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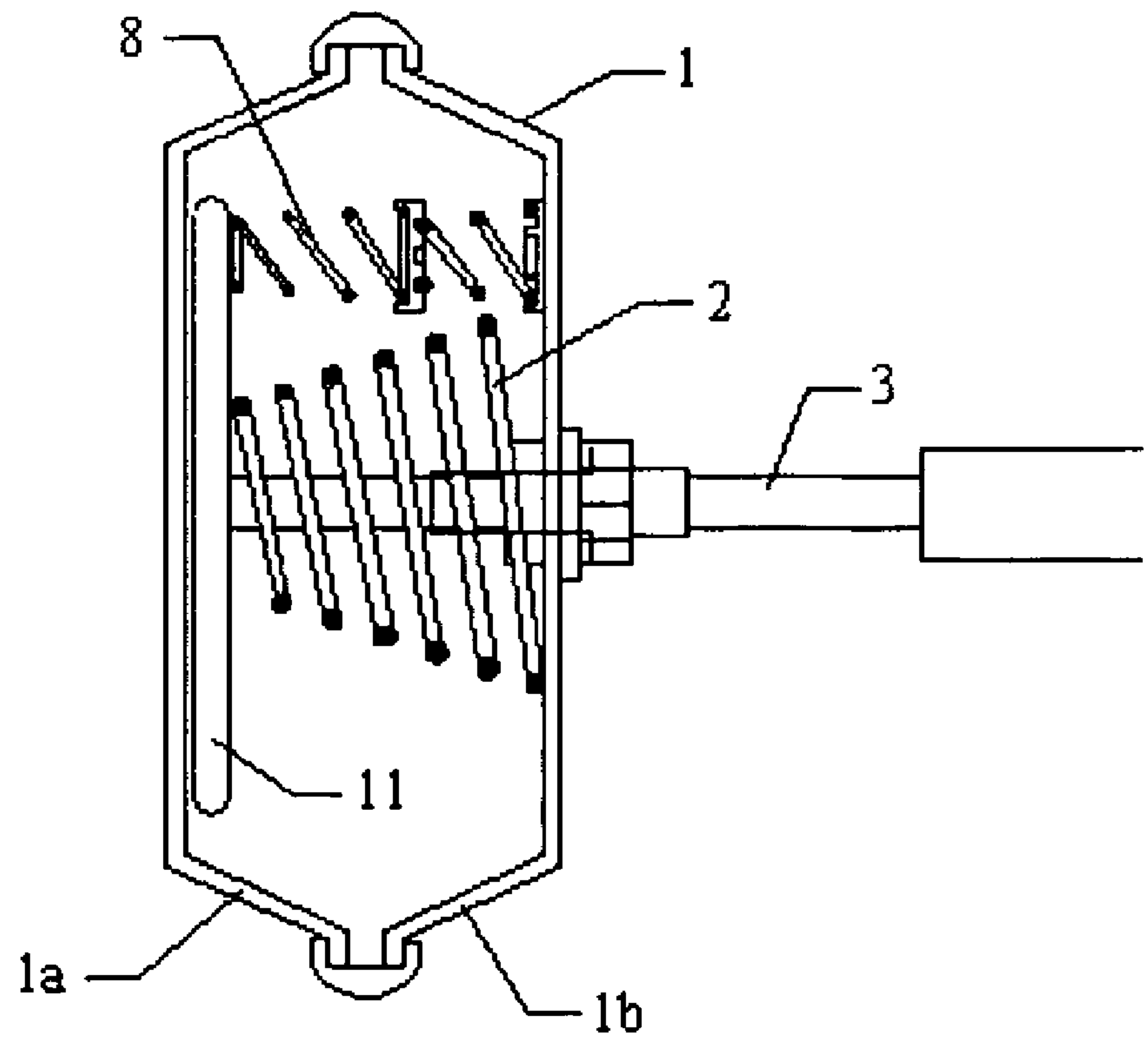

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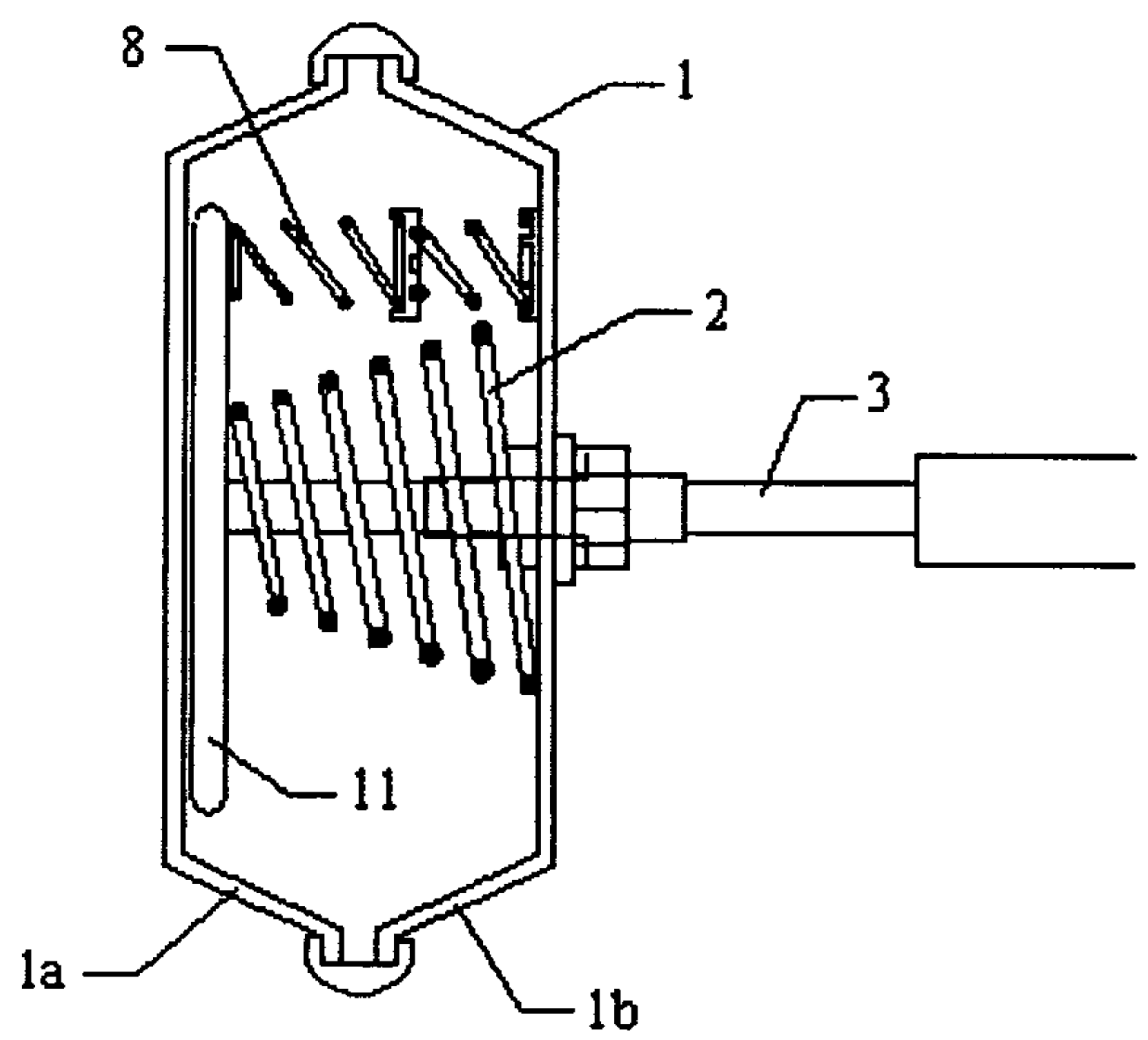

(57) Abstract: Structure disposed within a brake housing for measuring the displacement of a reference within said brake housing so as to indicate the brake stroke condition on a vehicle braking system.

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Description

BRAKE SYSTEM

Field of Invention

This invention relates generally to a braking system and in particular to means for indicating brake stroke condition on an air braking system.

Background Art

It is generally recognized that there is a need to be able to accurately determine the brake stroke condition on a vehicle's brakes so as to ensure the timely maintenance of the vehicle's braking system. As most braking systems are difficult to inspect many vehicle operators let the maintenance of the brakes lapse which can result in the loss of brake effectiveness. There have been many prior art devices to address the aforementioned problem such as for example U.S. Patent No. 4,279,214, 4,776,438 and 4,879,964.

Many of such prior art devices include gauges and reference indicators that are located on the brake rods or clevis pins such as for example disclosed by U.S. Patent No. 5,320,198 and 5,441,128. Canadian Patent No. 2, 186,271 which shows the use of a brake adjustment indicator including a mounting bracket having an elongated body with a slot and a spacer for receiving two bolts for indicating limit positions.

It is an object of this invention to provide an alternate means of measuring brake stroke conditions by disposing said means within a brake housing.

It is a further object of this invention to provide a simplified structure which is easy to install and maintain.

Disclosure of Invention

It is an aspect of this invention to provide a structure disposed within a brake housing for measuring the displacement of a reference within said brake housing so as to indicate the brake stroke condition on a vehicle braking system.

Brief Description of Drawings

Fig. **1** is a representative drawing of a section through a brake housing, and shows the strong spring in a free state.

Fig. **2** is a schematic drawing of the Hall-effect ratiometric sensor in a compressed state.

Fig. **3** is a representative drawing of a Hall-effect ratiometric sensor with both the strong spring and weak spring in a free state.

Fig. **4** is a representative drawing of a section through a second embodiment of the invention illustrating radar structure for receiving reflected radar waves measuring linear motion.

Fig. **5** is a representative drawing of a transport utilizing a wireless system.

Fig. **6** is a representative drawing of a transport utilizing a multiplex wireless system.

Fig. **7** is a representative drawing of a transport utilizing a multiplex unit and hard wires.

Fig. **8** illustrates one embodiment of the invention illustrating a Hall-effect sensor.

Fig. **9** illustrates the push rod and clevis pin.

Fig. **10** shows an exploded view of a magnetic clevis pin.

Fig. **11** is a side sectional view of the magnetic clevis pin.

Fig. **12** illustrates the mounting bracket.

Fig. **13** illustrates one embodiment of the assembled sensor.

Fig. **14** is an exploded view of the sensor.

Fig. **15** is a partial cut out view of the sensor.

Fig. **16** illustrates the slack travel time rotation and path.

Fig. **17** is a representative drawing of the multi vehicle multiplexed display.

Fig. **17a** is a representative drawing of a hardwired single vehicle display.

Figs. **18-24** inclusive illustrate the various display feature of the multiplexed display.

Fig. **25** is a representative view of the multiplexed module.

Fig. **26** is a table illustrating all trigger sequence, reference voltage and associated display colour.

<u>Best Mode for Carrying Out the Invention</u>

In the description which follows, like parts are marked throughout the specification and the drawings with the same respective reference numerals. The drawings are not necessarily to scale and in some instances proportions may have been exaggerated in order to more clearly depict certain features of the invention.

Generally speaking Hall-effect switches provide a convenient way of sensing linear or angular position. Hall-effect linear systems from Honeywell Micro Switch™, Allegro Microsystems™, Siemens and other manufacturers provide sensing function. "Ratiometric" means that the output voltage is proportional to the magnetic field strength. Hall-effect sensors, coupled with current excitation and signal conditioning means provide a voltage output in the presence of a magnetic field. The Hall-effect shown in Fig. 1 illustrates a contact less sensing (i.e. minimal mechanical wear), system. Hall-effect linear systems from Honeywell Micro Switch ™ and Allegro Microsystems ™ provide a ratiometric sensing function. "Ratiometric" means that the output voltage is proportional to the magnetic field strength.

Figure 1 illustrates one means or structure that is disposed within a brake housing **1** for measuring the displacement of a reference within the brake housing **1** so as to indicate the brake stroke condition on a vehicle braking system. The reference chosen in figure 1 comprises a push rod back plate **11** which is connected to the push rod **3** that extends within the confines of the brake housing **1** and extends upwardly and connected to the clevis generally illustrated by the "U-shaped" structure. The clevis is connected to the remainder of the braking system in a manner well known to those persons skilled in the art.

Upon activation of the braking system as shown in figure 1 the back plate **11** moves linearly from the position shown in figure 1 towards the right so as to compress the return spring **2**. In this fashion the push rod back plate **11** is displaceable or travels in a linear manner between the two spaced walls of the brake housing **1**. In other words during brake activation the push rod back plate **11** travels towards the right hand sidewall of the brake housing. Upon deactivation of the braking system the push rod back plate **11** is returned to its original position shown in figure 1 by means of the return spring **2**. The brake housing **1** shown in figure 1 consists of two brake housings **1a, 1b** connected together by means of a connector as shown in figure 1.

Accordingly one may insert means disposed within the brake housing **1** for measuring the displacement of the push rod back plate **11**. The means shown in figure 1 consists of a Hall-effect ratiometric sensor generally shown in figures 2 and 3. In particular the Hall-effect ratiometric sensor comprises a strong spring **4**, a ratiometric sensor **5** and a magnet housing **6** which includes the magnet **7**. More particularly the Hall-effect sensor includes a first housing **20** which is secured to one of said spaced walls **1b** and the first housing **20** includes the ratiometric sensor **5** as best illustrated in figure 3. The Hall sensor **5** also includes a second moveable housing **6** which includes the magnet **7**. The first and second housing **20** and **6** is connected together by a weak spring **10**. Figure 3 illustrates the weak spring **10** in a free state. A strong spring **4** is also utilized which is connected to the second moveable housing **6** and the push rod back plate **11**. Although strong and weak springs are illustrated in figures 1, 2 and 3 any other biasing means such as leaf springs or other biasing means such as cylinders or the like may be utilized so long as the following operation is realized.

The Hall-effect ratiometric sensor is one that reduces or increases the voltage output according to a magnetic flux strength. The principle of the Hall-effect sensor is to measure linear travel inside the air brake chamber. The sensor is fastened on the inside of the brake housing. The strong spring **4** is connected to the magnetic housing **6** while the weak spring **10** extends outwardly from the magnetic housing **6** to the sensor housing **20**. When the back plate **11** travels towards the sensor **5** the total difference in travel from the initial position of the back plate **11** to its final position during braking is determine by the difference in the spring forces between the strong and weak springs.

Moreover as the magnet **7** approaches closer to the ratiometric sensor **5** a voltage signal is generated according to the proximity of the magnet towards the face of the sensor. Such signal may then be utilized to indicate or measure the brake stroke condition on a vehicle braking system in a manner to be more fully described herein. More specifically a strong spring **4** and a weak spring **10** have been utilized in accordance with the ratiometric sensor **5** since the magnet **7** will have a predictable and effective impact on the sensor **5** over a defined path of travel toward and away from the sensor **5**. In other words, if the magnet was located on the back plate and the Hall sensor **1b**, the magnet **7** would generally be too far away from the sensor **5** to produce a meaningful accurate reading. However, by the arrangement shown in Figure 1, the strong spring presents the magnet **7** in the vicinity of the Hall sensor **5** where relatively accurate readings can be made, and as the back plate **11** moves toward the sensor housing **20** the distance of travel of the magnetic housing **6** and the magnet **7** relative from the sensor housing will be a function of the difference in the spring forces of the strong spring **4** and weak spring **10**. In other words, the distance of travel of back plate **1** relative the sensor housing **20** will be greater than the distance travel of the magnetic housing **6** relative the sensor housing **20**. Accordingly accurate and meaningful readings can be obtained.

Figure 4 illustrates an alternate embodiment of the invention which utilizes electromagnetic radiation generating means to generate an electromagnetic radiation wave towards the displaceable push rod back plate **6** as shown in figure 4 so as to measure the brake stroke condition.

In particular the electromagnetic radiation generating means shown in figure 4 may in one embodiment comprise a radar generating and receiving means **23** which generate radar waves towards the surface of the push rod back plate **11**. The radar waves bounce off the surface of the push rod back plate **11** back towards the radar transceiver **23**. The reflected radar waves **8** may be used to measure the linear motion of first the push rod back plate **11** and thus the brake travel of the push rod **3** and clevis and other braking surfaces. An antenna **9** may be utilized to generate transmitting waves **12** which may be picked up by display means so as to display the condition of the brake stroke in a manner to be more fully described herein. The brake housing **1** also includes the brake return spring **2**.

Accordingly the sensor shown in figure 4 utilizes radar waves which bounce off the push rod back plate **11** in a manner to measure linear motion. The sensor shown in figure 4 is capable of transmitting signals to a wireless receiver. One example of a wireless receiver is shown in figure 5, which consists of a truck transport, having battery operated sensors **14**. Such battery operated sensors **14** may consist of the sensor shown in figure 4 as well as the sensor shown in figures 1, 2 and 3. The batteries provide the power for the signals to be generated by the sensor shown in figures 1, 2, 3 and 4. The wireless system shown in figure 5 is well suited for the generation of the radar waves shown in figure 4 while the signals generated by the Hall-effect ratiometric sensor shown in figures 1, 2 and 3 need to be transduced into a radar or other signal such as radio frequency or the like. The signal could also be transduced into a radar or other signal such as radio frequency or the like and encoded\decoded by the module **80** and multiplexed to display **20** via wiring harness **50**.

The wireless system shown in figure 5 consists of the display module **20** and sensors that have self-contained battery power. Other power systems can be used. The sensors use transmitting technology and receive radar signals to measure the linear motion and also to transmit the sensor signals into the display module.

Figure 6 is a variation of the structure shown in figure 5 and particularly relates to a multiplex wireless system. Figure 6 illustrates the display module **20** and sensors **14** as well as, a wireless transmission signal **16**. Figure 6 also shows the transmitter modules **18**.

In particular figure 6 illustrates that the system consists of a display module **20**, sensors **14**, and transmitter mode module **18** through wireless transmission **16**.

Finally figure 7 illustrates a multiplex unit which is hard wired. In particular the transport shown in figure 7 illustrates the wiring harness **50**, which is generally added to the transport.

The system shown in figure 7 is well suited for the sensors shown in figures 1, 2 and 3 which generate a voltage in response to the Hall-effect described above. Figure 7 also illustrates the display module **20**, sensors **14** which measure the brake stroke travel. Numeral 80 illustrates the multiplex transmitter module.

The multiplex system consists of a display module **20** and using the truck and trailer harness **80** or an add on stand alone truck and trailer harness. A sensor **14** as illustrated may be utilized with a multiplexing transmitter module **80** to transmit multiple signals from multiple axles. When the multiplex transmitter module **80** receives the signals from the sensors **14** the multiplex transmitter module encodes the multiple signals through one of the existing wiring harness conductors unto the display module **1**. The availability of spare conductors eliminates running extra wiring through tractor and trailer units. A stand alone wiring harness may be added to the tractor and trailer to connect module **80** to display module **20**.

Fig. 8 illustrates another embodiment of the invention illustrating the Hall-effect sensor **14** attached to a bracket **30** which in turn is attached to the brake housing **1**. More specifically the brake housing **1** defines the air application cylinder having the back plate **11** as shown in fig. 1 which in turn is connected to the push rod **3**. One end of the push rod **3** presents a Y-bolt or clevis **19**.

The bifurcated ends of the clevis **19** include aligned holes **21** as best seen in fig. 9. The clevis pin holes **21** are adapted to receive the clevis pin **22**. The clevis pin **22** as shown in fig. 9 illustrates the standard clevis pin **22** which is locked in place by means of a cotter pin **23**. The end of the standard clevis pin **22** opposite the cotter pin **23** has been modified and includes a magnetic clevis pin head **24** such as the one shown in fig. 10. A cotter pin **23** is used as a retaining device to prevent the clevis pin **22** from becoming dislodged from the Y-bolt or clevis **19**.

More particularly in one embodiment described herein the standard clevis pin **22** is removed and substituted by the magnetic clevis pin **25** as shown in figs. 10 and 11. The modified clevis pin **22** with clevis pin hole **26** includes a bore **27** which is drilled into the body of the clevis pin **22** as shown in fig. 11. The bore **27** is adapted to receive a rod **28** which can be comprised of a variety of materials including mild steel. In one embodiment the rod **28** is press fit into bore **27**. An insert **29** can be placed over the rod **28** as shown in fig. 11 as well as an outer sleeve **30** which can comprise of a variety of materials including aluminium. A clevis pin magnet **31** is received within the outer sleeve **30** as shown in fig. 1.

Generally speaking fig 11. illustrates a clevis pin **25** having one end thereof magnetized. The magnetized end **32** is opposite the clevis pin hole **26**.

Accordingly a magnetized clevis pin **25** is assembled within the clevis pin holes **21** as shown in figs. 8 and 9 and retained in place by means of the cotter pin **23**. The magnetized end **31** of the clevis pin **25** is disposed adjacent the sensor **14** in a manner to be more fully described herein.

Furthermore fig. 8 also illustrates the use of a bracket **40** which is attached to the brake housing **1** by fastening means **41** which consists of a nut and bolt.

Fig. 12 shows the mounting bracket **40** which can be used to mount the sensor **14** to a truck or trailer or the like. In particular the mounting bracket **40** comprises a first attachment portion **42** and a second sensor attachment arm **44**. The bracket **40** can comprise a one piece metal whereby the attachment **42** is disposed generally perpendicularly or at 90° to the attachment arm **44**. Moreover the attachment portion **42** includes an attachment slot **45** adapted to receive the fastening means **41** as shown in fig. 8. Furthermore the attachment slot **45** is generally elongated in the direction of the axis A as shown in fig. 12 so as to permit the bracket **40** to be adjusted along the slot in the direction A with respect to the fastening means **41** which defines a first degree of movement within the slot **45** along the direction of the axis A. More specifically the first attachment portion **42** is adapted to contact the cylinder end surface **46** as shown in fig. 8.

As mentioned above, the sensor attachment arm extends generally perpendicularly outwardly from the attachment portion **42**. In other words, the bracket **40** can be stamped from a single piece of mild steel and then bent along fold line **47** so that the first attachment portion **42** is at a generally perpendicular angle to the sensor attachment arm **44**. Furthermore the axis A of the first attachment portion **42** is disposed at an angle B from an horizontal plane as best seen in fig. 12. In other words, when the sensor arm **44** is disposed 90° to a flat surface (not shown) the edge **48** of the attachment portion **42** is at an angle B to the horizontal plane. Accordingly the bracket **40** may be rotated about the axis of the fastening means **41** in an arc represented by C as shown in fig. 8. This represents a second degree of movement of the bracket relative the clevis pin **22**.

Moreover the sensor attachment arm **44** also includes an attachment arm slot **49** as best shown in fig. 12. The slot **49** is disposed along an axis D as best shown in fig. 12 and represents a third degree of movement of the sensor **14** in a manner to be described herein.

Accordingly the bracket **40** provides an easy and efficient way of mounting the sensor **14** adjacent the magnetic clevis pin **25** by manipulating the bracket and sensor **14** relative the clevis pin along the four degrees of movement, namely, A, C, D and E.

One embodiment of the sensor is shown in figs. 12-15.

Specifically figs. 13-15 illustrate a Hall sensor although any variety of sensors can be utilized within the spirit of the invention and figs. 13-15 are for illustrative purposes only and should not limit the scope of the invention.

More specifically fig. 14 illustrates a PCB board **51** having a plurality of Hall switches **52**. In particular there are six Hall switches **52** shown in fig. 14 which are spaced apart as illustrated on the PCB board **51**. Furthermore a magnetic flux plate **53** is also shown whereby the magnetic flux plate **53** is brought together with the PCB board **51** so as to fit within the interior chamber **54** defined by the mating of the upper sensor board plastic insert **55** with the lower sensor board plastic insert **56** as best seen in fig. 14. Once the inserts **55** and **56** are mated, they are adapted to fit within the interior confines **57** of the sensor housing **58**. The sensor housing **58** includes a sensor starting point mark **59**.

The sensor housing **58** also includes a fastening plate **60** to attach the sensor **14** to the bracket **40** as best illustrated in fig. 12.

The fastening plate **60** includes hex-head slots **61** adapted to receive the heads **62** of hex-bolt **63**. Hex-head slots **61** provide a fourth axis of movement to pitch the sensor at an angle to maximize the magnetic field strength in relationship to E.

Figure 12 also illustrates the use of visual brake stroke indicating means **65** which consists of visual indicating bracket **66** having two spaced indicating fingers **67** and **68**. The visual indicating bracket **66** also includes a mounting bracket **69** having two spaced slots **70** adapted to receive the ends of the bolts **63**. More specifically the bolts **63** are adapted to be received by the slots **70** and attachment arm slot **49** and are fastened thereto by means of washers **71** and nuts **72**. Accordingly the sensor **14** may be moved relative the sensor arm **44** by loosening the nuts **72** and moving the assembly along the arm **44** along the direction D until the magnetic clevis **25** lines up with sensor starting mark **59**.

Figure 16 illustrates generally the slack adjuster **75** which automatically adjusts for brake wear in a manner well known to those persons skilled in the art. Generally speaking fig. 16 shows the slack adjuster **75** moving in the forward rotation **76** and reverse rotation **77**.

The sensor **14** is assembled close to the magnetic clevis pin **25** by adjusting the bracket **40** with the four axis of movement, namely, A, C, D and E so that the magnetic tip of the clevis **31** is adjacent the sensor starting point mark **59**. As the brake is activated the back plate **11** moves as described causing the clevis pin **3** to move outwardly so as to move the magnetic tip of the clevis pin from the sensor start point **59** as shown in fig. 16 along the travel path **78** of the clevis pin **25**. The indicating finger **68** will visually show the starting point **59** of an unactivated brake. Once the brake is activated the push rod **3** moves outwardly in a direction **78** towards the second indicating finger **67**. The distance between the indicating fingers **67** and **68** represent the safe brake stroke travel. Once the magnetic clevis pin **59** travels past the indicating finger **67**, the brake stroke travelling limit has been reached or exceeded the maximum recommended limits.

Also as shown in fig. 16, the tip of the magnetic clevis **25** tends to move in an arc represented by dash line E. The sensor **14** may be optimally adjusted (so the travel path of the arc E will be within the region of the face of the sensor) by loosening the nuts **72** and rotating the sensor **14** as well as the visual indicating brackets **66** relative the sensor attachment arm **44**. In other words, the sensor **14** as well as the visual indicating bracket **66** may be pitched or tilted slightly relative the sensor attachment arm **44** so that the influence of the magnetic tip of the clevis **25** optimally falls within the range of the sensor **14**. This represents a fourth axis of movement

Figure 9 illustrates that in some circumstances a clamp on magnetic indicator pin **79** may be utilized instead of the magnetic clevis pin shown in figs. 10 and 11 depending on the configuration of the truck or trailer or the like. In the arrangement shown in fig. 9, a standard clevis pin **22** is utilized and in addition a clamp on magnetic clevis pin **79** can be used. The magnetic clamp on indicator pin **79** consists of a top part clamp clevis **15** and a bottom part clamp clevis **17** which are attached unto a clevis push rod **3** by means of fasteners **13**. The magnetic clamp on indicator pin **79** also includes a magnet **84,** which would then be oriented as described above so that the tip of the magnet is next adjacent, the mark **59**.

As the magnetic tip **31** of the clevis pin **25** moves from the starting mark **59** in the direction of travel **78**, the magnetic clevis pin **25** generates a magnetic field which sequentially turns on the Hall sensors **52**. More specifically by viewing fig. 14 the magnetic flux of the magnet **31** will first influence Hall sensor **52a** and then Hall sensor **52b** and so on until the magnet **31** finally influences Hall sensor **52f**. In one embodiment the magnet **31** can influence up to three Hall switches **52** at a time. Such Hall switches can be unipolar or bipolar. Although fig. 14 illustrates the use of six Hall switches **52**, any number of switches can be used within the spirit of the invention.

Each Hall switch **52** can have certain voltages associated therewith when influenced by the magnet **31**. For example, the following Hall switches may have the following voltages associated therewith:

Switches	Single Hall Voltage
52a	0.8 volts
52b	1.6 volts
52c	2.4 volts
52d	3.2 volts
52e	4.00 volts
52f	4.55 volts

As the magnet **31** sequentially moves past each of the Hall sensor **52** a signal **81** is generated in wire **82** depending on the movement of the magnet **31**. For example, once the magnet **31** moves from Hall switch **52a** to Hall switch **52b** a differential or summation voltage (i.e. Hall Trigger Reference Voltage) may be generated which for example may represent 0.6 volts thus representing that the clevis pin has moved a distance from the starting mark **59** next adjacent the Hall switch **52b**. Fig. 26 is a table showing other examples of the Hall Trigger Sequence Reference Voltage and associated display **20** colours to be described. Therefore such signal would represent movement of the back plate **11** and its corresponding brake wear value. Any combination of Hall switches **52** and voltage values may be selected within the spirit of this invention.

As seen in fig. 7 each wheel axle **90** includes two brake cylinder assemblies as shown in fig. 8, namely, one on the left wheel sides L and one on the right wheel sides R. Generally speaking a single airbrake cylinder assembly as shown in fig. 8 will be utilized on the left side L and a single air brake cylinder assembly utilized on the right side R of an axle.

Fig. 17a is a representative view of a display which can be located within the cabin of a truck or the like or mounted on the under side of a trailer or the like. The display **20** shows four axles **90**, the first axle group showing left air cylinder 1L and right air cylinder 1R. The second axle is represented by left air cylinder 2L and right air cylinder 2R with the third axle **90** showing the left air brake cylinder assembly 3L and right air brake cylinder 3R. Finally display **20** also shows the fourth axle and the air brake cylinder 4L and right air brake cylinder 4R. A maximum of four axles can be shown in display **20**.

Each of the air brake cylinder assemblies as shown in fig. 12 can be hard wired and connected to a multiplex transmitter module **80**. In other words, the wires **82** from the sensors **14** are gathered to a multiplex transmitter module **80** as shown in fig. 18.

Fig. 25 illustrates the multiplexing of signals from the left and right sensors **14** associated with air brake cylinder assemblies as seen in fig. 12 from each of the axles **90** representing the display in fig. 17. The multiplex transmitter module **80** includes a computer chip **83** which is programmed to represent brake stroke travel as well as the various conditions to be described herein by generating signals **81** under the influence of the magnet **31** which influence the Hall switches **52** and the generation of the associated voltage values as for example shown in fig. 25. The multiplex unit **80** then generates in the hard wire version illustrated in fig. 7 a plurality of signals travelling through the wiring harness **50** connected to the display **20**. The multiplex transmitter module **80** can also include a connector **120** to connect a number of multiplex modules **80** in series.

Alternatively a wireless multiplex system as shown in fig. 6 may be utilized as described previously.

Alternatively a four axle hardwired (non multiplex) system may be utilized to provide connection to display 20.

Fig. 17 shows that the display **20** can monitor up to 12 axles by utilizing the toggle **94** so as to first light up the 1-4 vehicle axle status which generally illustrates the monitoring of the display **20** of a truck TR. By toggling once again the vehicle axle status of 5-8 lights up which represents a first trailer TL1. By toggling again vehicle axle status 9-12 lights up which represents a second trailer TL2. Therefore if one turns to fig. 7 the display **20** would have a TR which would monitor the three truck axles while the display **20** would also monitor the trailer axles TL.

The display **20** also displays the brake wear gauge represented by LED displays **100, 102, 104, 106,** and **108**. In particular the first LED **100, 102** and **103** can be configured so as to successively display green lights which represent progressive travel of the magnetic clevis pin **25** relative the sensor **14** in the manner described herein and shown in fig. 26. For example the first LED display

100 could represent 1/8th of an inch of travel while the second LED display **102** would successfully light up after a further 1/8th of an inch of travel and finally LED display **104** could light up after a total of 3/8 of an inch of travel. LED display **106** could be configured so as to light up a yellow signal representing to the driver that the brake wear is successively deteoriating while the LED **108** could light up red to show that the maximum brake wear has been reached. The toggle **94** can be utilized to toggle through successively each of the air brake cylinder 1L, 1R, 2L, 2R, 3L, 3R, 4L and 4R.

Furthermore the LR or RR LED display will automatically light up once a yellow or red status of the brake wear **106, 108** has been reached.

Display **20** also includes an alignment fault signal AF and a sensor fault signal SF.

Fig. 18 shows that the truck display TR is green and the wheel end status LED's are also green which represents that the foot brake is on and all air brake cylinders are working properly.

Fig. 19 shows that the truck TR shines yellow and that the first left air cylinder 1L also shines yellow whereas the remaining left and right L and R air brake cylinders are shining green. This represents that the foot brake is on and that the first left air brake cylinder is close to the maximum brake wear allowed such as for example 1/8th of an inch remaining.

Fig. 20 shows that the TR is red and that 1L is red with the remaining left and right air brake cylinders are green. This display illustrates that the foot brake is on and that the first left air brake cylinder has brake wear at the maximum allowable position. Brake replacement is required.

Fig. 21 shows that the truck TR has a flashing red light with the fourth left air brake cylinder also flashing red, with the remaining brake cylinders LR showing green. This display illustrates that the foot brake is on and that the fourth left air brake cylinder did not activate. The system described herein is capable of diagnosing non-activated air brake cylinders through the computer chip **83** since the required voltage changes have not taken place because the magnetic clevis pin has not travelled past the sensor **14**.

Fig. 22 illustrates that the truck TR has a yellow flashing signal and that the sensor fault SF is also flashing yellow along with a flashing yellow light at position 1R. All remaining air brake cylinders LR remain green. The display shown in fig. 22 shows that the foot brake is on and that the first right sensor **14** is faulty. Since the proper voltage sequences of the magnetic tip **31** travelling past the Hall switches **52** were not experienced.

Fig. 23 next shows that the truck TR has a flashing green along with an alignment fault AF showing a flashing green. The fourth right LED is also showing a green flashing light. All other sensors or air brake cylinders LR show a normal green light. This represents that the foot brake is on and that the fourth right sensor is out of alignment with the magnetic tip **31** of the clevis pin **25**. Again this is accomplished through the use of the computer chip **83** and the program logic therein.

Fig. 24 next shows a truck TR showing a flashing red light with a sensor fault SF showing a yellow flashing light and an alignment fault AF showing a green flashing light. Furthermore fig. 24 shows a red flashing light at position 4L with a green flashing light at position 4R. Position 1L shows a yellow flashing light, position 2L shows a yellow steady light, position 4L shows a red flashing light and position 4R shows a green flashing light with a normal green steady light at position 3L, 1R, 2R and 3R. The display shown in fig. 24 illustrates that the foot brake is on, the first left sensor 4 is faulty, the second left air brake cylinder is 1/8th of an inch away from maximum, that the fourth left sensor did not activate and the fourth right air brake cylinder is out of alignment. Generally speaking the computer chip **83** is programmed that if the multiplex unit **80** does not receive the right voltage this could represent that the sensor is faulty. Furthermore the computer chip **83** may be programmed so as to recognize when the sensor **14** is out of alignment with the magnetic tip **31** of the clevis pin.

Furthermore if debris hits the sensor **14** or if the magnet **31** is not present, the Hall switches **52** are selected to generate a specific voltage, which the system recognizes.

If the sensor **14** is out of alignment, the correct sequence of voltages are not experienced which the system recognizes.

The display **20** can be toggled for memory recall. For example if the toggle **94** is toggled up the memory is recalled to the last full reading. By manipulating the toggle **94** down one can toggle down to each of the wheels individually. Furthermore by toggling down to each of the individual wheels, if no light is present this means that there is no power.

Furthermore the data can be logged so as to store up to 16,000 exception reports which represent fault conditions. The display **20** can use a RF232 output so as to download brake activities into a computer.

Various embodiments of the invention have now been described in detail. Since changes in and/or additions to the above-described best mode may be made without departing from the nature, spirit or scope of the invention, the invention is not to be limited to said details. For example although radar generating and receiving means have been described in relation to electromagnetic generating means other means such as light, radio frequency or microwave apparatus may be used.

WHAT IS CLAIMED IS:

1. A sensor for attachment to a brake chamber having a moveable push rod comprising: (a) a sensor housing comprising: (i) a magnetic flux plate; (ii) a PCB board having a plurality of spaced apart Hall switches; (b) a bracket connecting said sensor housing to said brake chamber comprising: (i) an attachment portion; (ii) an attachment arm connected to said attachment portion at a substantially perpendicular angle relative said attachment portion in a first reference plane and at an acute angle at a second reference plane; (iii) said attachment portion and attachment arm each including a slot; (iv) said attachment portion slot adapted for connection to said brake chamber; (v) said attachment arm slot adapted to receive said sensor housing; (c) a magnet connected to said moveable push rod wherein said magnet comprises a magnetic clevis pin for displaceable movement relative to said sensor housing, whereby said POB board disposed between said magnetic flux plate and said magnetic clevis pin generates a signal in response to said magnetic clevis pin for measuring the brake condition of a vehicle.

2. A sensor as claimed in claim 1 wherein said bracket includes three degrees of adjustment.

3. A sensor as claimed in claim 2 wherein each said sensor generates a signal to a display by means of a wire.

4. A sensor as claimed in claim 3 wherein said vehicle includes a sensor for each wheel having a brake chamber and said signals for each said sensor are multiplexed in a module.

5. A sensor as claimed in claim 4 wherein said signal is delivered by said multiplex module to said display.

6. A sensor as claimed in claim 2 wherein each said sensor generates a wireless signal to a display.

7. A sensor as claimed in claim 6 further including a visual indicating bracket associated with said sensor, said visual indicating bracket attached to said attachment arm.

8. A sensor as claimed in claim 7 wherein said magnetic clevis pin moves along an arc spaced from and adjacent to said sensor housing, and between said visual indicating bracket.

9. A sensor as claimed in claim 8 wherein said magnetic clevis pin successively influences each said plurality of spaced Hall switches to generate a plurality of signals respectively.

10. A sensor as claimed in claim 9 wherein each said Hall switch has a generated voltage associated therewith when influenced by said magnetic clevis pin.

11. A sensor as claimed in claim 10 wherein said display includes a representation of each said brake chamber on said vehicle.

12. A sensor as claimed in claim 11 wherein said multiplex module includes a computer chip programmed to represent brake stroke travel, when said signals are received by said multiplex module and delivered to said display.

13. A sensor as claimed in claim 1 wherein said sensor is capable of being tilted relative said bracket to optimize the influence of said magnet relative to said plurality of sensors.

14. A sensor for attachment to a brake chamber having a moveable push rod comprising: (a) a sensor having a plurality of Hall switches; (b) a bracket for attachment to said brake chamber comprising: (i) an attachment portion; (ii) an attachment arm connected to said attachment portion at a substantially

perpendicular angle relative said attachment portion in a first reference plane and at an acute angle at a second reference plane; (iii) said attachment portion and attachment arm each including a slot; (iv) said attachment portion slot adapted for connection to said brake chamber; (v) said attachment arm slot adapted to receive said sensor housing; (c) a magnet clevis pin attached to said push rod and spaced from said sensor housing for traversing said Hal switches and generating a signal in response to movement of said magnetic clevis pin relative to said switches to measure a brake condition of a vehicle.

15. A sensor for measuring the displacement of a reference within a brake housing so as to indicate a brake stroke condition on a visual braking system comprising:

a. said brake housing including two spaced walls, and said reference comprising a push rod back plate moveable between such spaced walls

b. a Hall-effect radiometric sensor generating a signal in response to linear displacement of the push rod plate

c. a first housing secured to said one spaced wall, said first housing including a ratiometric sensor

d. a second moveable housing containing a magnet

e. said first and second housing connected to a weak spring

f. a strong spring connected to said second moveable housing and said push rod back plate

so as to generate a signal in response to cylinder displacement of the push rod back plate.

FIG 1

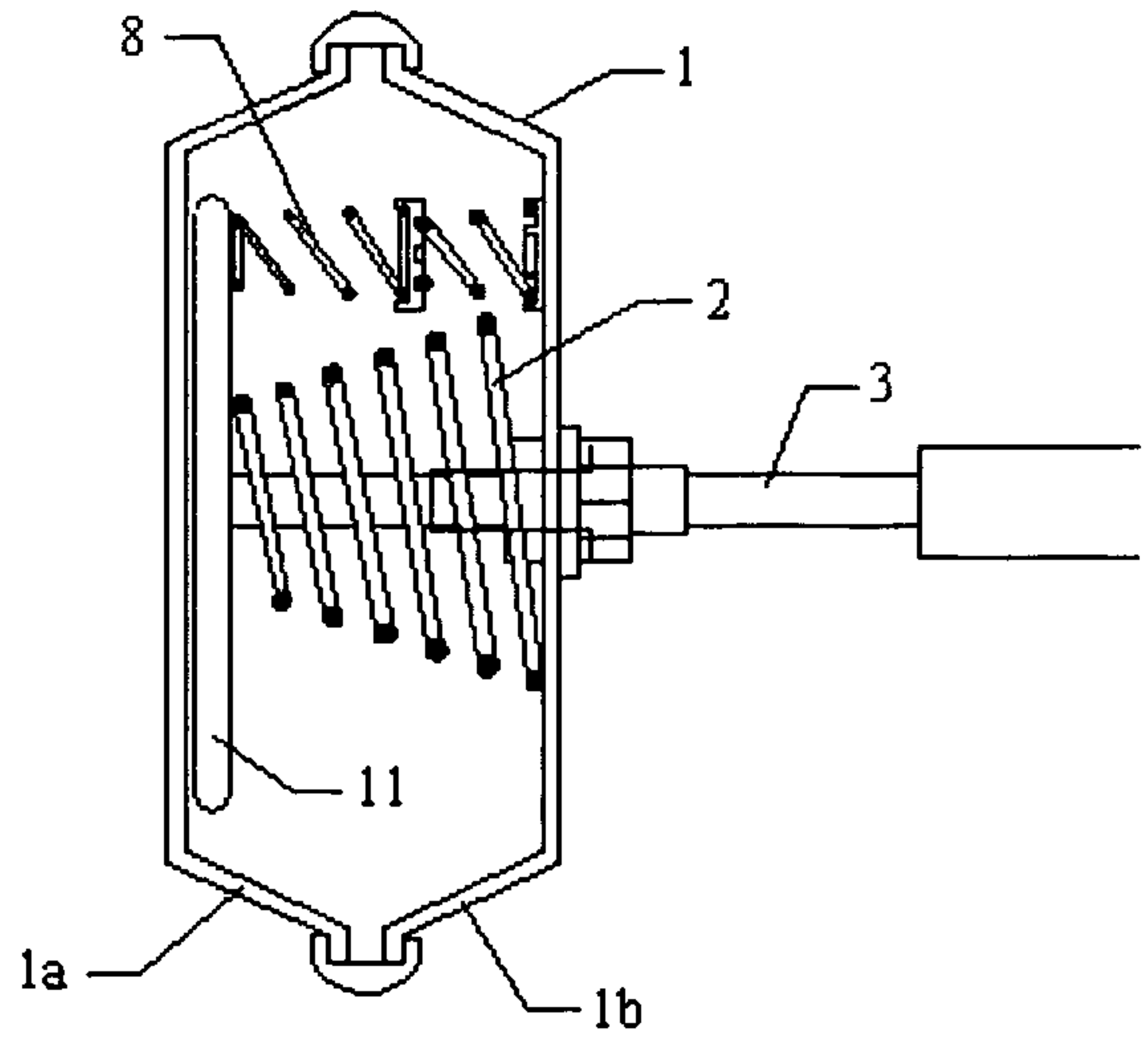


FIG 3

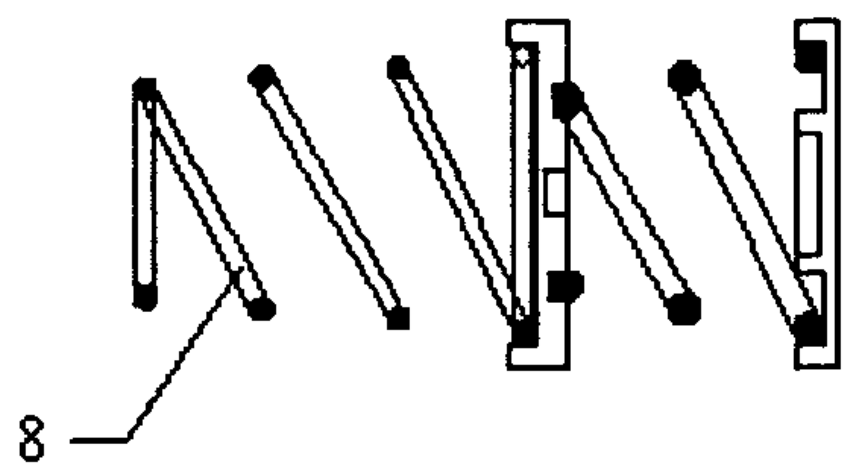
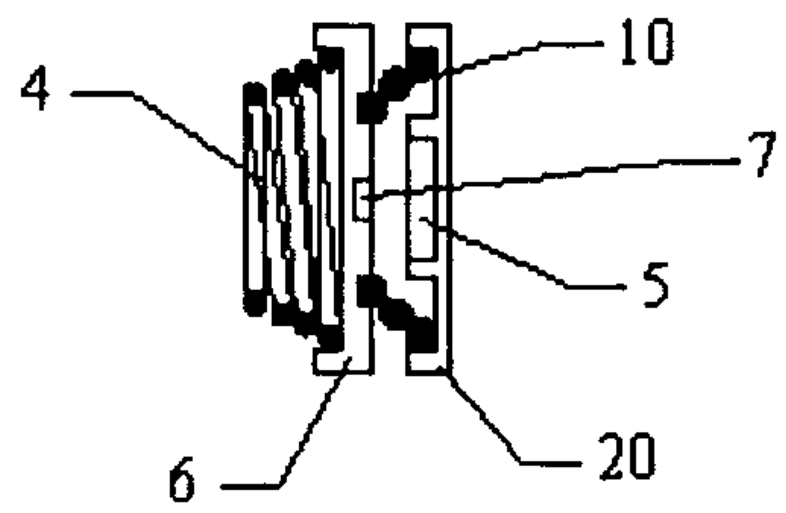


FIG 2



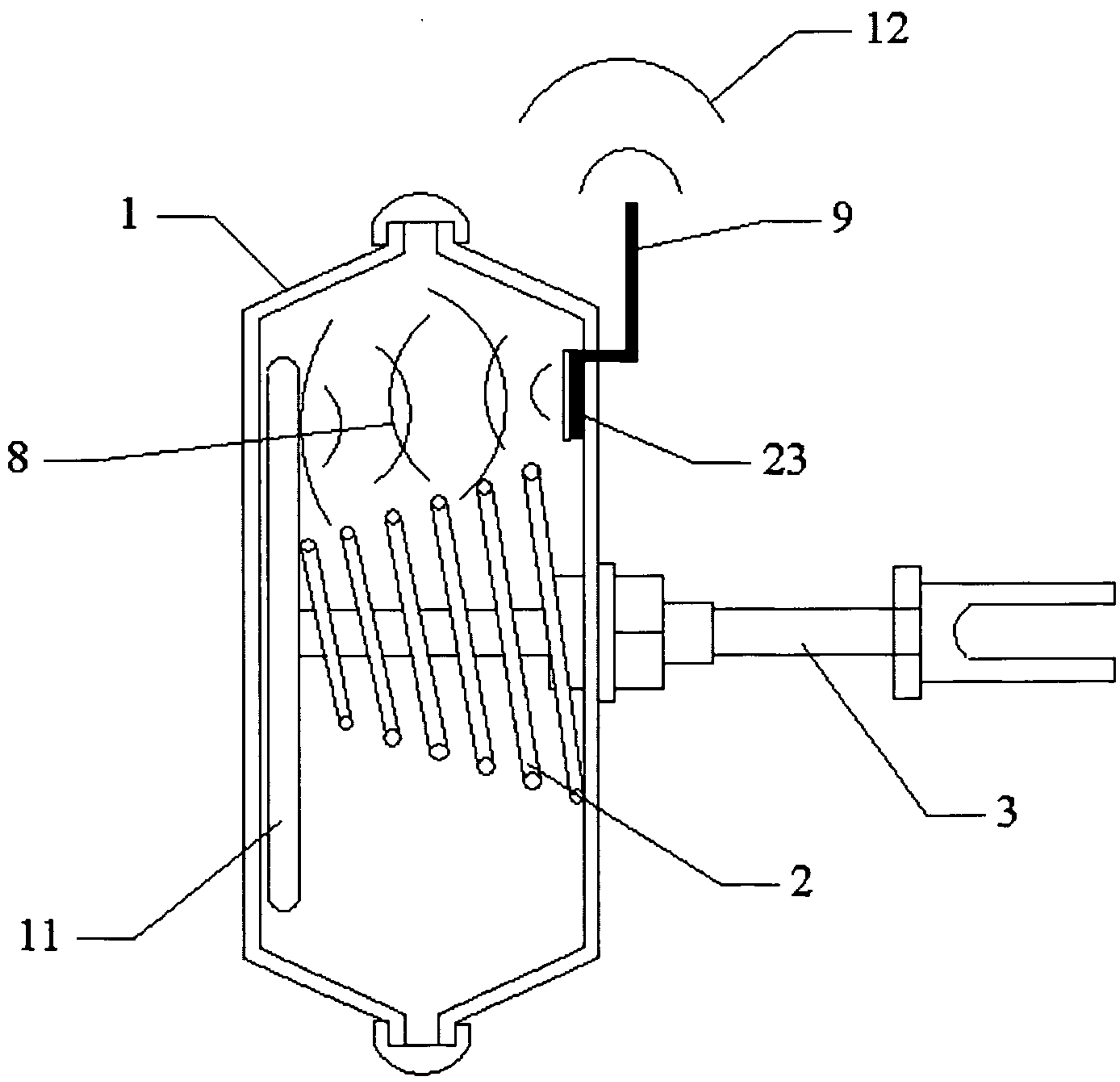


FIG 4

FIG 5

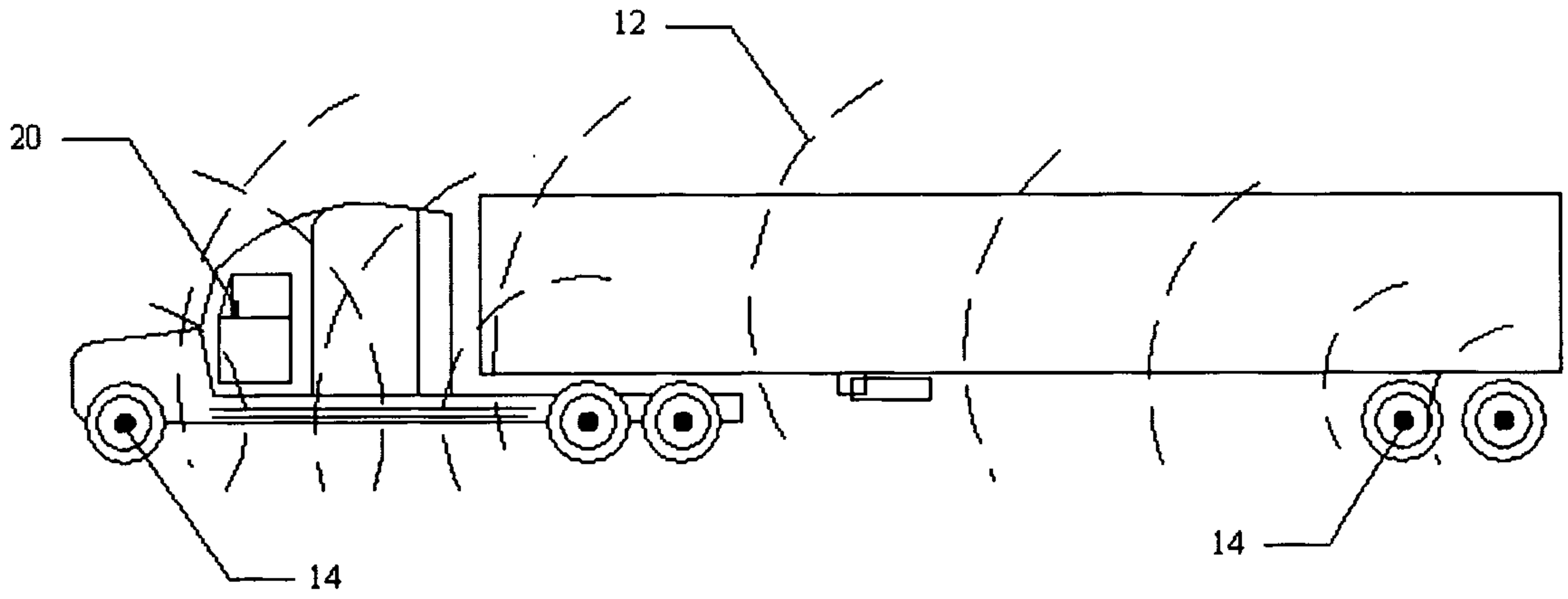


FIG 6

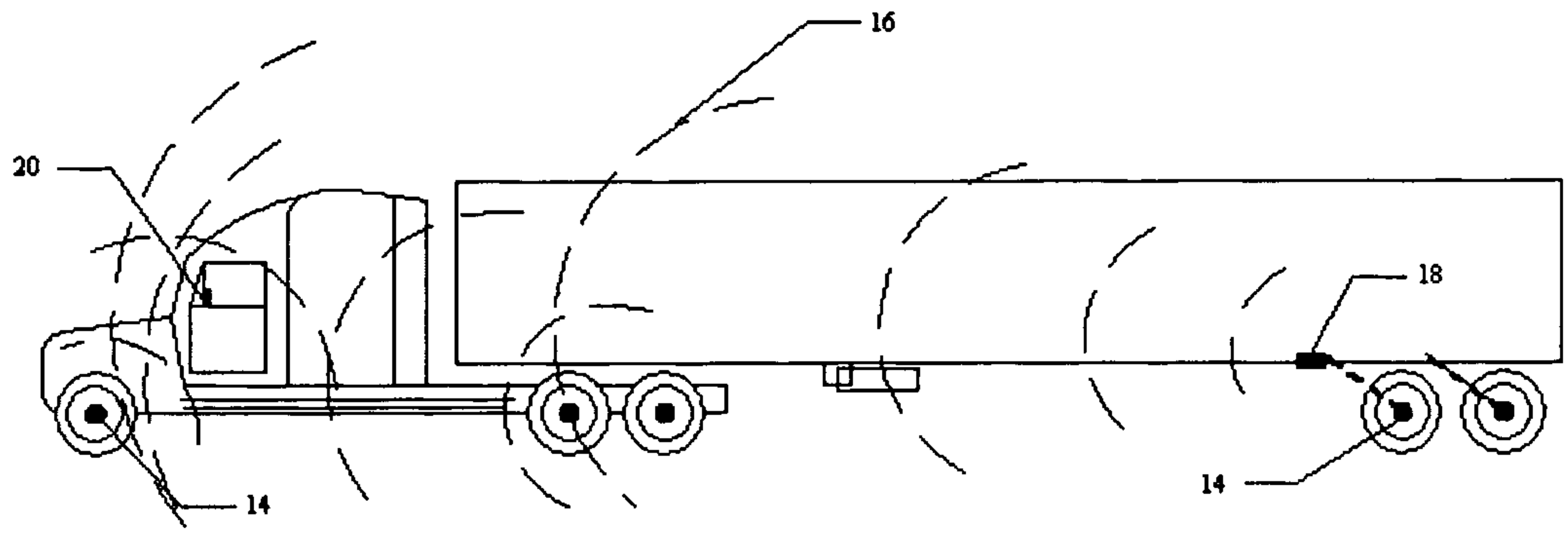
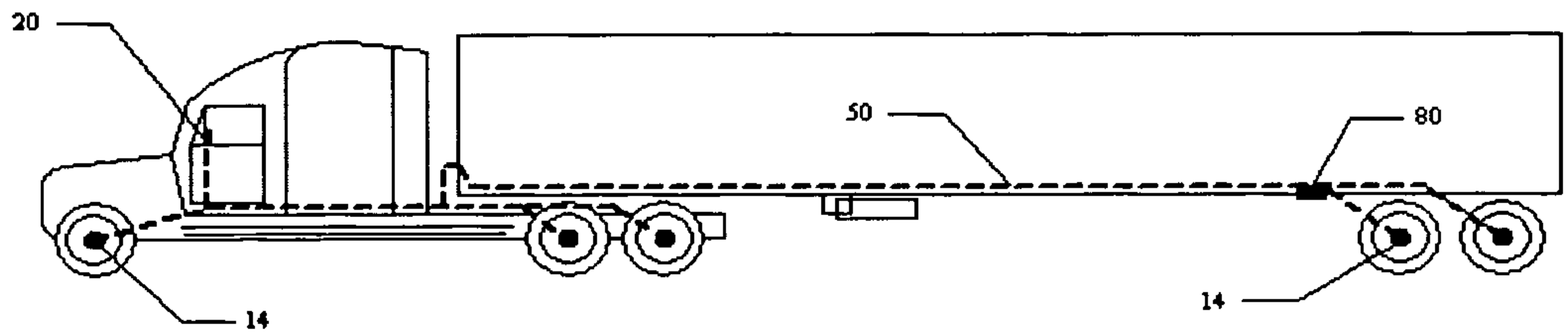


FIG 7



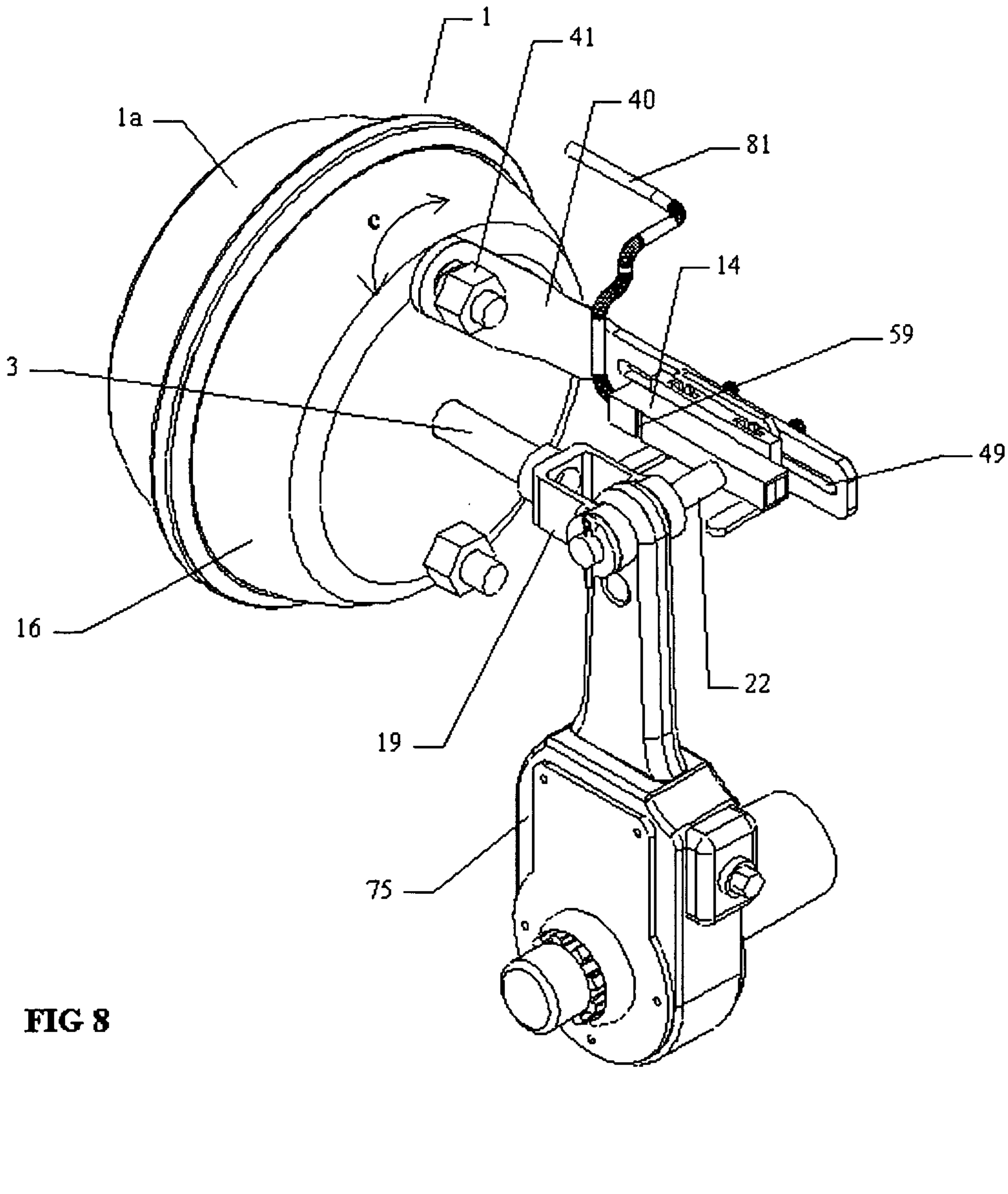


FIG 8

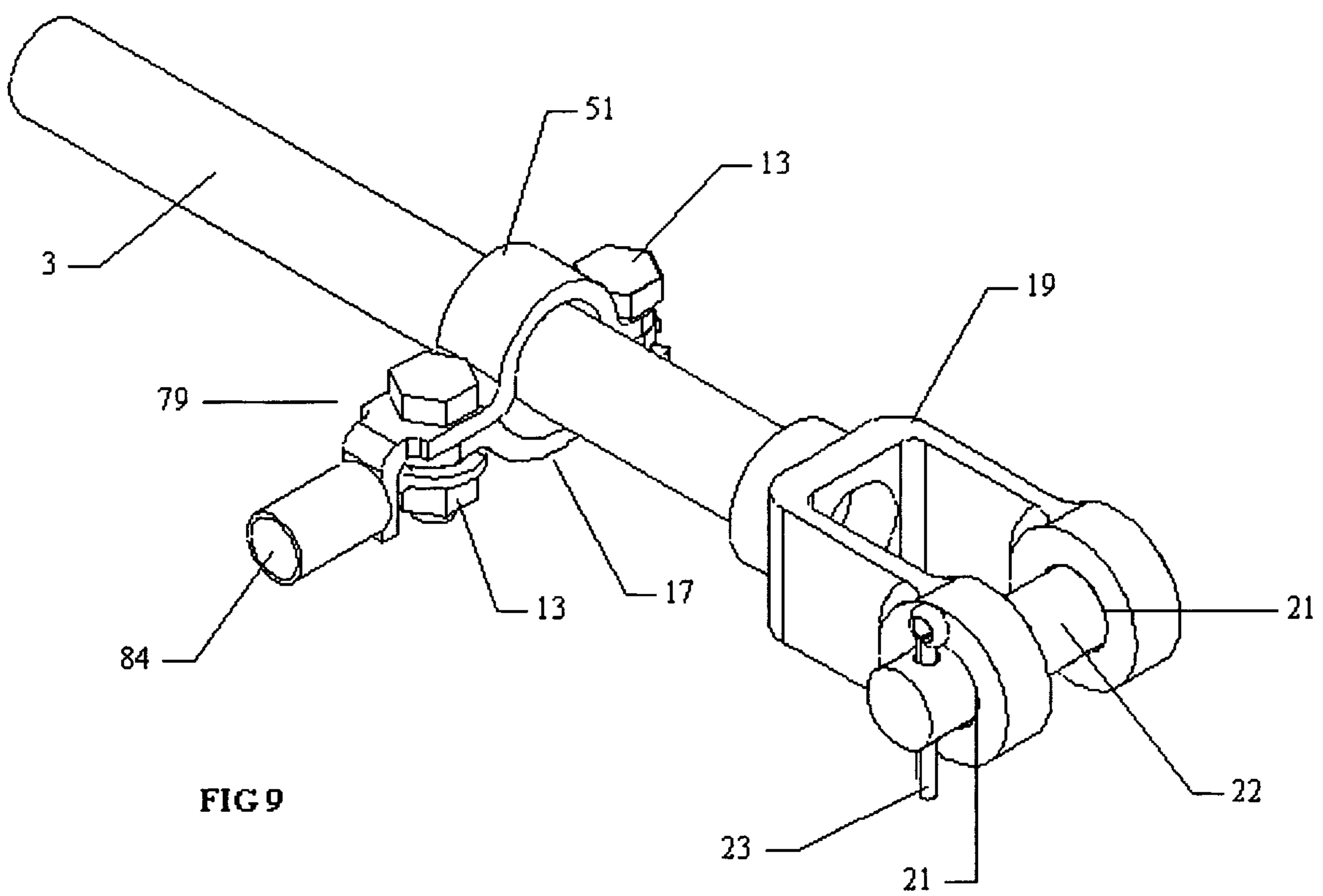


FIG 9

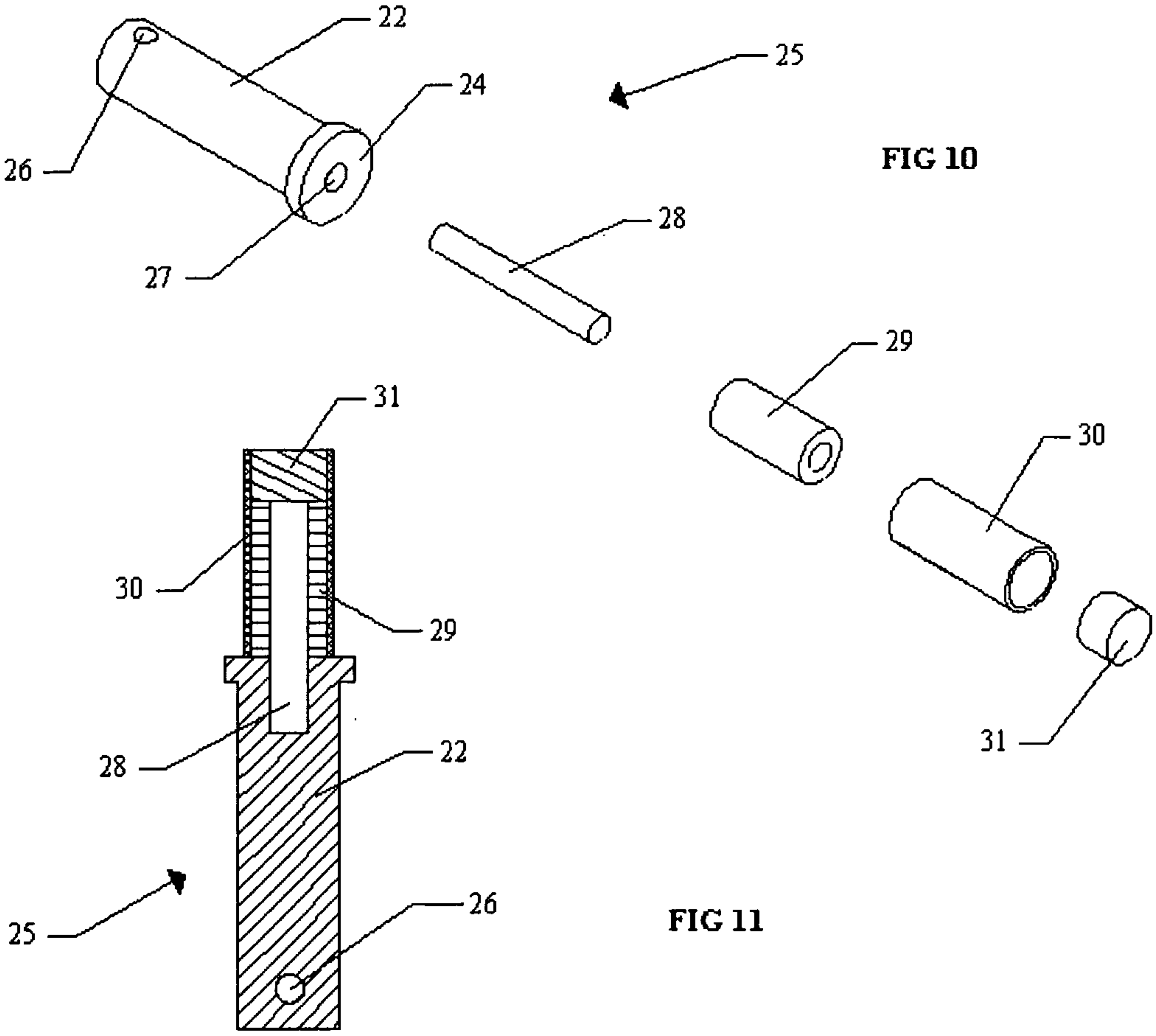


FIG 10

FIG 11

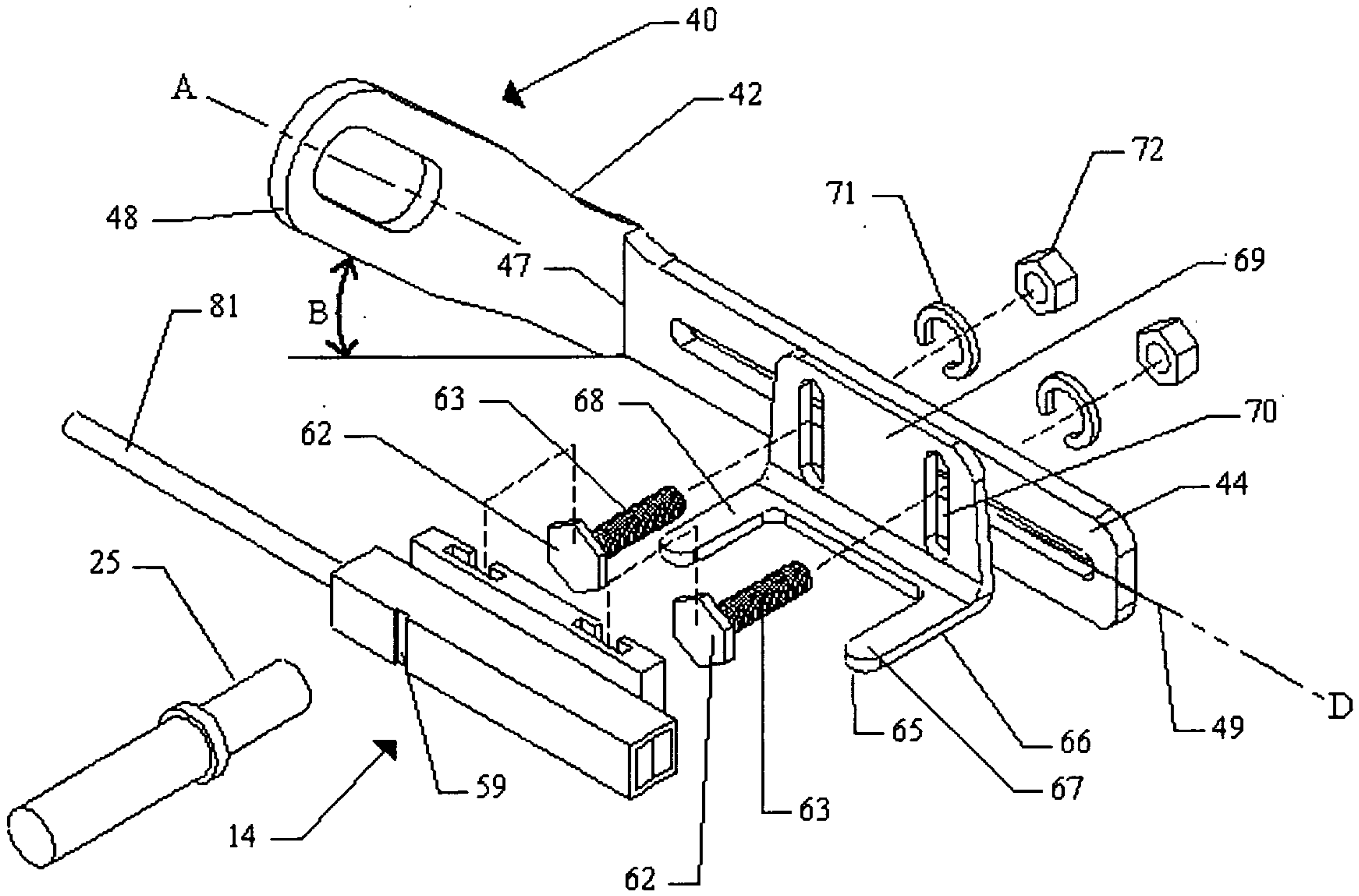


FIG 12

FIG 13

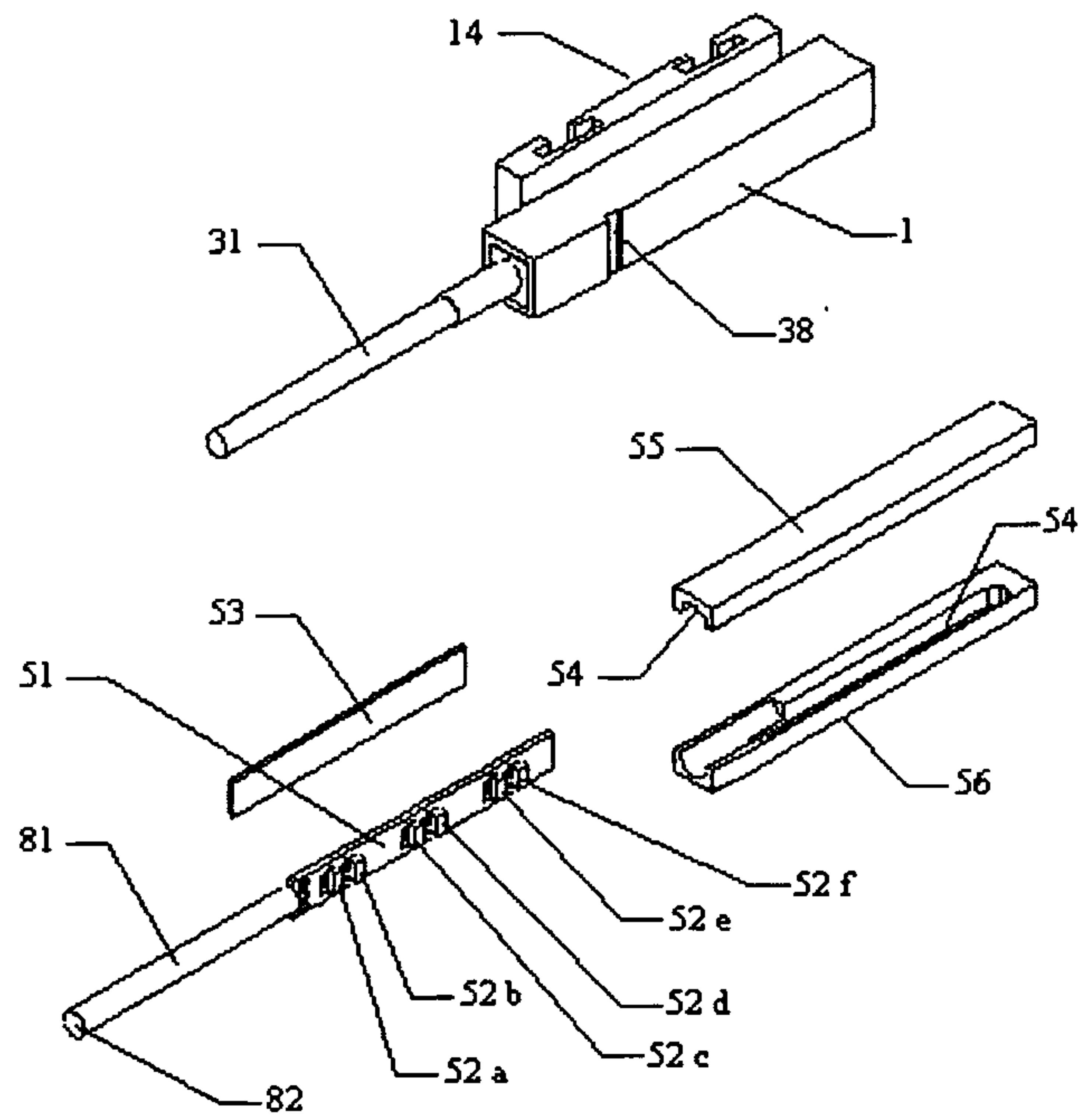


FIG 14

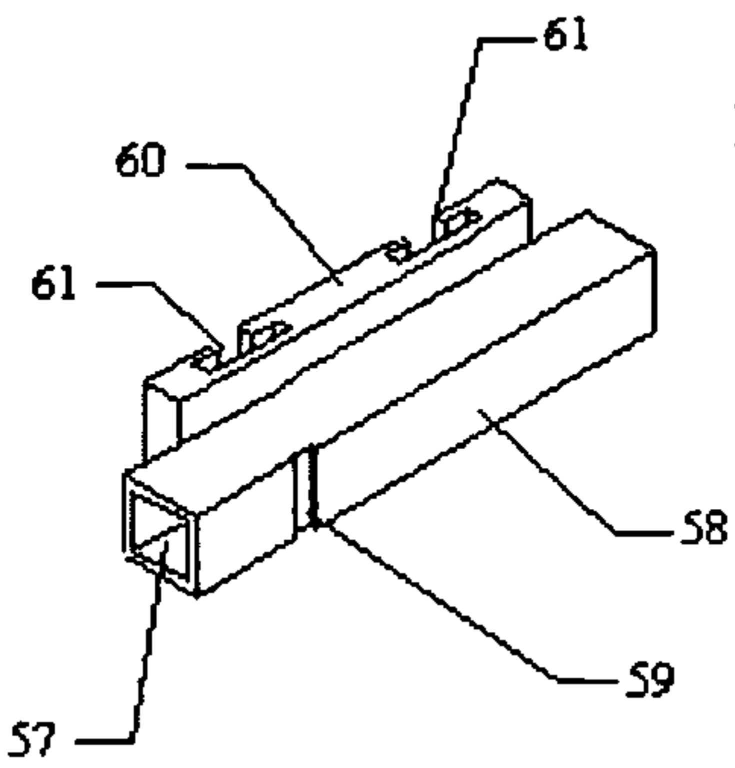
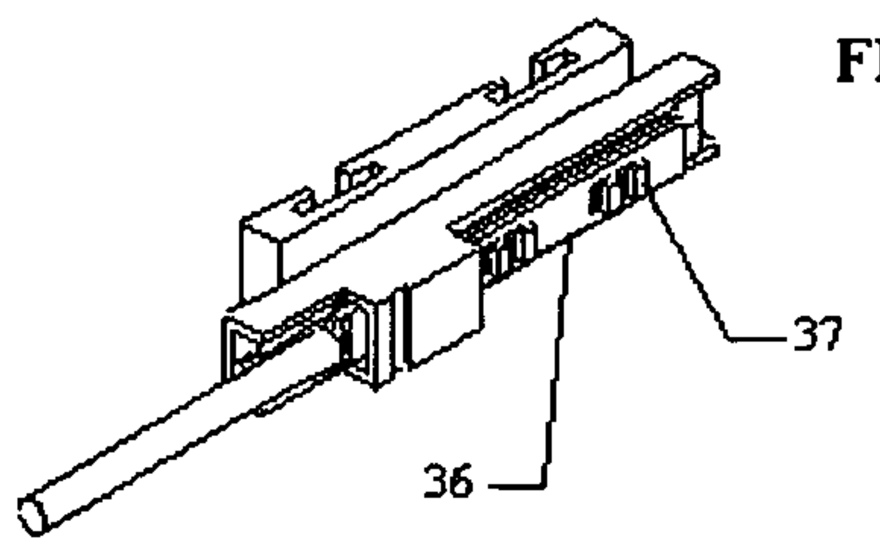


FIG 15



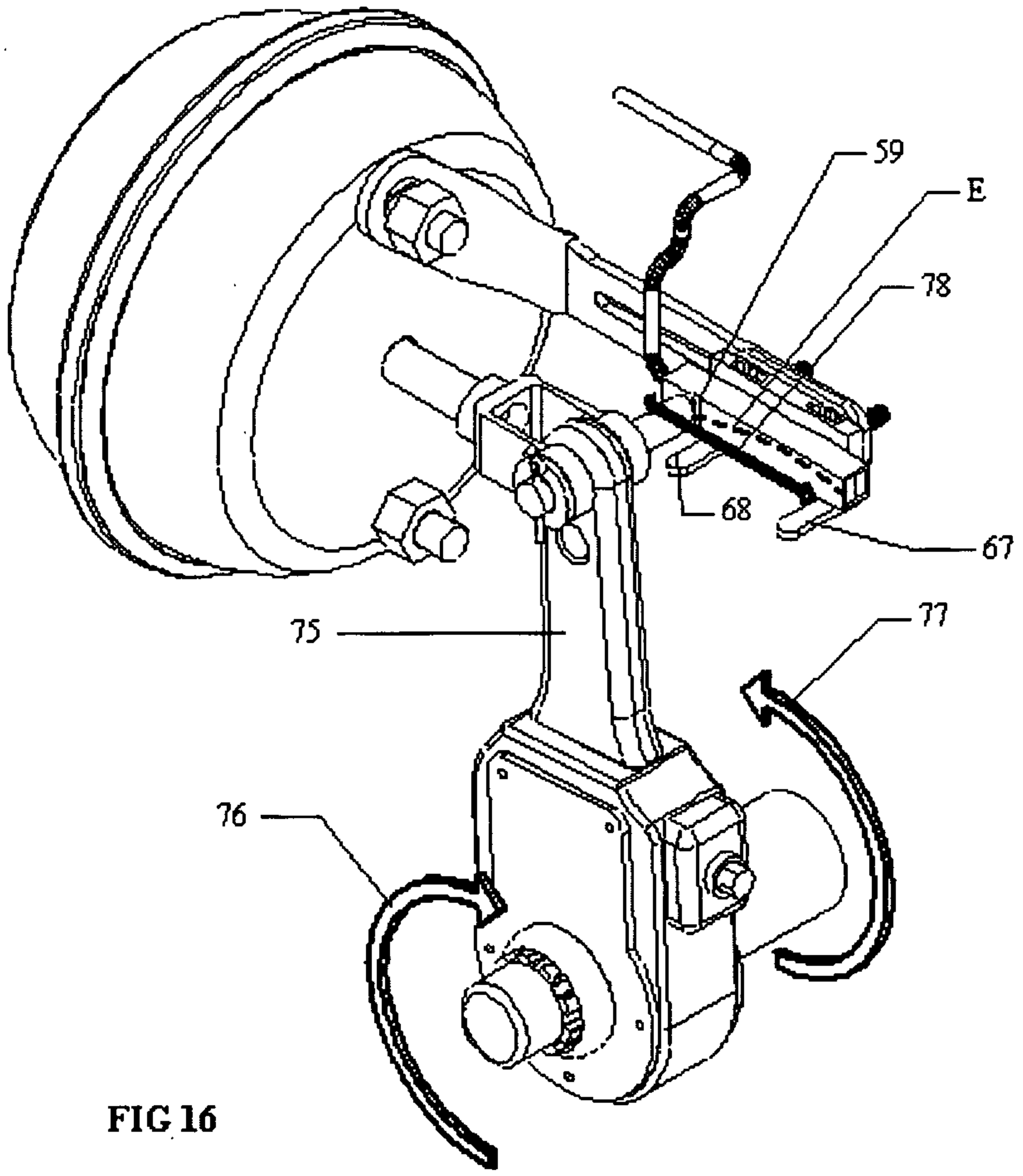


FIG 16

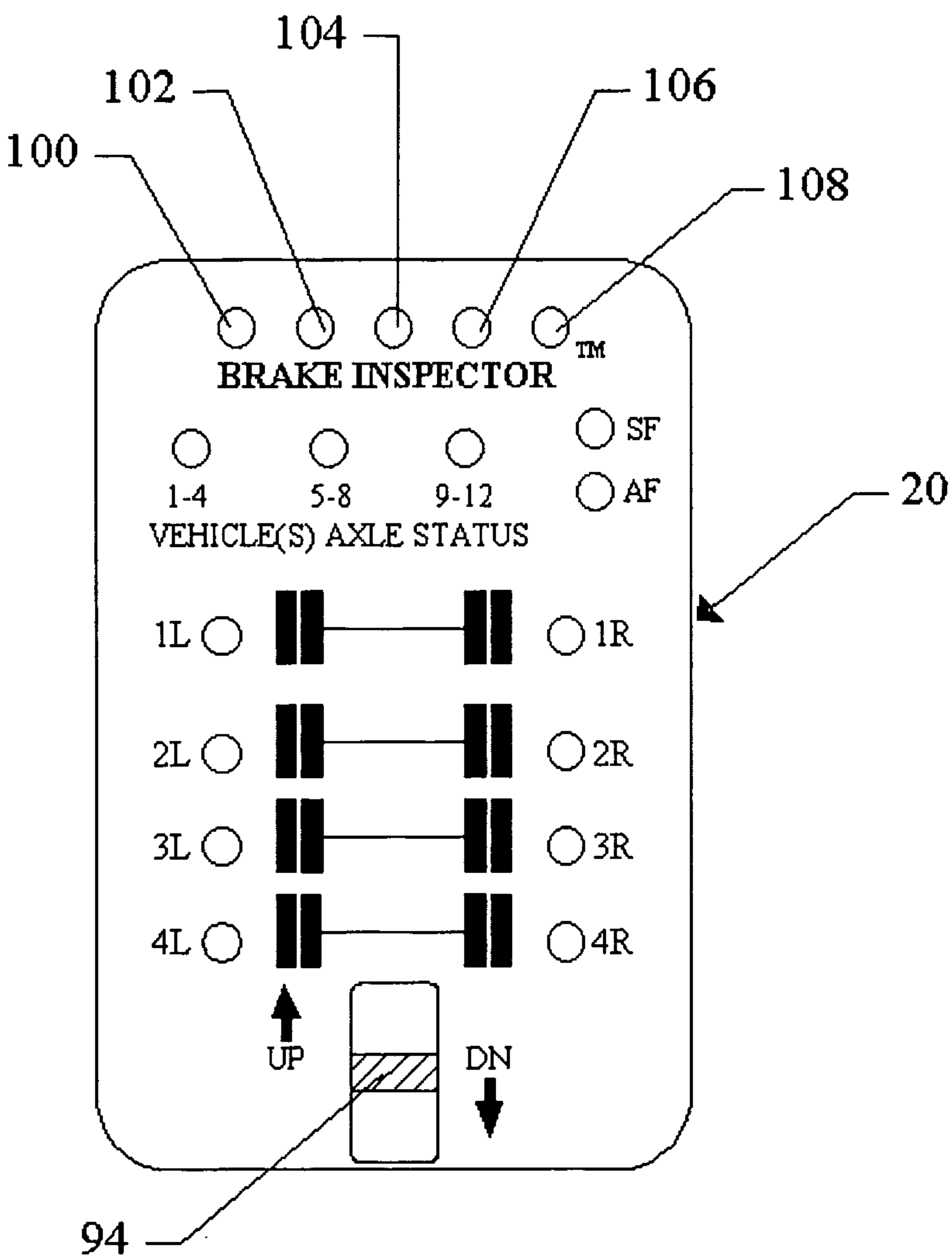

104
102
106
100
108
BRAKE INSPECTOR TM
SF
AF
1-4
5-8
9-12
20
VEHICLE(S) AXLE STATUS
1L
1R
2L
2R
3L
3R
4L
4R
UP
DN
94

FIG 17

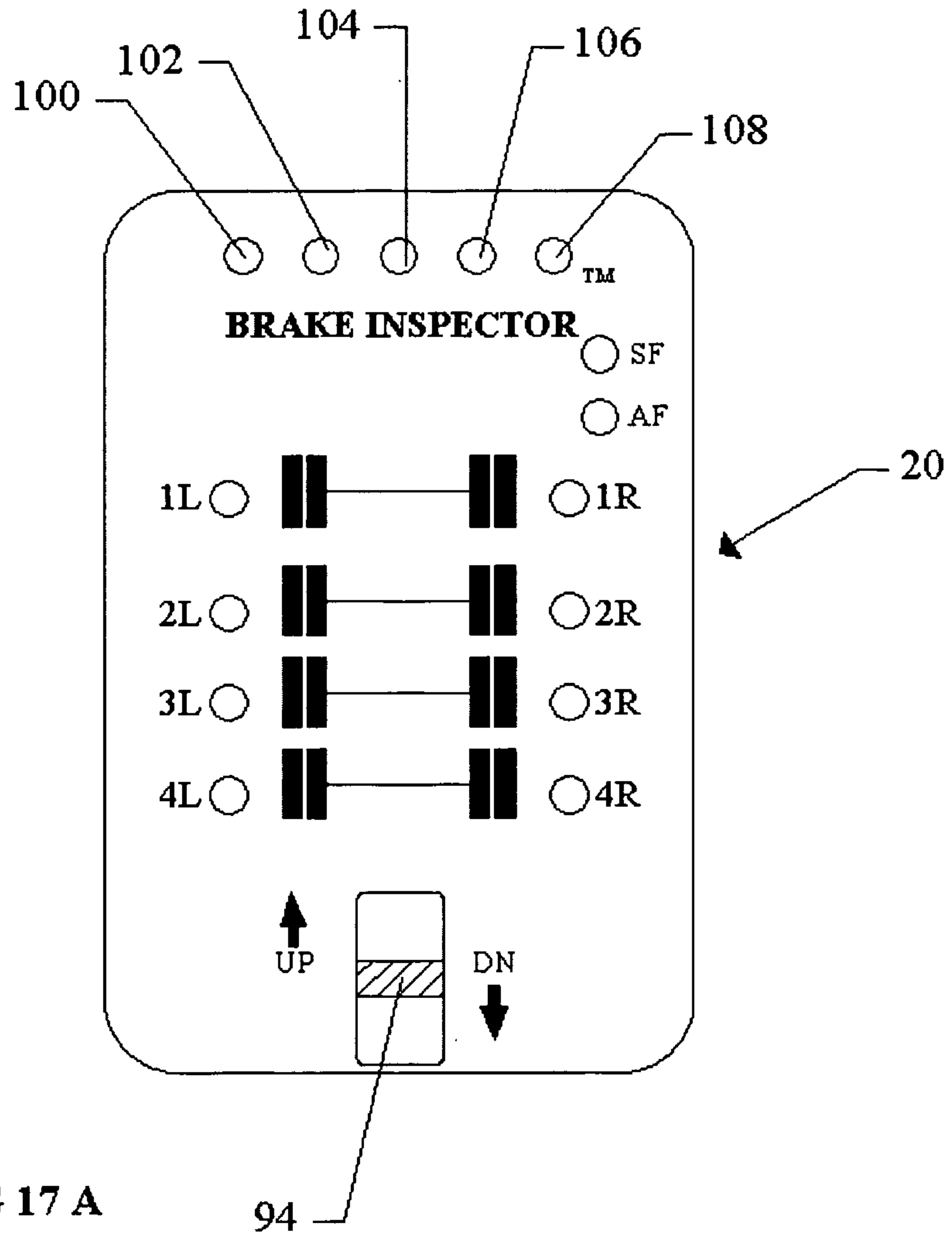

100
102
104
106
108
TM
BRAKE INSPECTOR
SF
AF
20
1L
1R
2L
2R
3L
3R
4L
4R
UP
DN
94

FIG 17 A

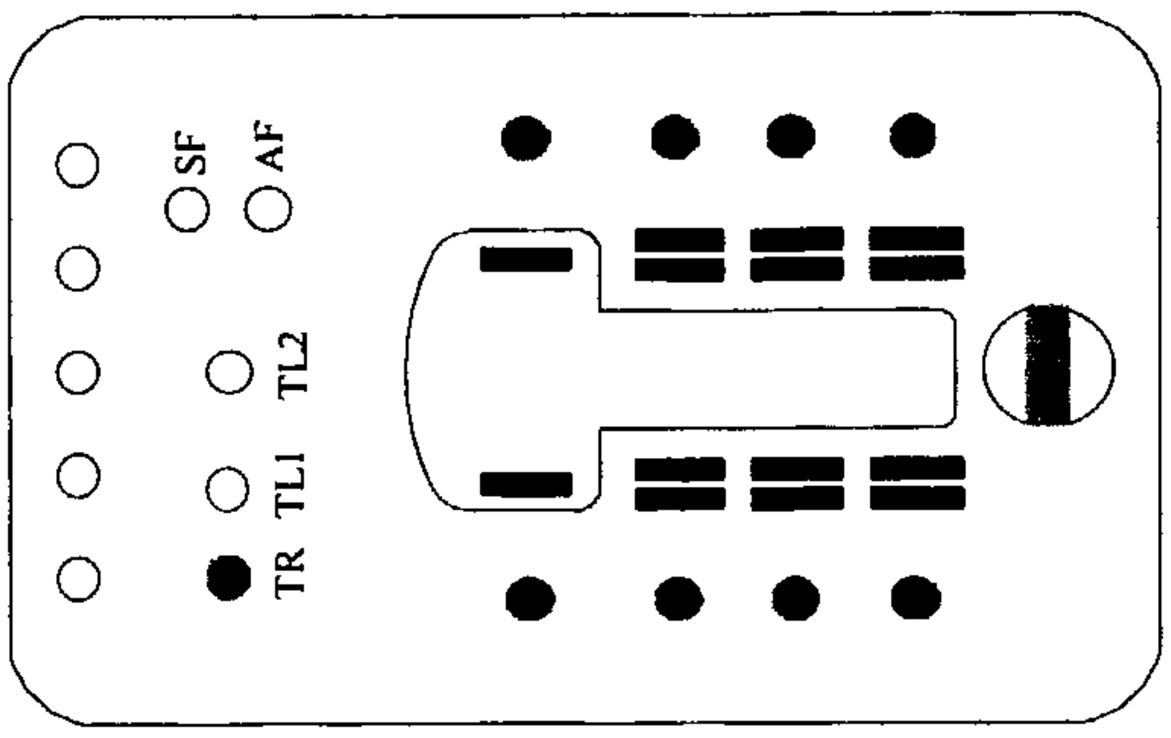


FIG 20

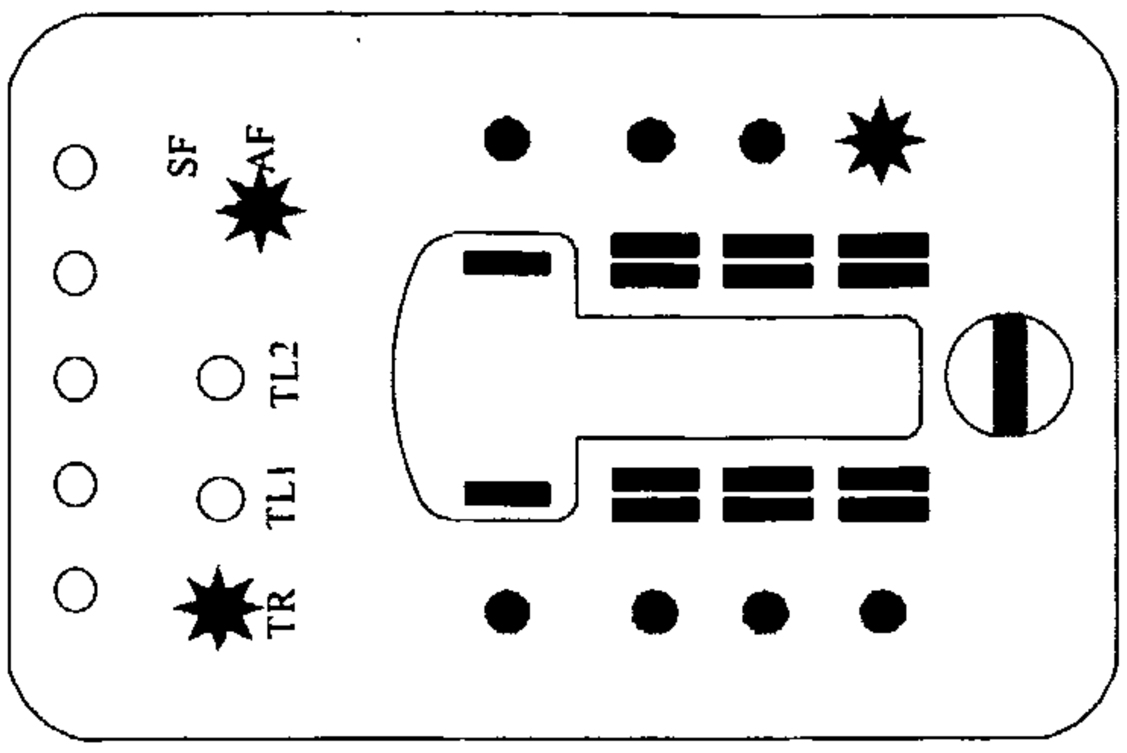


FIG 23

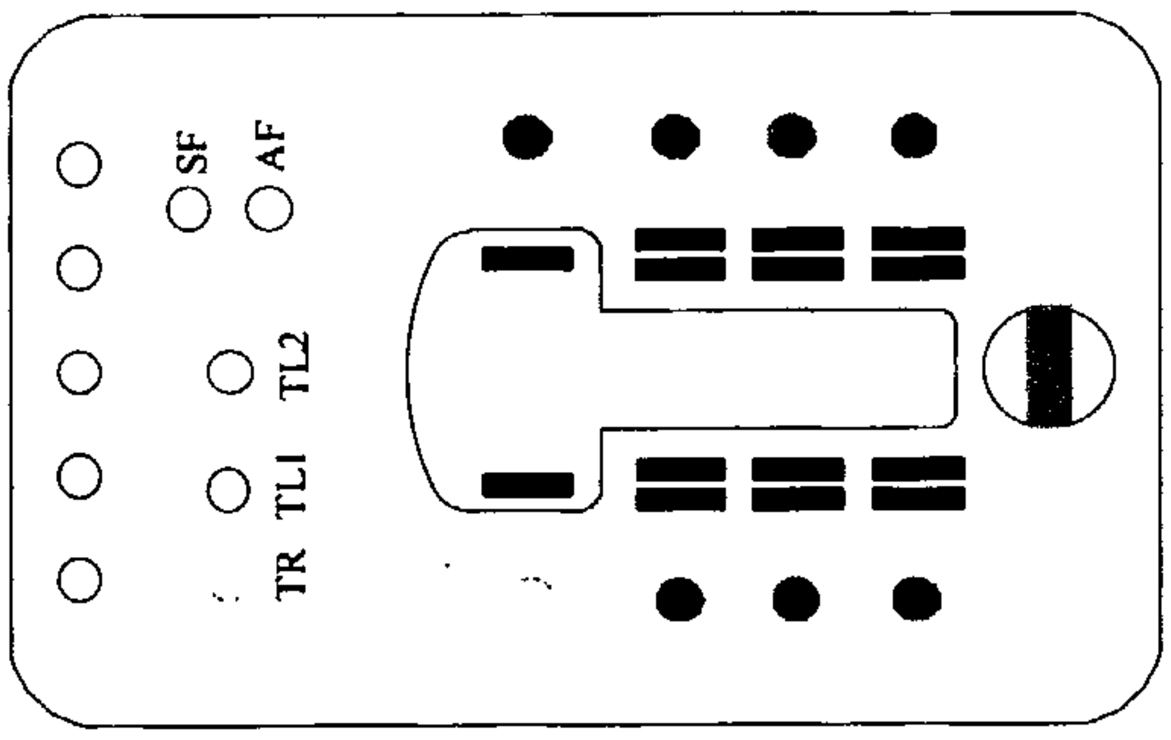


FIG 19

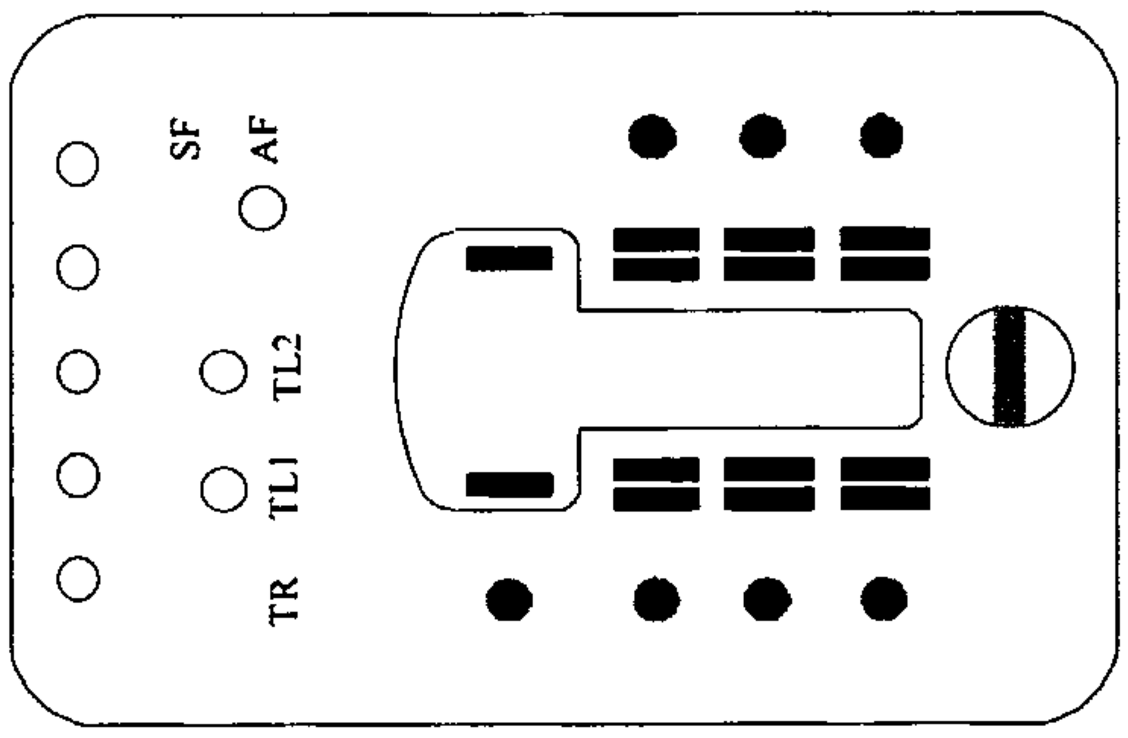


FIG 22

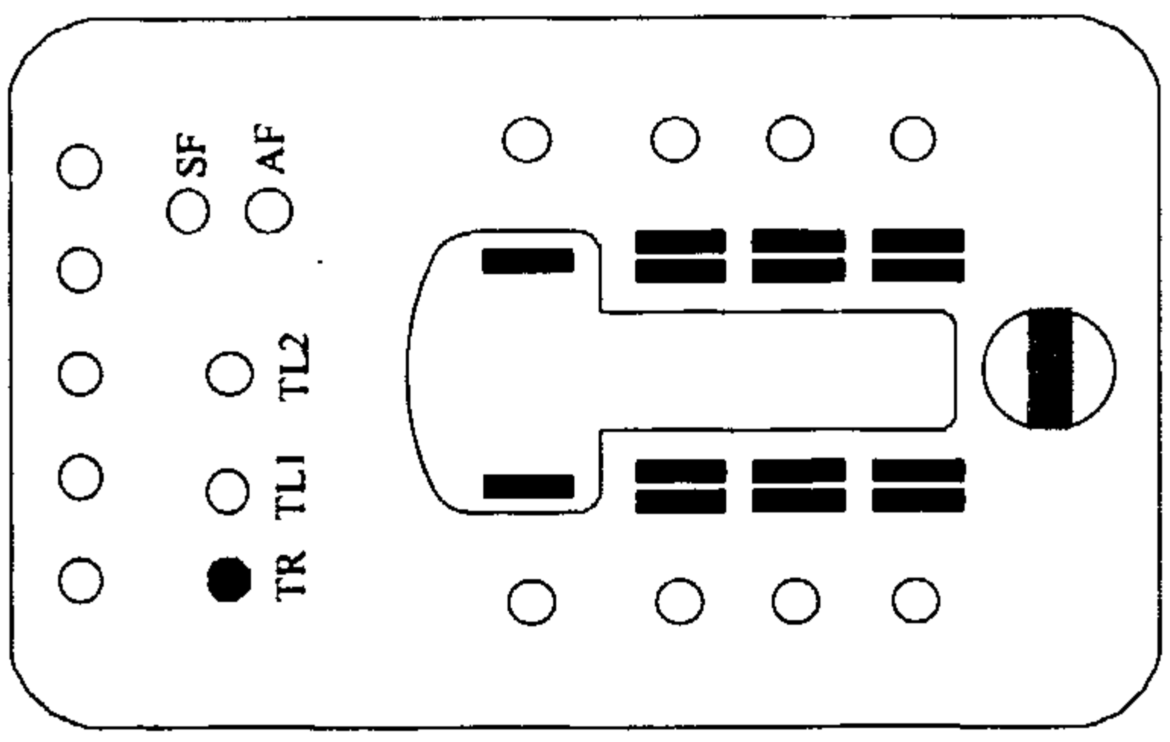


FIG 18

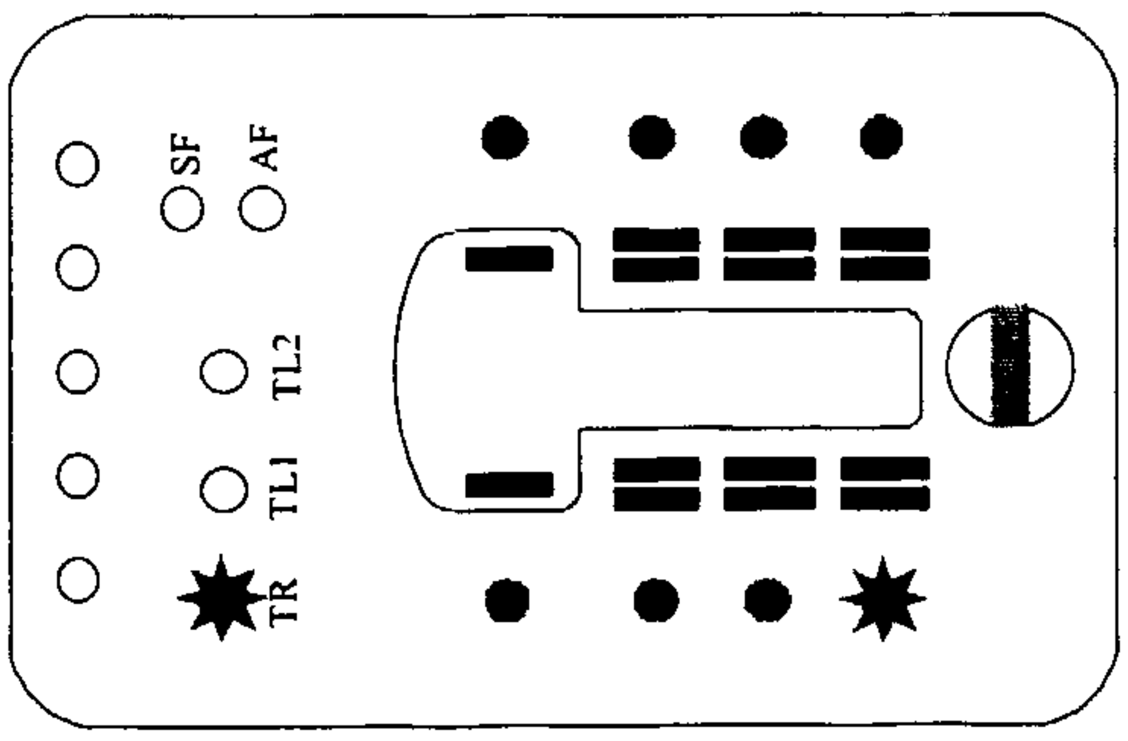


FIG 21

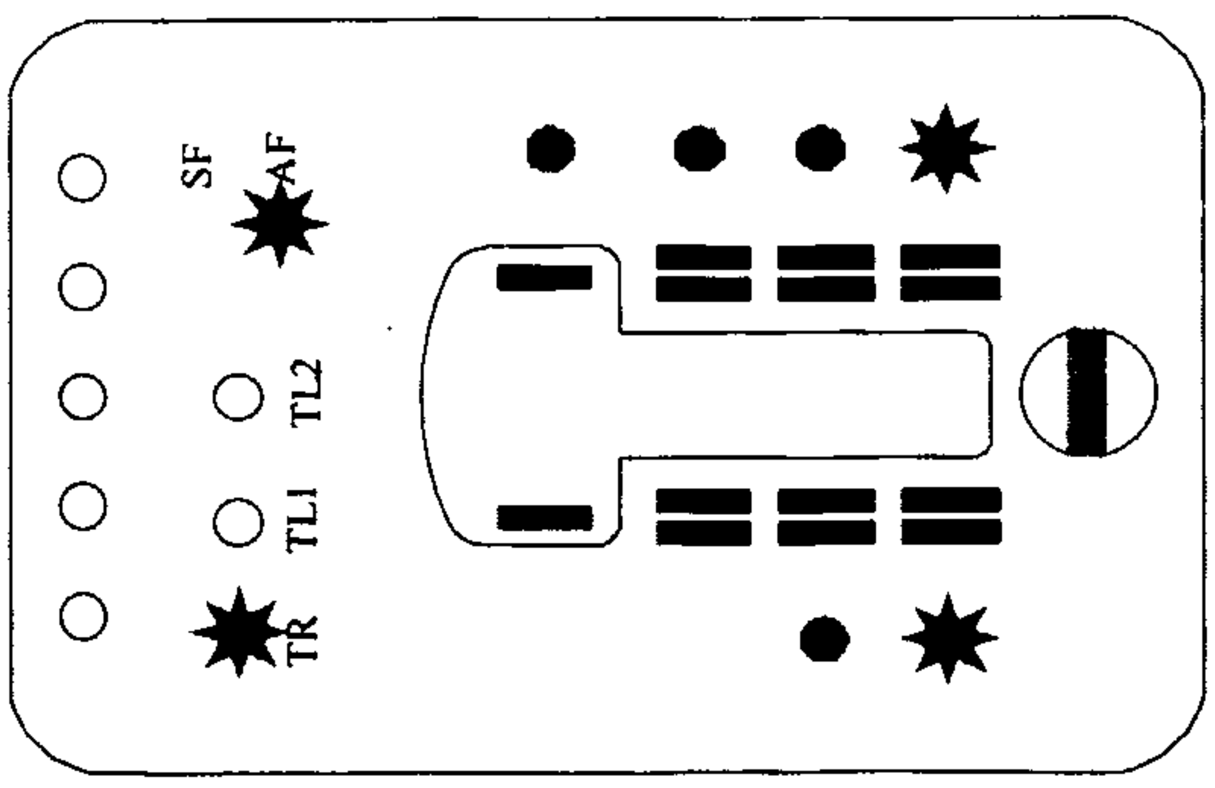


FIG 24

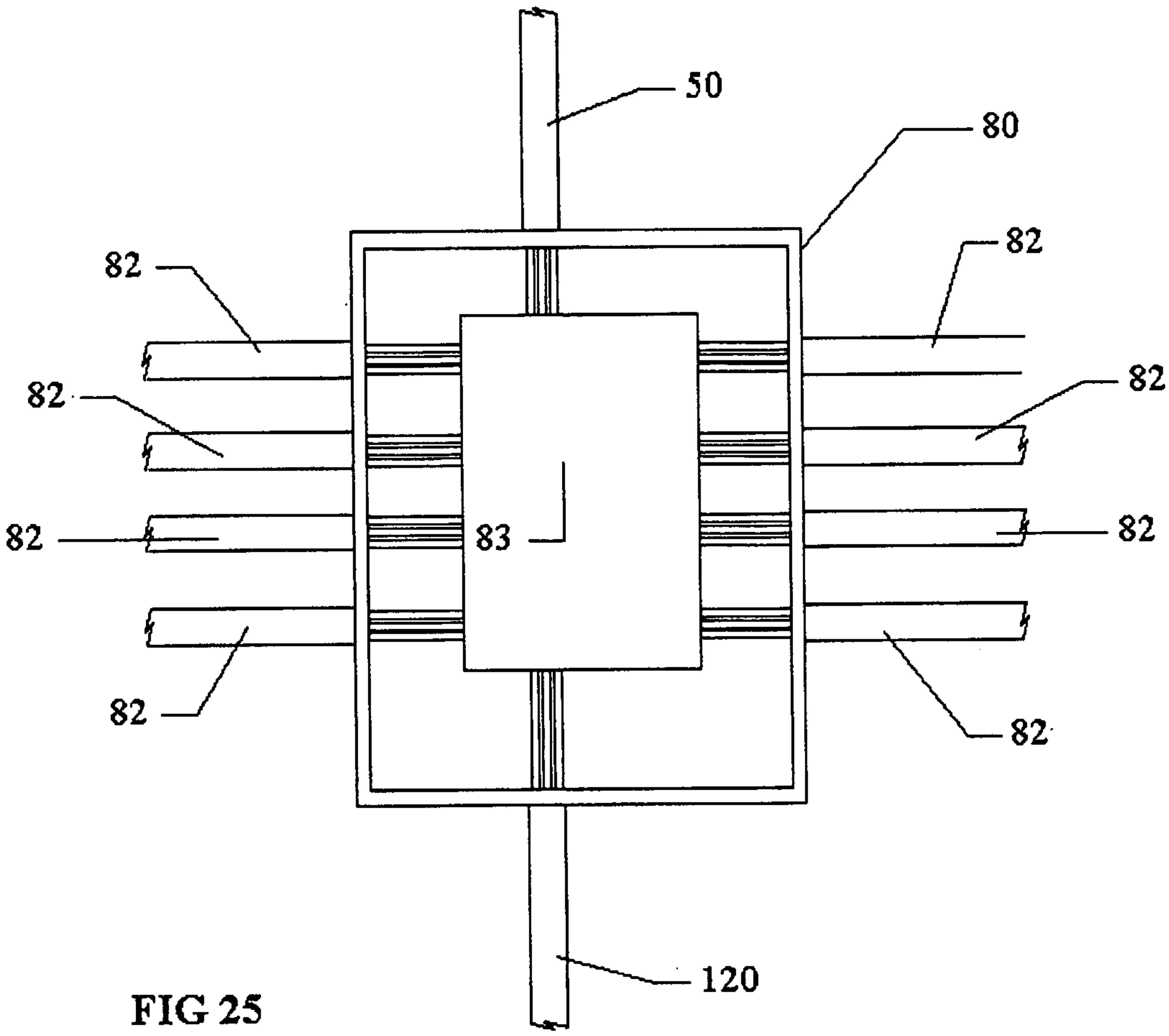
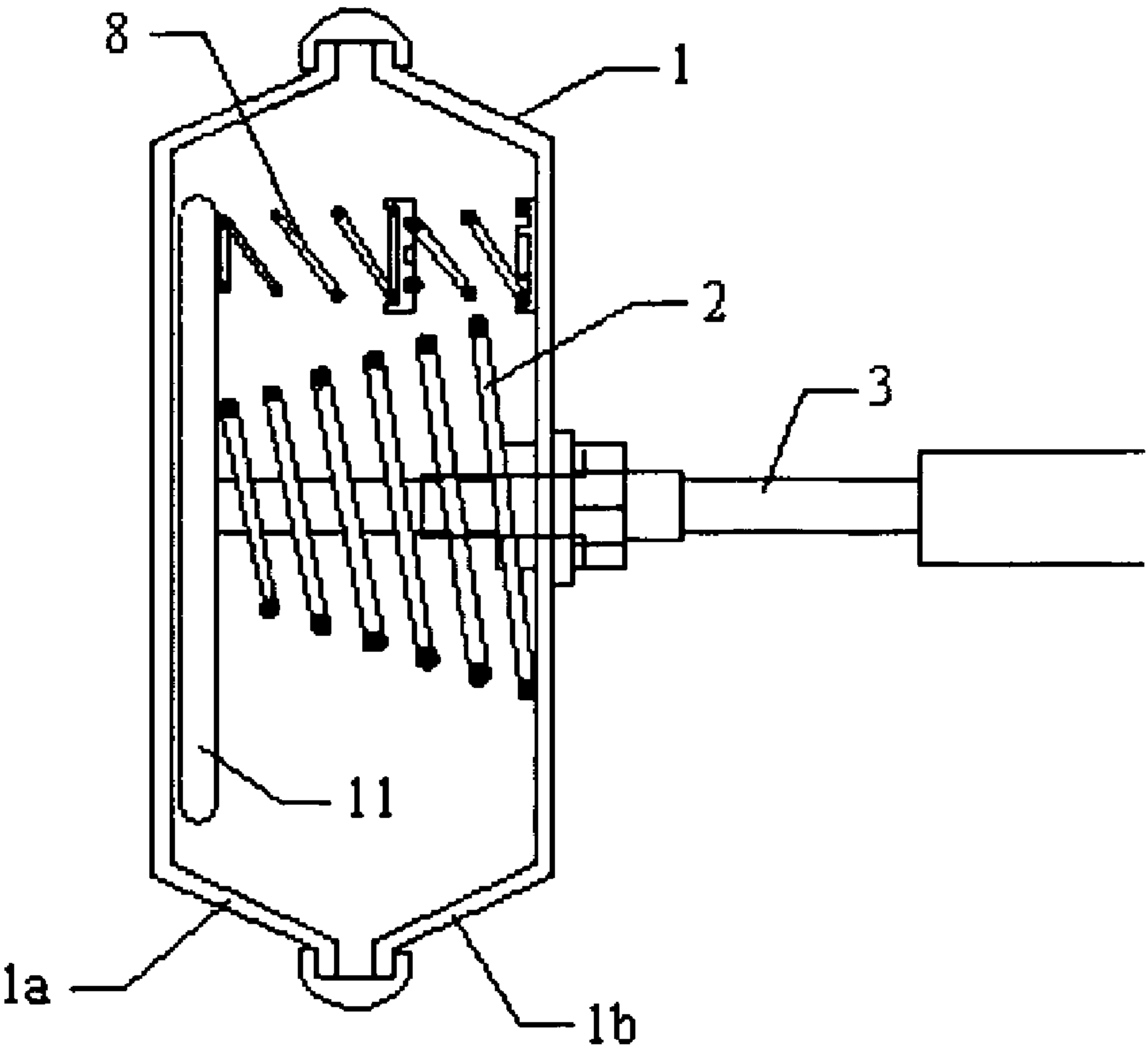


FIG 25

HALL TRIGGER SEQUENCE	REFERENCE VOLTAGE	ASSOCIATED DISPLAY COLOR
52a,52b	0.6	START
52a,52b,52c	0.5	
52b,52c	1.25	
52b,52c,52d	1.1	FIRST GREEN
52c,52d	1.9	
52c,52d,52e	1.78	SECOND GREEN
52d,52e	2.8	
52d,52e,52f	2.63	
52e,52f	3.71	THIRD GREEN
52f	4.55	YELLOW
	5.0	RED

Fig 26


8
1
2
3
11
1a
1b