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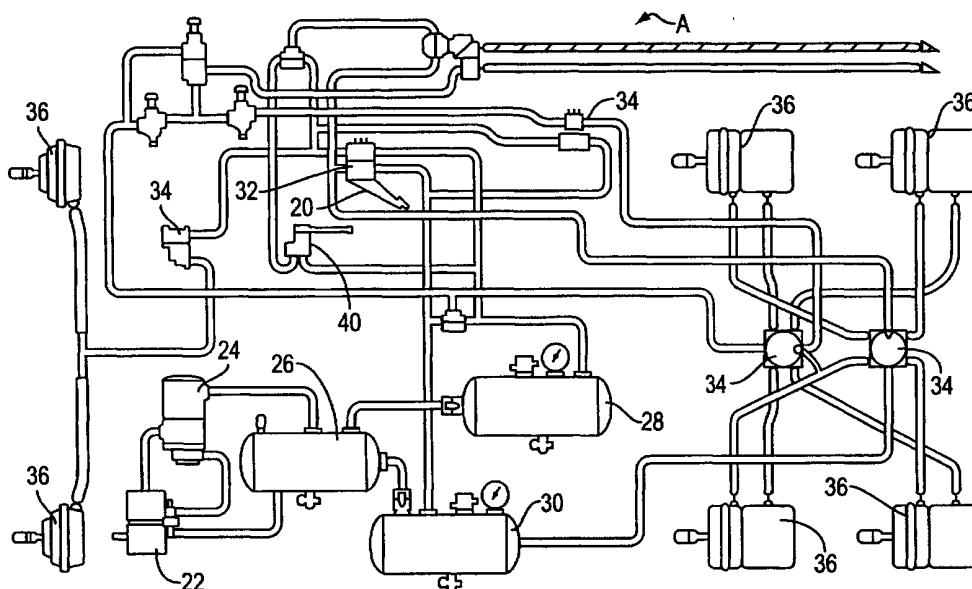
(43) International Publication Date
14 December 2000 (14.12.2000)

PCT

(10) International Publication Number
WO 00/74985 A2

- (51) International Patent Classification⁷: **B60T 7/00** (72) Inventors: **GEORGE, Ajit**; 423 Powell Drive, Bay Village, OH 44140 (US). **TAYLOR, Clyde**; 9775 Douglas Lane #202, Olmsted Falls, OH 44138 (US).
- (21) International Application Number: **PCT/US00/15636**
- (22) International Filing Date: **7 June 2000 (07.06.2000)** (74) Agents: **CRISS, Roger, H.** et al.; AlliedSignal Truck Brake Systems, 101 Columbia Road, P.O. Box 2245, Morristown, NJ 07960 (US).
- (25) Filing Language: **English**
- (26) Publication Language: **English** (81) Designated States (*national*): **CA, MX.**
- (30) Priority Data:
09/326,942 7 June 1999 (07.06.1999) **US** Published:
— Without international search report and to be republished upon receipt of that report.
- (71) Applicant: **ALLIEDSIGNAL TRUCK BRAKE SYSTEMS COMPANY [US/US]**; 101 Columbia Road, P.O. Box 2245, Morristown, NJ 07960 (US). For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: **ELECTRONIC TRAILER HAND CONTROL**



(57) Abstract: An electronic trailer control brake assembly can be conveniently mounted in the cab because of its reduced size. Only a single line extends from the assembly and provides an electrical signal proportional to the degree of movement of the actuating handle. In modified embodiments, the actuating handle can be maintained at intermediate positions between the actuated and deactuated positions. A detent mechanism provides a positive feedback to the operator and secures the actuating handle in a desired position.

ELECTRONIC TRAILER HAND CONTROL

Background of the Invention

5 This invention pertains to the art of control valves, and more particularly to a control valve used in a pneumatic or air brake system.

10 The invention is particularly applicable to a manually operated control valve that provides selective, graduated control of service brake air pressure in a tractor trailer combination. However, it will be appreciated that the invention may have wider applications and be advantageously employed in related environments and applications.

15 Brake systems for heavy vehicles typically employ a pneumatic system in which an air compressor charges a supply reservoir and actuation of a control valve selectively provides air pressure to one or more brake chambers associated with the tractor trailer. In the particular environment and embodiment at issue here, the manually operated control valve is mounted inside the operator's cab, for example, inside the steering column or is clamped to the exterior of the column. Thus, pneumatic lines extend to and from the control valve so that selective application of service brake air pressure to the trailer
20 brake chambers is provided upon demand by the vehicle operator or driver. For example, when descending through a steep grade, the driver may opt to actuate the control valve in order to provide selective braking to the trailer brakes. Thus, depending on the degree of valve handle rotation, the brakes may be gradually applied over a range of operation.
25 Known trailer control brake valves are usually biased to a first or closed position so that in the absence of an actuating force, air pressure is not provided to the brakes.

30 Although trailer control brake valves for pneumatic brake systems are well known in the art, the industry continues to develop toward increased electronic control of the tractor and trailer service brakes. This necessitates modification of the current pneumatic trailer

control brake valve so that it is compatible with an electropneumatic system. Because of the familiarity and acceptance of known trailer control brake valves in the pneumatic environment, any modified brake valve for an
5 electropneumatic system must offer at least the same benefits and advantages in a similar manner.

Accordingly, a need exists for a new and improved control brake valve for a trailer that is compatible with an electropneumatic system and provides a reliable, simple, and
10 economical product.

Summary of the Invention

The present invention contemplates a new and improved trailer control brake valve that may be operated in
15 first and second positions, and intermediate positions, to provide selective, graduated application of the service brakes to a trailer.

According to a preferred embodiment of the invention, an actuating handle extends from a housing and is
20 adapted for selective rotation by an operator. The handle is biased toward a first or non-actuated position. A position sensor or potentiometer mounted to the housing is operatively driven by the actuating handle and provides an electrical signal indicative of movement of the actuating
25 handle.

According to another aspect of the invention, positive first and second stops are provided to limit movement of the actuating handle between release and fully applied positions.

30 According to another aspect of the invention, a detent arrangement holds the actuating handle against the biasing force at an intermediate position.

A principal advantage of the invention is the elimination of pneumatic lines into the operator cab for
35 effecting trailer hand brake application.

Another advantage of the invention resides in the faster braking response associated with the electropneumatic system.

Yet another advantage of the invention is the ability to program the trailer braking control to accommodate various trailer brake systems.

A further advantage of the invention is realized by the reduced size of the assembly.

Still other advantages and benefits of the invention will become apparent to those skilled in the art upon a reading and understanding of the following detailed description.

Brief Description of the Drawings

The invention may take physical form in certain parts and arrangements of parts, preferred embodiments of which will be described in detail in this specification. The invention is illustrated in the accompanying drawings which form a part of the invention, and wherein:

FIGURE 1 is a schematic representation of a typical, prior art pneumatic truck/tractor air brake system;

FIGURE 2 is a longitudinal cross-sectional view of a first preferred embodiment of an electronic trailer hand brake assembly in accordance with the subject invention;

FIGURE 3 is a top plan view thereof;

FIGURE 4 is an exploded perspective view of a second preferred embodiment;

FIGURE 5 is a perspective view of the embodiment of FIGURE 4;

FIGURE 6 is a longitudinal cross-sectional view of a third preferred embodiment;

FIGURE 7 is a top plan view of the FIGURE 6 embodiment;

FIGURE 8 is a longitudinal cross-sectional view of yet another embodiment; and,

FIGURE 9 is a graphical representation of a preferred relationship between rotational input through the handle and the output voltage.

5 Detailed Description of the Preferred Embodiments

Referring now to the drawings wherein the showings are for purposes of illustrating the preferred embodiments of the invention only, where the drawings are not intended to limit the invention, the FIGURES show a brake system **A** of
10 the type used for heavy vehicles such as tractor-trailer combinations. More particularly, and with reference to FIGURE 1, a prior art brake system is schematically represented. The structure and operation of these systems are well known in the art; however, a brief review of the
15 overall system is helpful in understanding the present invention. The braking system **A** is a pneumatic, or air, brake system in which a pedal or treadle **20** mounted in the truck cab (not shown) is selectively depressed by the operator. Pressurized air from a compressor **22** passes
20 through an air dryer **24** and is stored in supply reservoir **26** which, in turn, supplies a front axle service reservoir **28** and a rear axle service reservoir **30**. A dual control valve **32** is actuated by the foot pedal to provide air pressure from the reservoirs to valves **34** associated with the front
25 and rear axles. These valves control the application of air pressure to brake chambers **36** associated with the individual wheels.

Also illustrated in FIGURE 1 is a conventional trailer control brake valve **40**. It is a manual or hand-
30 operated control valve that provides graduated application of service brake air pressure to the trailer. A handle extends from the valve housing and provides for selective application of air pressure to the trailer brakes. As will be appreciated, since the trailer control brake valve of the
35 conventional pneumatic system is typically mounted in the cab, provision must be made for a supply line, a delivery line, etc. Neither of these components is very flexible and

thus difficulties are presented in mounting the components in the truck cab. Moreover, although the valve is very robust, its size presents its own mounting problems and thus limits flexibility in accommodating the valve in the truck cab without adversely impacting on other components.

FIGURES 2 and 3 illustrate a preferred embodiment of the present invention. Particularly, these FIGURES show an electronic trailer hand control valve assembly 50 that provides an electrical signal to an electronic control unit (ECU) representative of the position of the actuating handle. Accordingly, instead of a pneumatic system, this arrangement is designed for an electropneumatic system where a position sensor or potentiometer associated with the hand control valve eliminates relatively inflexible supply and delivery lines associated with the prior pneumatic systems. Moreover, the electrical signal also has the advantage of allowing the output to be programmed or changed to alter the characteristics of the output curve. For example, an angular position of an actuating handle on one truck may provide a first pressure, e.g. 20 psi, but when mounted on another trailer, will provide a second pressure, e.g. 50 psi. Conversion to an electrical braking or electropneumatic system of the present invention, however, allows the curve characteristics to be altered in the ECU without disturbing the remaining components of the braking system.

The assembly includes a housing 52, having an internal cavity 54 that receives a drive shaft 56, biasing spring 58, and a position sensor 60. The housing can be formed as a multi-component assembly or, alternatively, it may be an integrally molded component to eliminate parts inventory and reduce costs associated with assembly. In the illustrated embodiment, the spring 58 is received in the housing cavity 54. A first end 62 of the spring is received in a recess of the housing to secure it against rotation. A second end 64 of the spring abuts against a portion of the drive shaft assembly, shown here as a spring return pin 66.

Again, as will be appreciated, in select embodiments, the drive shaft may be formed as a single component so that a projection or recess is adapted to receive the second end of the spring 64 to impart a biasing force to the assembly in a manner to be described further below.

The drive shaft is received in the housing cavity and adapted for free rotational movement therein. In the illustrated embodiment, the drive shaft 56 includes a shoulder 70 received on a shoulder 72 of the housing. A first or upper end of the drive shaft includes an attachment assembly 74 that permits convenient connection with actuating handle 80. As will be appreciated by one skilled in the art, any number of actuating handles 80 can be used as desired by the end user, so that the illustrated handle is merely exemplary of one arrangement. A relatively simple screw assembly can be used as a preferred means for securing the handle to the drive shaft. Alternatively, other connecting or securing arrangements can be used or the handle can be integrally formed with the drive shaft if so desired. A retaining ring 82 is received in an associated groove 84 of the housing to maintain the drive shaft in mounted relation when all of the components are assembled in the housing. A second, or lower end 86 of the drive shaft is operatively connected to the position sensor or potentiometer 60 in any convenient manner. Here, a lower end of the shaft includes a recess 88 that receives a pin 90 extending from the position sensor. The pin and drive shaft are secured together to rotate as a unit, i.e., no relative rotation, so that movement of the handle 80 between stops 92, 94 provides rotational movement of the drive shaft, overcoming the spring biasing force, and providing an angular or rotational input to the position sensor. In a manner well known in the art, the position sensor 60, such as a potentiometer, outputs an electrical signal dependent on the movement of the actuating handle, here, the rotational movement of the handle. Signals output through connector 100 thus require that only a single connection

extends outwardly from the electronic trailer hand control. Moreover, the wire associated with the connector is flexible enough, and small enough, to be easily accommodated in the cab. If the operator releases the actuating handle, the
5 spring 58 urges the handle toward the first stop to a non-actuated position. Otherwise, the degree of angular movement of the actuating handle, and thus the drive shaft, provides a variable signal via the potentiometer to mimic the operation of the prior art pneumatic counterpart.

10 As best illustrated in the embodiment of FIGURES 4 and 5, the assembly is substantially similar to that described above so that like numerals with a primed suffix ('') will reference like components, and new numerals will identify new components. In this arrangement, the
15 electronic trailer hand control valve assembly 50' further includes a detent 110 so that a desired intermediate position of the actuating handle can be maintained. A conventional ball detent extends through the sidewall of the housing 52' and the ball member 112 is adapted to cooperate
20 with enlarged surface 114 of the shoulder. By depressing the detent, the ball 112 engages the shoulder 114 and applies a radial force that is sufficient to oppose the return or biasing force of the spring 58'. This allows the actuating handle 80' to be maintained at an intermediate
25 position while the driver or operator completes, for example, a walk-around inspection of the trailer.

The embodiment of FIGURES 6 and 7 illustrates yet another arrangement for holding the electronic trailer control in a desired intermediate position. Again, where
30 possible, like components are referenced by like numerals with a double prime suffix ('') and new components are identified by new numerals for ease of illustration and understanding. Rather than using the detent mechanism of FIGURES 4 and 5, the actuating handle 80'' is modified to
35 provide a selective locking arrangement. A positioning mechanism 120, shown as a generally L-shaped arm, is adapted for selective radial movement. A first or inner end thereof

122 selectively engages serrations or teeth 124 provided on an external surface of the housing. Thus, the serrations and positioning mechanism operate as a ratchet mechanism.

To actuate the locking assembly, a button 126 is
5 depressed (in a radial direction) to urge the positioning mechanism radially inward against biasing spring 130. The torsional force imposed by the spring 58" rotates the handle sufficiently to lock the handle end 122 against the teeth 124. To release the handle from the locked angular
10 position, the button includes an enlarged shoulder 132 that can be manually grasped by the operator and the radial outward force of spring 130 aids in the release function. In this manner, the button is depressed and the positioning mechanism locks the positioning handle at the desired
15 rotational position. This position is maintained until the button is pulled outward whereby the restoring force of the torsion spring urges the actuating handle of the valve toward its first stop 92.

The embodiment of FIGURE 8 has a number of
20 similarities to the embodiment described with respect to FIGURES 6 and 7; however, the output is linear rather than the angular sensor previously described. Thus, only the new components are highlighted below and one skilled will readily recognize that the remaining components is
25 structurally and functionally similar unless specifically noted otherwise. A cam 150 is secured to and rotates with the handle. A tapered or inclined lower cam surface 152 cooperates with a cam follower 154 which is adapted for axial motion along the axis of rotation of the handle in
30 response to angular movement of the cam. The torsion spring urges the cam follower into operative abutting engagement with the cam. In addition, a linear position sensor 160 includes a stem 162 that protrudes axially therefrom for engagement with the cam follower. Thus, as the cam follower
35 is urged axially downwardly (as shown), the stem is compressed and a suitable proportional signal representative of the amount of linear movement of the stem is output.

Still other linear sensor configurations can be used with equal success and without departing from the scope and intent of the subject invention.

FIGURE 9 illustrates that the sensor can include multiple outputs. For example, switches can be incorporated into the position sensor so that in response to an angular or linear input, discrete signals or output voltages are obtained. Line 170 provides, for instance, an indication that the handle has been sufficiently moved to apply an output pressure. Likewise, line 172 indicates that no further pressure will be applied. Line 176, on the other hand, represents the potentiometer output that provides a desired proportion of ratio output in response to an operator input through the handle, either as a linear or angular input.

The invention has been described with reference to the preferred embodiments. Obviously, modifications and alterations will occur to others upon a reading and understanding of this specification. It is intended to include all such modifications and alterations in so far as they come within the scope of the appended claims or the equivalents thereof.

Having thus described the invention, we claim:

1. An electronic trailer hand control brake valve for selectively applying service brakes on a trailer,
5 the brake valve comprising:
 - a housing;
 - a handle extending from the housing and selectively moveable between first and second positions;
 - a position sensor in operative communication
10 with the handle and providing an electrical signal in response to the position of the handle; and
 - a biasing member for urging the handle toward the first position.
- 15 2. The invention of claim 1 further comprising a detent assembly for selectively locking the handle relative to the housing until released by an operator.
3. The invention of claim 2 wherein the detent
20 assembly includes an arm extending from the handle that selectively engages serrations on the housing.
4. The invention of claim 3 wherein the arm is biased by a spring toward a non-engaged position to
25 assist an operator in releasing the detent assembly.
5. The invention of claim 3 wherein the arm includes an enlarged shoulder that can be grasped to release the detent assembly.
30
6. The invention of claim 1 further comprising first and second stops that limit movement of the handle between the first and second positions.
- 35 7. The invention of claim 1 further comprising a shaft operatively associated to the handle and received

in the housing, the biasing member being received about the shaft and secured at one end to the housing and at the other end to the shaft to urge the handle toward the first position.

5

8. The invention of claim 7 wherein the position sensor is a potentiometer operatively associated with the shaft for outputting the electrical signal in response to the angular position of the shaft.

10

9. The invention of claim 1 further comprising a cam and cam follower received in the housing and operatively interposed between the handle and the position sensor for providing a linear input to the position sensor.

15

10. The invention of claim 1 wherein the position sensor provides a first signal indicative of handle movement from the first position.

20

11. The invention of claim 10 wherein the position sensor provides a second signal indicative of handle movement approaching the second position.

25

12. A tractor trailer braking assembly providing selective pneumatic braking to brake actuators associated with wheels thereof, the assembly including:

an electronic hand control brake having a housing and a handle mounted thereto adapted for selective movement by an associated operator between actuated and deactuated positions and providing an electrical signal in response to the handle movement, the brake further including a spring urging the handle toward the deactuated position, and a detent assembly for selectively holding the handle in a desired position.

30

35

13. The invention of claim 12 wherein the detent assembly includes an arm extending from the handle that selectively engages serrations on the housing.

5

14. The invention of claim 13 wherein the arm is biased by a spring toward a non-engaged position to assist an operator in releasing the detent assembly.

10

15. The invention of claim 13 wherein the arm includes an enlarged shoulder that can be grasped to release the detent assembly.

15

16. The invention of claim 12 further comprising first and second stops that limit movement of the handle between the first and second positions.

20

17. The invention of claim 12 further comprising a shaft operatively associated to the handle and received in the housing, the spring being received about the shaft and secured at one end to the housing and at the other end to the shaft to urge the handle toward the first position.

25

18. The invention of claim 17 wherein the position sensor is a potentiometer operatively associated with the shaft for outputting the electrical signal in response to the angular position of the shaft.

30

19. The invention of claim 12 further comprising a cam and cam follower received in the housing and operatively interposed between the handle and the position sensor for providing a linear input to the position sensor.

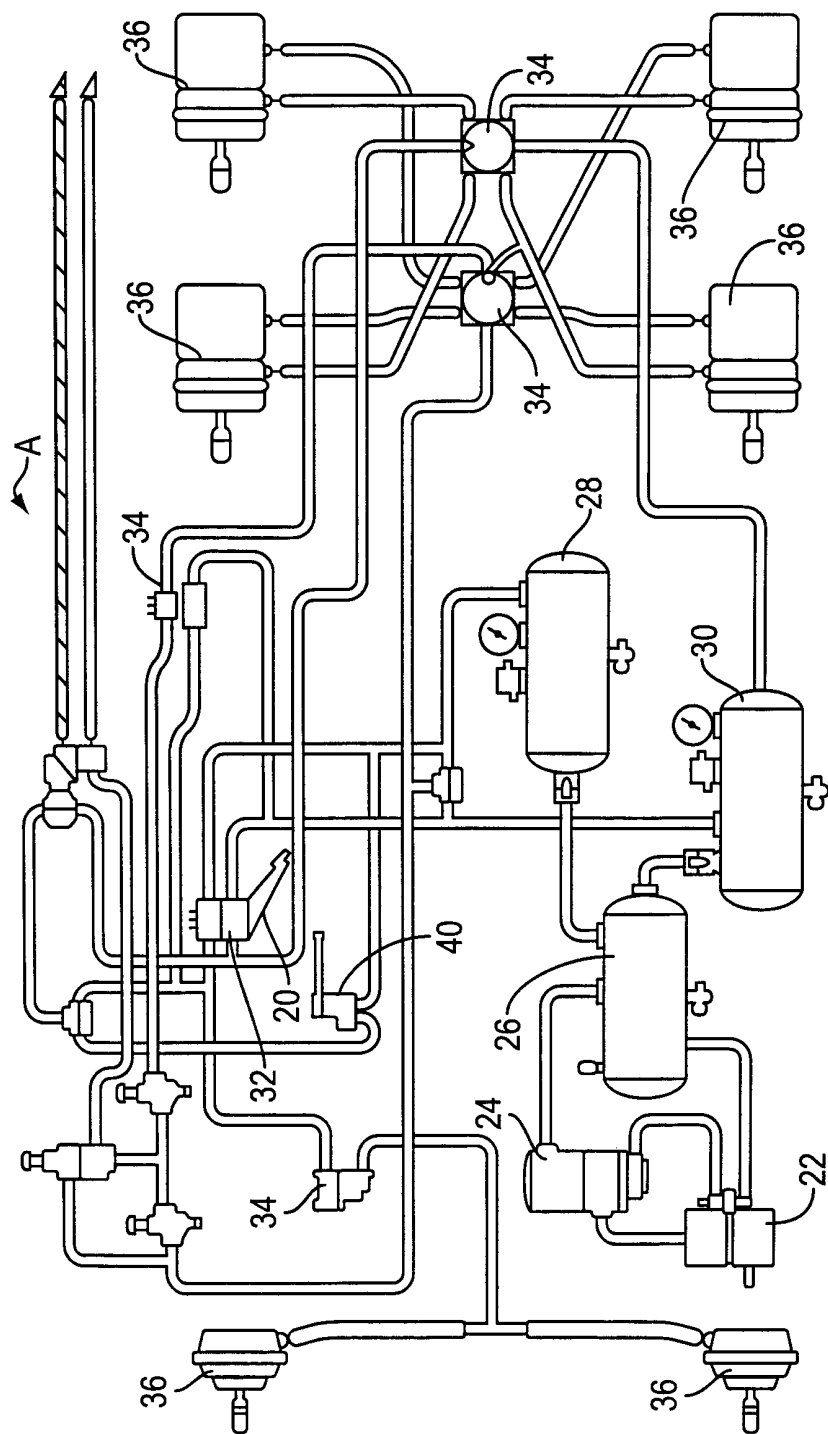


FIG. 1

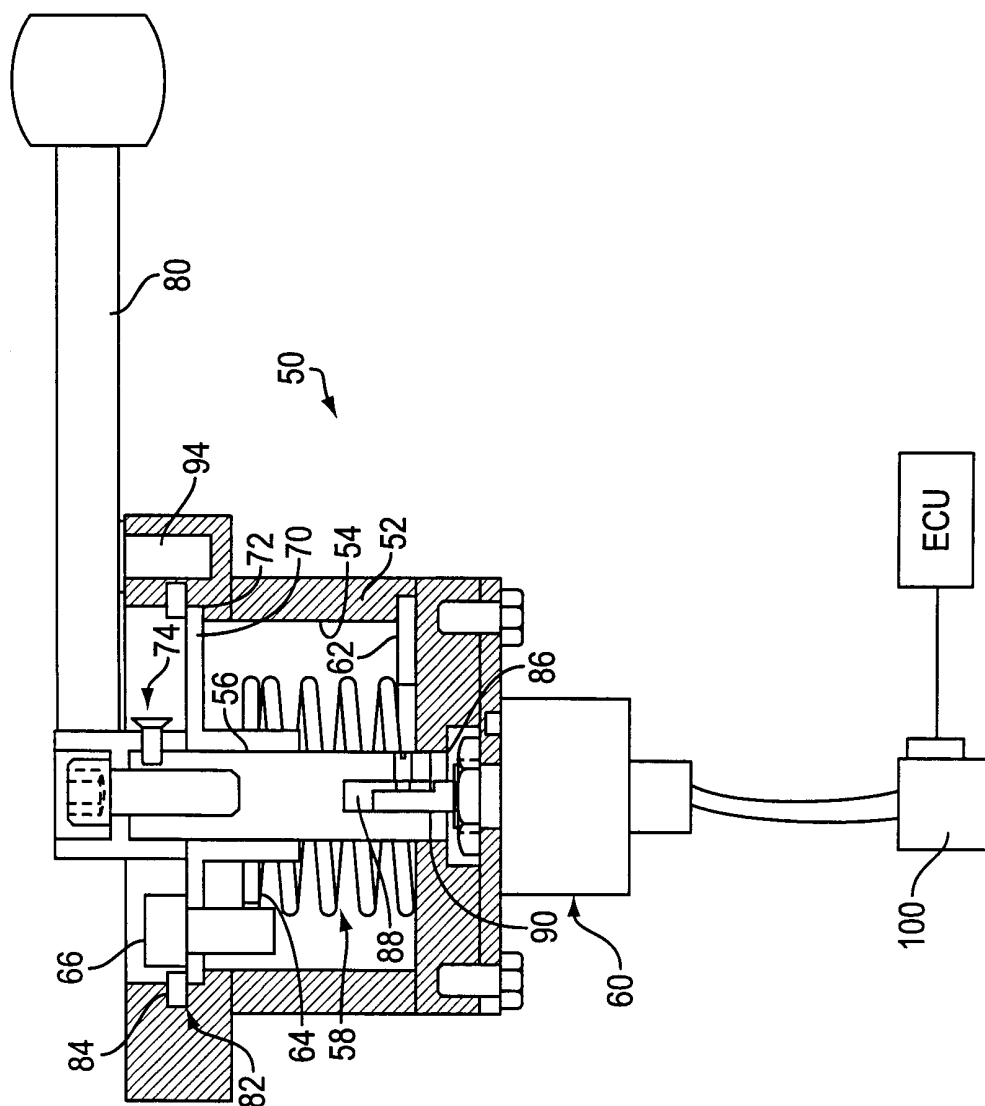


FIG. 2

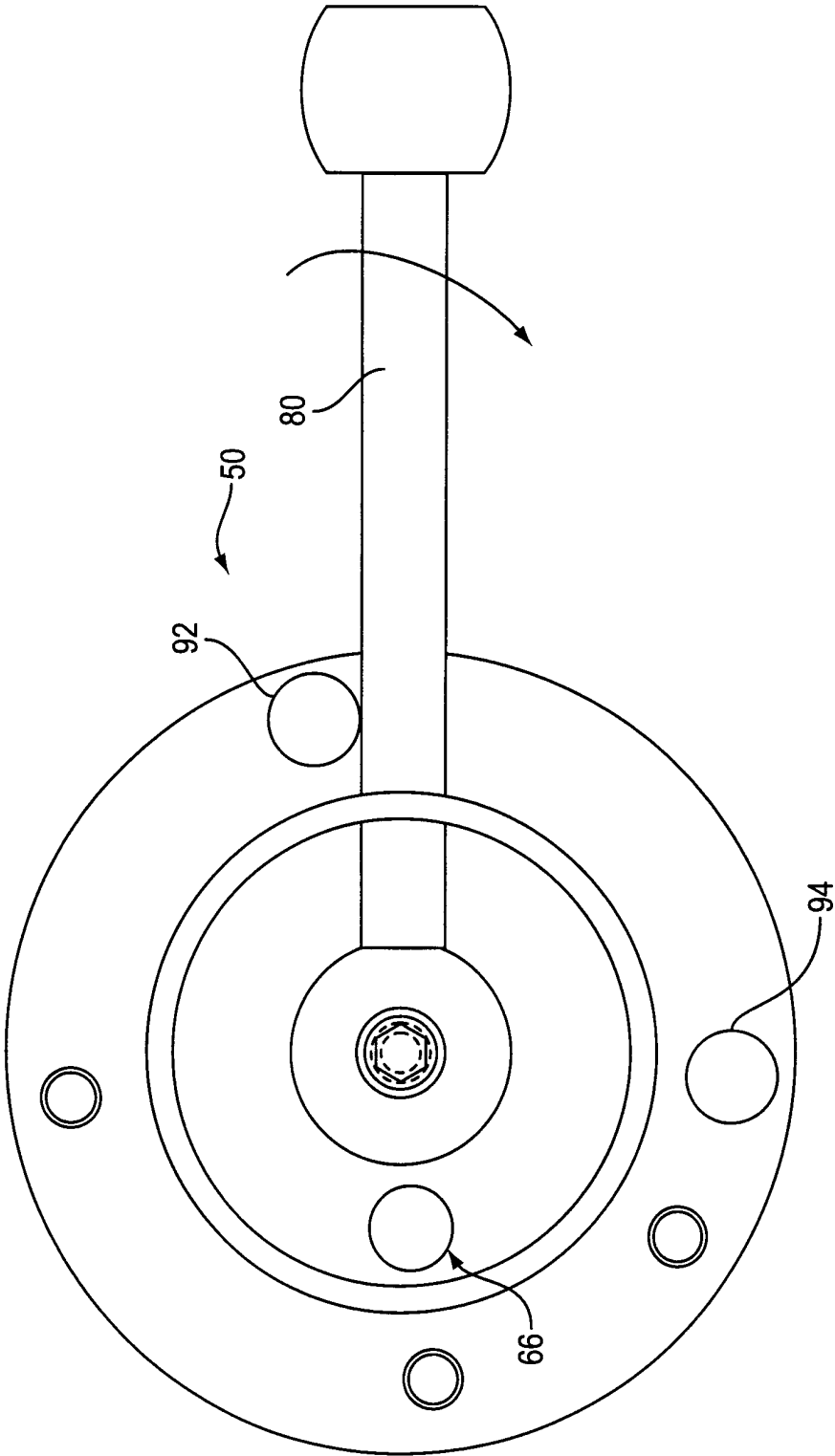


FIG. 3

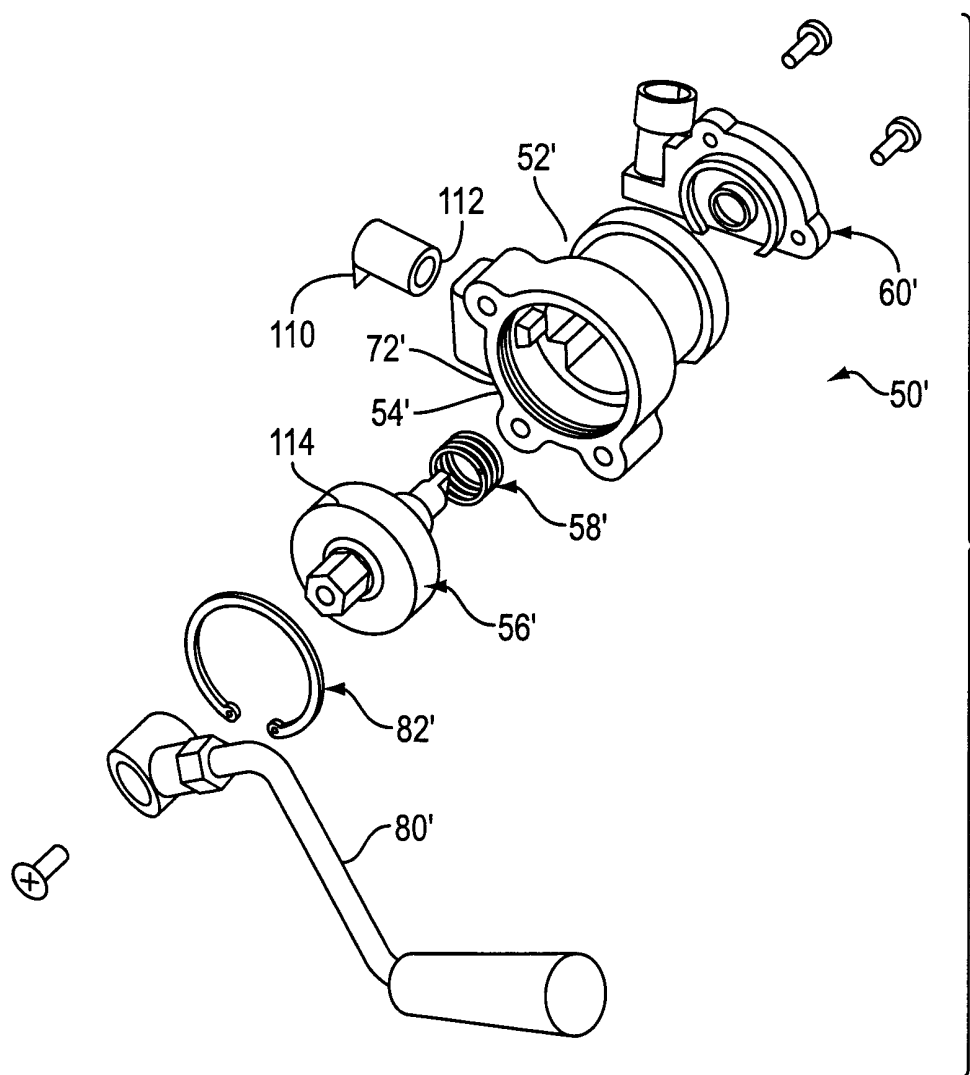


FIG. 4

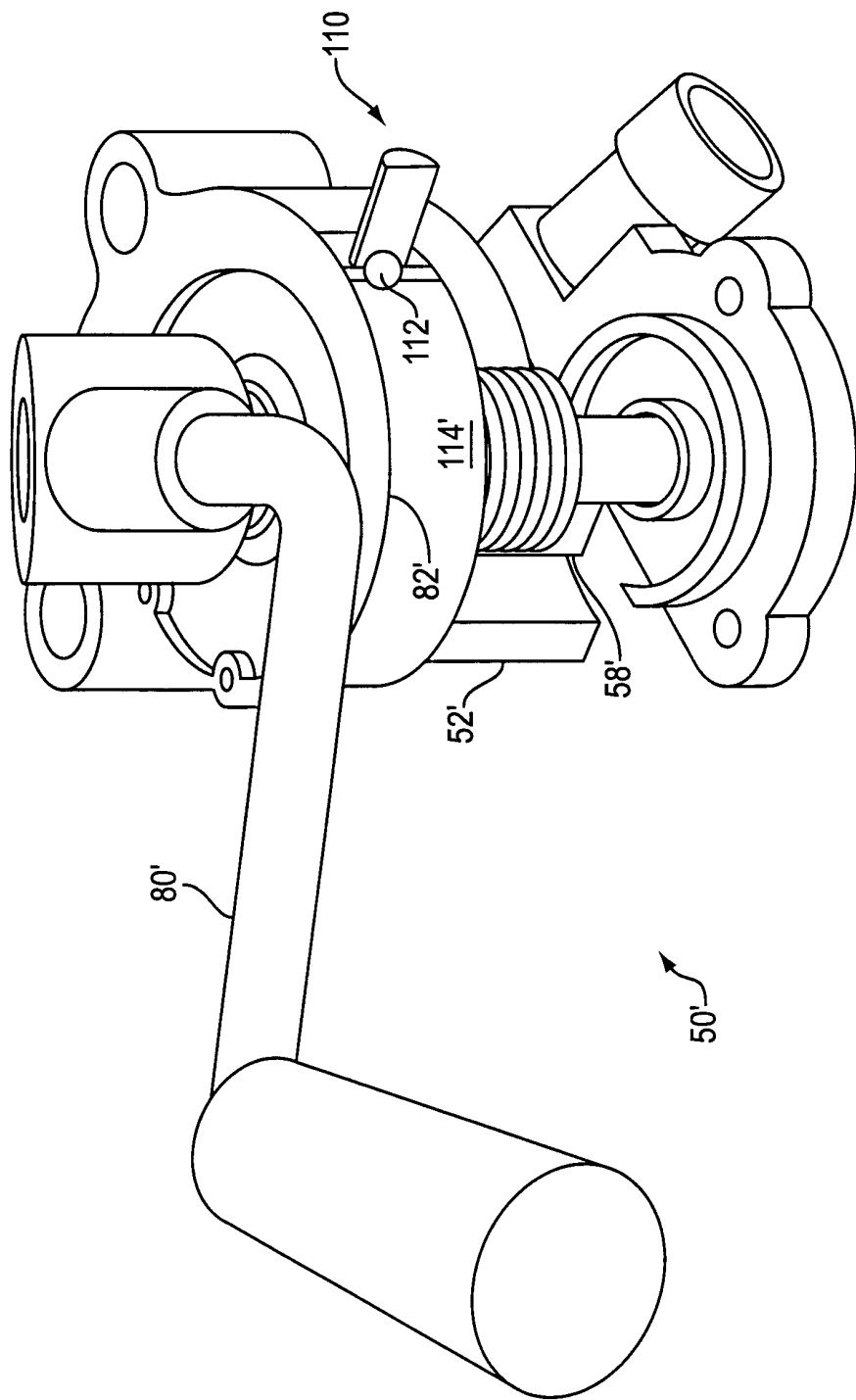


FIG. 5

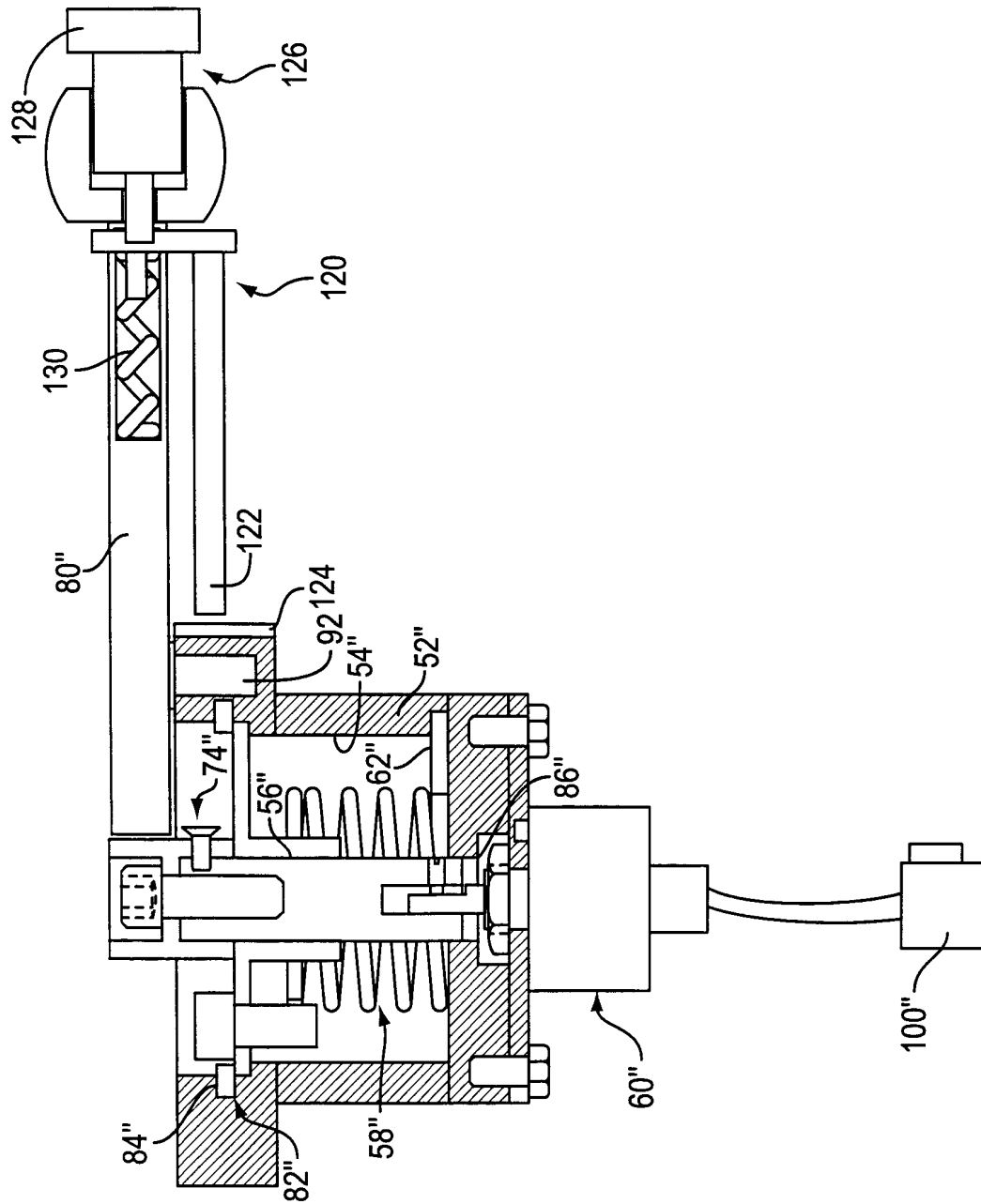


FIG. 6

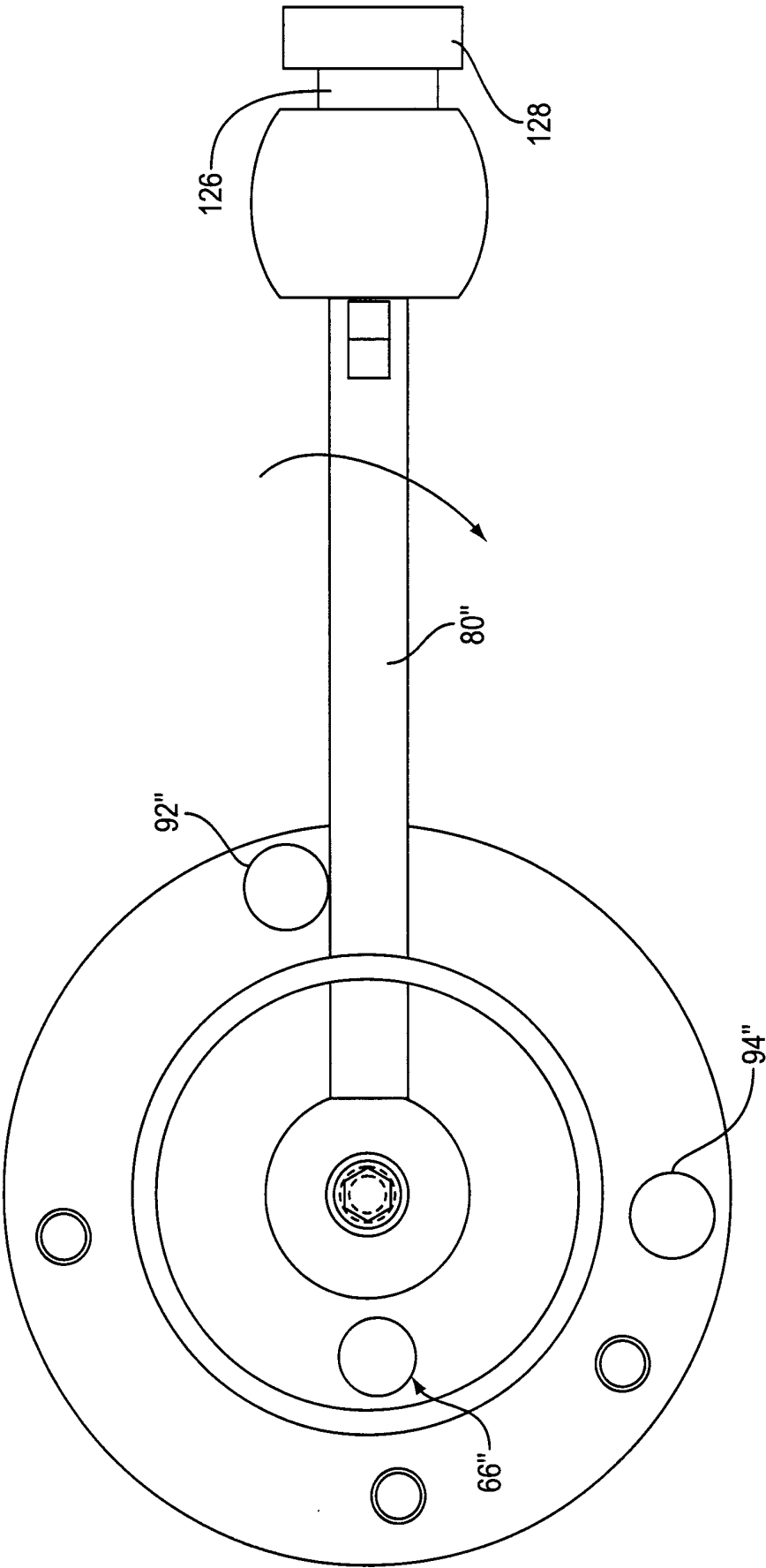


FIG. 7

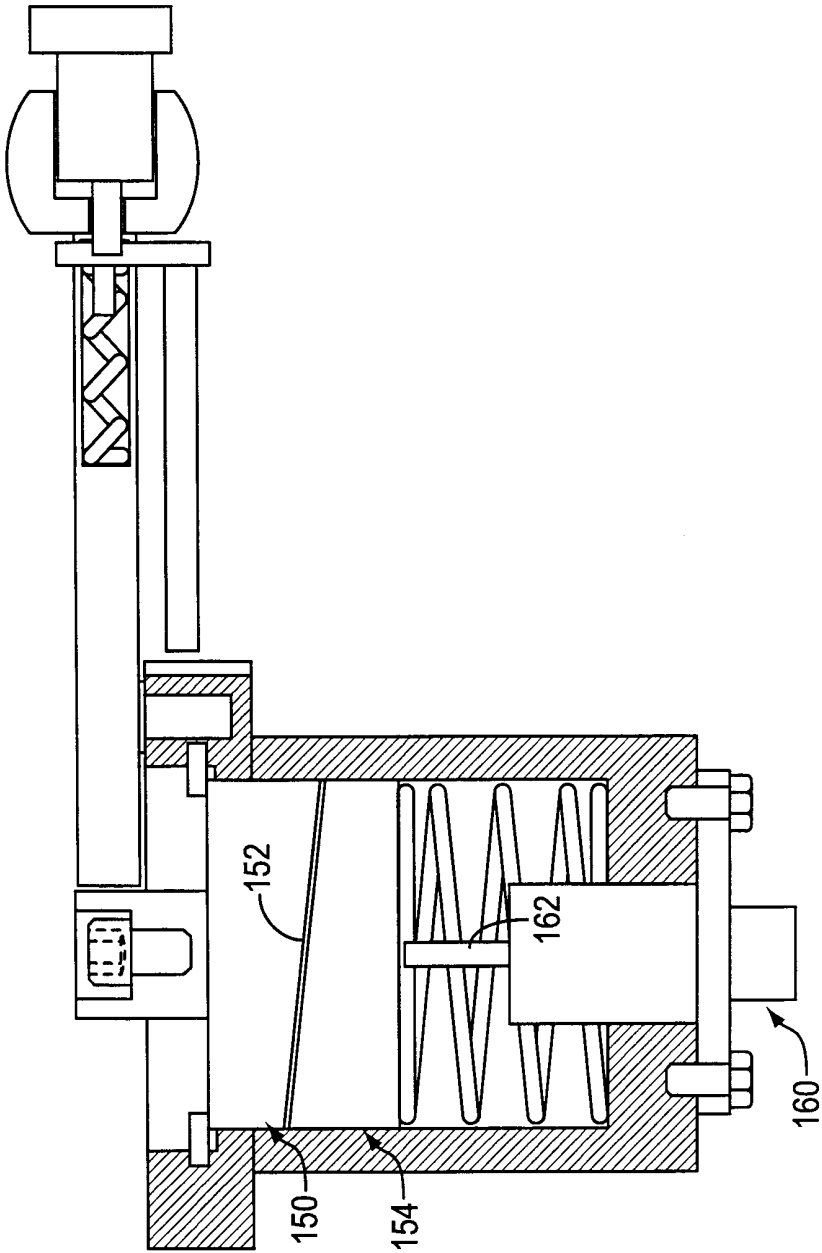


FIG. 8

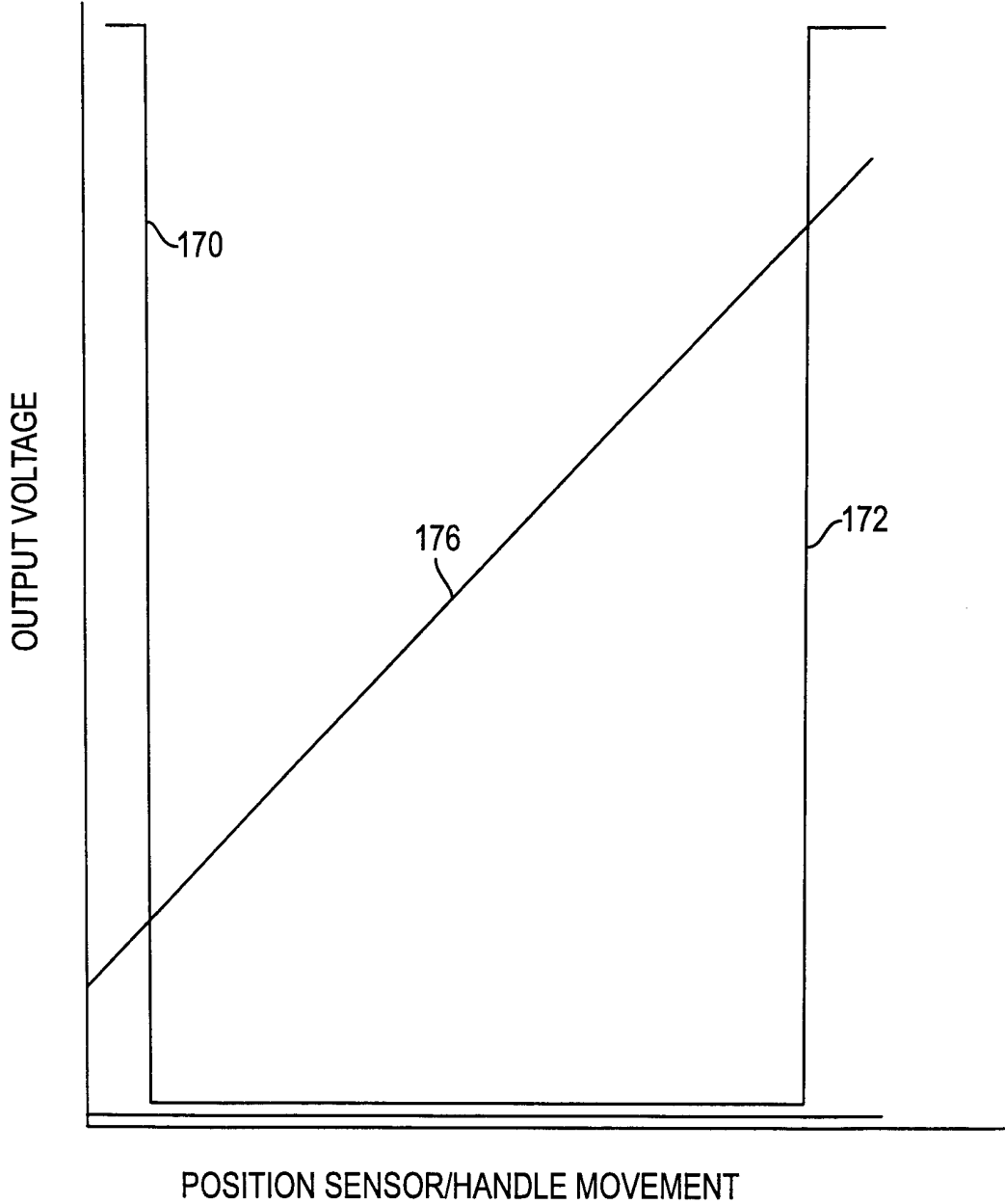


FIG. 9