
TRIGGERING EVENT S303 PRESENT?
S302
NO
YES
S303
TRIGGERING EVENTS
INPUT 178 INSTRUCTS CONTROLLER 170 TO ALTER BETWEEN SERIES & PARALLEL OPERATION
S303a
MOTORS 130, 140 HAVE OPERATED IN PARALLEL FOR A PREDETERMINED AMOUNT OF TIME
S303b
MOTORS 130, 140 ARE OPERATING IN THE REVERSE DIRECTION
S303c
SENSOR 172 INDICATES INCREASED TORQUE IS NOT NEEDED FOR FEED ROLLER 132
S303d
S304
ACTUATE RELATIONAL CONTROL VALVE 166 TO PROVIDE HYDRAULIC FLUID TO MOTORS 140, 150 IN SERIES

FIG. 9C

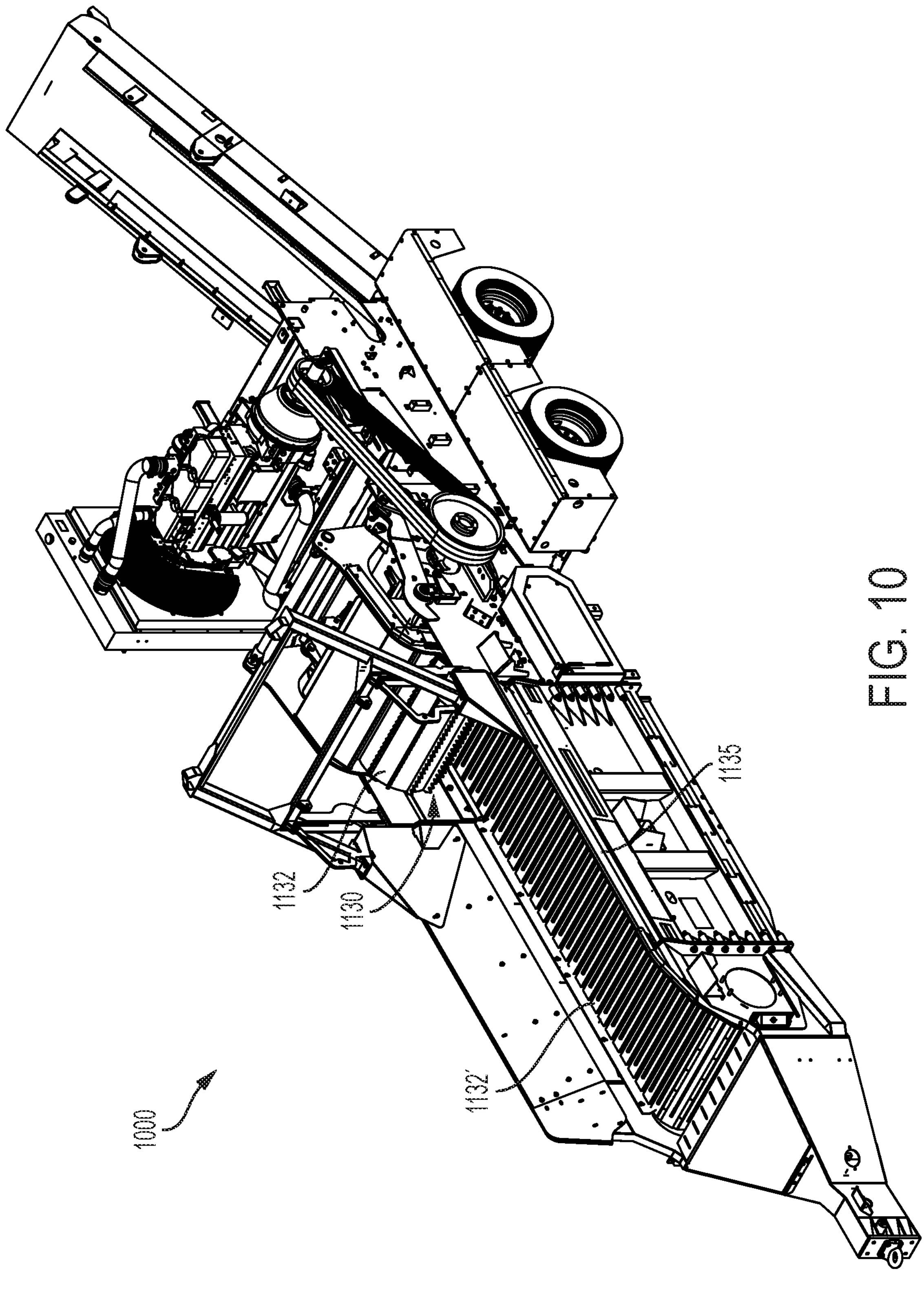

FIG. 10

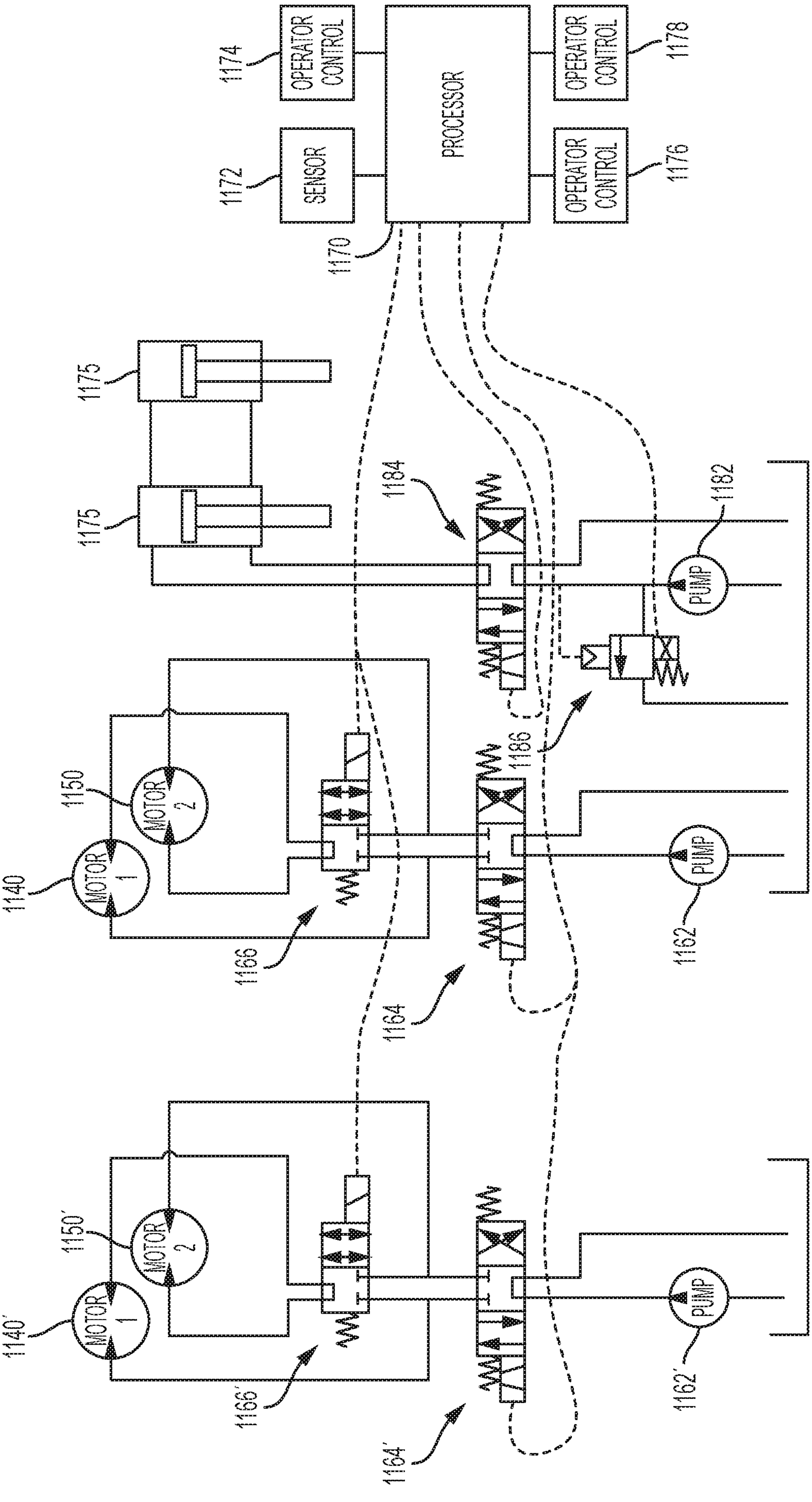
OPERATOR CONTROL
1174
PROCESSOR
OPERATOR CONTROL
1178
SENSOR
1172
OPERATOR CONTROL
1176
1170
1175
1175
1184
PUMP
1182
1186
MOTOR 1
1140
MOTOR 2
1150
1166
1164
PUMP
1162
MOTOR 1
1140'
MOTOR 2
1150'
1166'
1164'
PUMP
1162'

FIG. 11

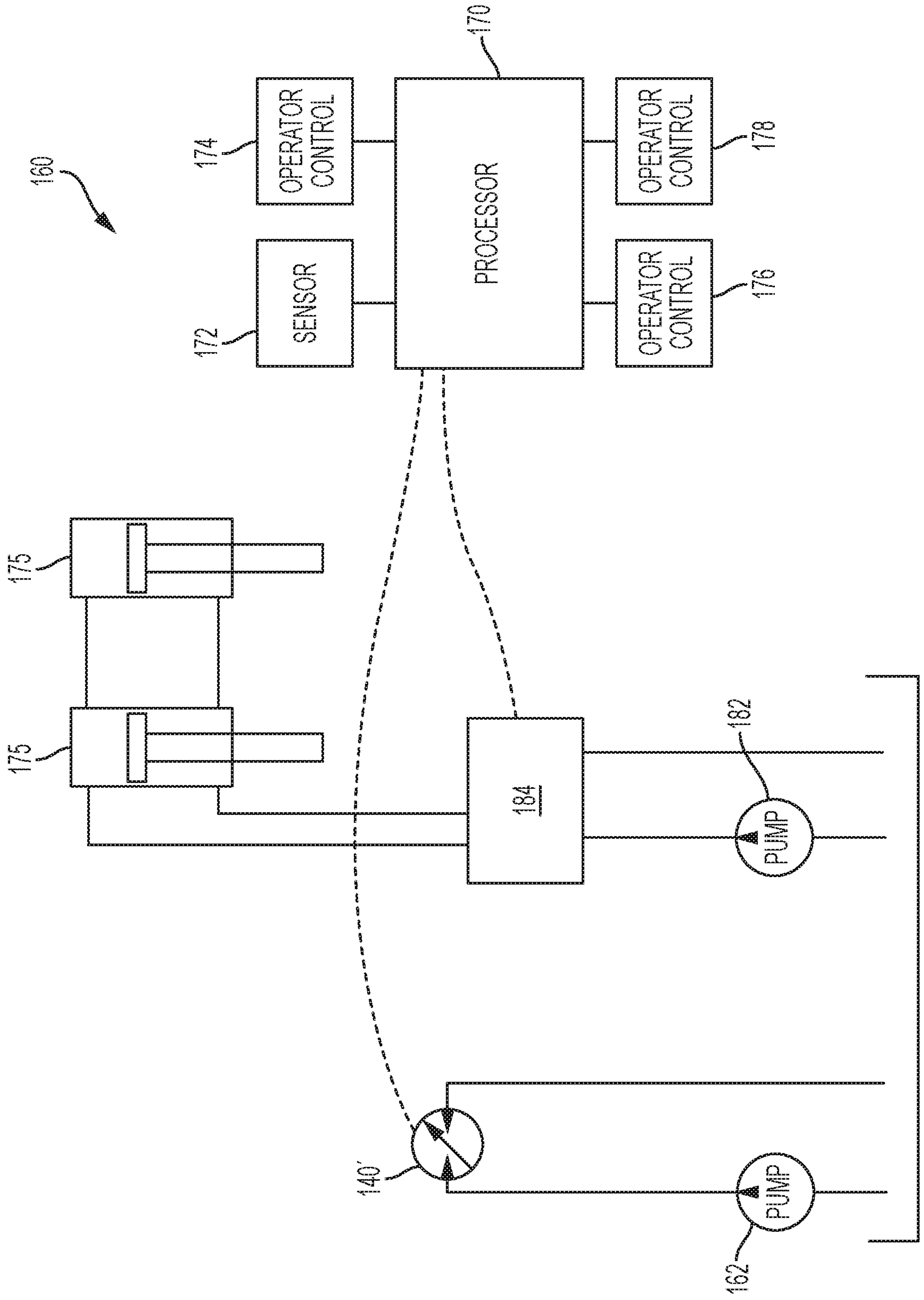
160
170
OPERATOR CONTROL
174
PROCESSOR
OPERATOR CONTROL
178
SENSOR
172
OPERATOR CONTROL
176
175
175
184
182
PUMP
140'
PUMP
162

FIG. 12