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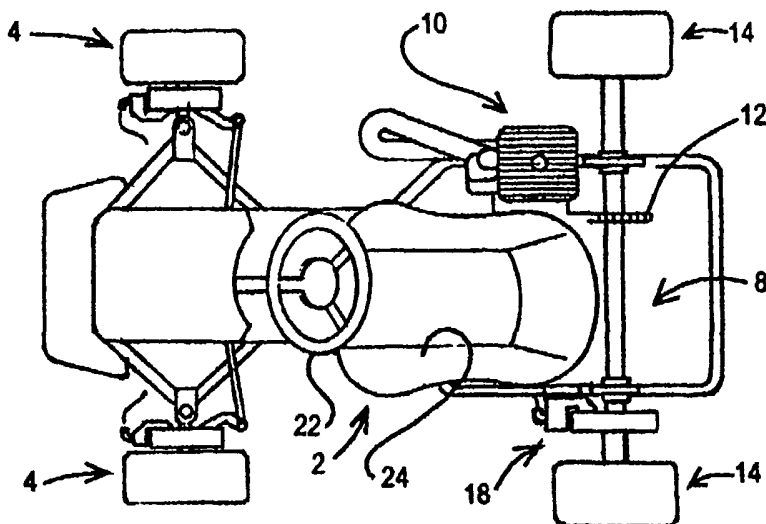
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(54) Title: BRAKE ASSEMBLY AND BRAKE PAD



(57) Abstract: A ring brake has a ring braking member with a caliper arrangement rotatably supported on the ring braking member. This arrangement is particularly useful for any live axle or rotating shaft application which requires braking. The ring brake is easily secured on a live shaft and is movable therealong in a simple manner. The mounting of the caliper on the rotating braking member maintains alignment of the brake pads with the rotating braking member even if racking of a frame or surrounding environment occurs. Thus, the ring brake defines a stable environment and the caliper is merely held in a non rotatable manner by a simple connecting link.

TITLE: BRAKE ASSEMBLY AND BRAKE PADFIELD OF THE INVENTION

5 The present application relates to vehicle brakes and in particular, relates to effective retraction of brake pads. The invention has particular application for ring brakes and disc brakes.

10

BACKGROUND OF THE INVENTION

 Ring brakes for vehicle application have been described in patents but have not been readily accepted in the marketplace. The ring brake due to its inner and
15 outer braking surfaces is somewhat vulnerable to road contamination, and for demanding braking applications, such as race applications heat must be removed from the large braking surfaces. Various arrangements for forcing a cooling airflow through or over the ring braking member
20 have been proposed.

 A ring braking member requires a much larger rotating member with most of the mass of this larger rotating member being spaced a substantial distance from
25 the rotary axis. From a design point of view, it is desirable to keep the rotating mass as small as possible and to provide a mass which allows effective heat transfer away from the braking surfaces and from the mass to the surrounding air.

30

 Cast iron ring brakes have been proposed, however, in this case, the weight of the brake is high. It has also been proposed as set out in my earlier patents, to use an aluminum alloy as the ring braking member with a
35 series of ports provided therethrough which assist in reducing problems associated with contamination and also assist in the transfer of heat to the airflow. Specialized aluminum alloys are of high wear, however,

their maximum temperature is in the order of 800 degrees Fahrenheit before the structural properties thereof diminish rapidly.

5 Brake pads for use in association with aluminum alloy ring braking members use organic fibers as metal fibers tend to score and rapidly wear the braking surfaces. The organic fibers proposed for ring brakes have not proven entirely satisfactory as these fibers
10 tend to be bundles of thin filaments and these fibers tend to lie in a plane parallel to the braking surface. As these fibers become exposed to the braking surfaces, the fibers have a tendency to be stripped out of the braking surface and often leave a rut or gouge in the
15 braking pad. The fibers tear out readily as they are a bundle of individual filaments and thus once one filament separates, the other filaments tend to follow.

 A further problem associated with ring braking
20 members is the caliper for holding of the braking pads. Floating calipers are prone to contamination of the slideway and in addition, a floating caliper inherently uses some contact of the brake pad with the braking surface to retract the pads. With these arrangements
25 there is typically some drag during rotation of the ring brake even when the brake is not actuated. Furthermore, the pistons used to apply pressure to the pads for braking, are also affected by the mass of the caliper which also moves. In ring and disc braking systems, the
30 brake pads drag, resulting in increased wear and lost efficiency.

 Attempts have been made to modify disc brakes to provide more effective braking. The diameter of the disc
35 can be increased in accordance with the wheel design of the vehicle and many disc brakes have a series of ventilation channels therein for pumping air through the disc. Although this assists in removing heat from the

disc member, the wheel size limits the size of the disc and for many applications, the life of the brake is relatively short or the performance of the brake deteriorates quickly. This is particularly true for racing applications. Some racing vehicles such as shifter carts have relatively small diameter wheels and this limitation further decreases the performance of disc brakes.

Hydraulic brake pad actuation used in both ring brakes and disc brakes removes hydraulic pressure when the brake pedal is released, however, the rotating ring brake or disc urges the brake pads to a clear position. Some scuffing or brake pad drag often occurs generating heat and reducing the life of the brake. It is also possible that the close proximity of the brake pads to the rotating brake member reduces heat transfer to the surrounding air and/or may render the brake more prone to dirt contamination.

Many seals associated with the brake pistons are of a rubber compound and operate satisfactorily below about 225°F. If the temperature of the caliper and brake fluid exceeds this level, the seals change and retraction movement of the brake pads is restricted. This leads to more heat and wear and reduces the effectiveness of the brake.

The present invention seeks to overcome a number of the problems associated with the prior art.

SUMMARY OF THE INVENTION

A ring brake according to the present invention comprises a ring braking member having an interior braking surface and an exterior braking surface, a caliper arrangement with opposed brake pads, means for supporting said caliper relative to said ring brake

member to position said brake pads to the inside and the outside of said ring braking member for engaging said braking surfaces, said caliper arrangement including piston means for selectively moving said brake pads into
5 braking engagement with said surfaces, and wherein said caliper arrangement is rotatably mounted on said ring braking member by means of bearings supported by said ring braking member and said caliper arrangement includes a linkage for connecting said caliper to a structure to
10 prevent rotation of said caliper with rotation of said ring braking member.

According to an aspect of the invention, the ring braking member includes means for mounting said ring
15 braking member to a live axle to be rotatable with said live axle.

In yet a further aspect of the invention, the ring braking member includes a center port and a tapered
20 sleeve insertable in the center port. The tapered sleeve has threads at a narrow end of the tapered sleeve. The tapered sleeve is partially inserted through the center port until the sleeve forms an interference fit with the center port with the threads being partially exposed
25 beyond the center port. The ring brake includes a threaded nut member in engagement with the threads of the sleeve for drawing the sleeve into the center port and locking the ring member to a live axle for braking thereof.

30

In a further aspect of the invention, the ring brake is mounted to a live axle of a shifter cart.

A race vehicle according to the present invention
35 has a frame supporting two steerable front wheels and a pair of rear wheels at a rear portion of the frame. The vehicle includes an engine and a drive arrangement for powering the rear wheels via a live axle. Each front

wheel has a ring brake with a rotating braking surface with a pair of opposed brake pads movable into and out of contact with the rotating braking surface for braking thereof. The live axle includes a rear ring brake having
5 a rear ring braking member mounted coaxial with the live axle. The rear ring braking member includes a caliper mounted on bearings of the rear ring braking member and coaxial with the live axle. The caliper includes a connecting link maintaining the caliper in position as
10 the live axle rotates. The caliper includes brake pads movable by a hydraulic arrangement between a braking position opposing rotation of the rear ring braking member and a release position allowing rotation of the rear ring braking member and the live axle.

15

According to an aspect of the brake includes a brake pad retraction mechanism that positively moves the pads to a position out of contact with the rear ring braking member. This retraction mechanism is self
20 adjusting to accommodate brake pad wear and uses a locking spring washer to provide positive retraction.

A racing vehicle according to the present invention comprises two front wheels and two rear wheels
25 with each front wheel including a ring brake arrangement. Each ring brake arrangement includes a ring braking member rotatable with the wheel with braking surfaces either side of the ring braking member. A caliper is provided with opposed braking pads actuatable to engage the
30 braking surfaces. The rear wheels include a rear ring braking means for braking of the rear wheels.

In an aspect of the racing vehicle of the present invention, the rear wheels are interconnected by a live
35 axle and the live axle supports the rear ring braking means.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the invention are shown in the drawings, wherein:

Figure 1 is a top view of a shifter cart with the improved ring brake system;

Figure 2 is a partial exploded view of the shifter cart of Figure 1;

Figure 3 is an exploded perspective view of a front corner of the shifter cart showing the caliper, the mounting bracket and the ring braking member;

Figure 4 is an exploded perspective view of the brake caliper;

Figure 5 is a sectional view through the braking system;

Figure 6 is a partial perspective view of a modified ring brake mounted on a live axle;

Figure 7 is a top view of the modified ring brake;

Figure 8 is a partial sectional view of the modified ring brake, illustrating the bearing mount arrangement of the caliper and the ring braking surface;

Figure 9 is an exploded perspective view of the ring brake;

Figure 10 is a sectional view through the shaft showing mounting details of the ring brake;

Figure 11 is an exploded perspective view of an actuating piston of spring return mechanism;

Figures 12 and 13 are partial sectional views showing race pad application;

Figure 14 is a partial exploded perspective view of the piston actuator;

Figure 15 is a perspective view of an alternate view of the ring braking member;

Figure 16 is a section through the alternate ring braking member when mounted on a stub shaft;

Figure 17 is a perspective view of the alternate ring braking member;

Figure 18 is a sectional view through the alternate ring braking member mounted on a shaft and supporting a wheel rim;

Figure 19 is a sectional view of an alternate ring braking member mounted on a wheel rim;

Figure 20 is a further alternate view of a ring braking member mounted on a steel rim;

Figure 21 is a schematic of the power assist arrangement of the brake;

Figure 22 is a sectional drawing through the servo valve with the push rod actuator in an off position;

Figure 23 is a sectional drawing of the servo valve with the push rod actuator fully on; and

Figure 24 is a sectional drawing through the servo valve with the push rod actuator modulating the pressure provided to the back piston.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The shifter cart 2 shown in Figures 1 and 2 has front wheel corners 4 which share a number of common components. The shifter cart includes a live rear axle 8 which is driven by the engine 10 in combination with the drive sprocket 12. A rear ring brake assembly 18 is provided to one side of one of the rear wheels 14 and is rotated with the rear axle. The shifter cart includes the steering wheel 22 and a driver seat 24.

The front corner, as shown in Figure 3, includes a mounting bracket 40 having a steering arm 42, a vertically disposed bearing 44, a generally horizontal wheel spindle 46, a removable caliper 48 and opposed brake pads 50. The ring braking member 60 is of an aluminum alloy and includes outer braking surface 62 and inner braking surface 64. The gap 70 between the brake pads 50 receives the edge of the ring braking member such that the pads are immediately adjacent the inner and outer braking surfaces. The fan 74 is connected to or

integral with the ring braking member and causes a flow of air through the ring braking member to remove heat therefrom. The fan 74 also acts as a heat sink for the ring braking member. A wheel mounting tube 76 includes
5 bearings at either end thereof for engaging the wheel spindle 46 and allowing rotation of the ring braking member and the associated wheel. One of the bearings is accessible through the open end of the ring braking member and the other bearing is at the free end of the
10 wheel mounting tube 76.

The mounting bracket 40 has the wheel spindle 46 integral therewith and this wheel spindle includes a slight angle. For this reason, the mounting bracket 40
15 will be a right hand bracket or a left hand bracket for accommodating the different wheel at the front of the vehicle. The caliper and the ring braking member and fan and wheel mounting tube 76 can be used for a left front wheel or a right front wheel.

20 The caliper 48, shown in Figure 4, is mechanically connected to the mounting bracket 40 by means of upper and lower screw bolts 43 and upper and lower screw bolts 45. Only the upper screw bolts are shown. These screw
25 bolts pass through plate 47 and engage the aluminum block 100. The caliper is made from an aluminum block 100 having a center recess 101 for receiving the brake pads and receiving an edge of the ring braking member 60. The caliper includes two opposed pistons 106 each having an
30 associated cup seal 108 which moves within the respective cylinders 102 or 104 of the caliper. The aluminum block 100 includes upper internal conduit 114 and a similar lower internal conduit 116. These conduits serve to connect the two cylinders 102 and 104 and thus the
35 pistons 106 effectively share the same hydraulic fluid pressure supply. An end plate 120 is provided on the end of the caliper closing cylinder 102. As can be appreciated, cylinder 102 and 104 are aligned and can be

drilled through the end of the caliper that would be closed by the end plate 120. Cylinder 104 is a blind cylinder although it does connect with the internal conduits 114 and 116.

5

Hydraulic fluid is introduced through inlet 140 of the end plate 120. Thus the cylinder 102 is exposed to hydraulic pressure and this hydraulic cylinder is also connected to the ports 126 and 128 via the channels 122 and 124 in the end plate. An O-ring seal 124 is provided about these components and serves to provide an outer seal. Hydraulic fluid through the inlet 140 finds its way through channels 122 and 124 to the enlarged ports 127 and 129 in the caliper. These enlarged ports are connected to the internal conduits 114 and 116 respectively. Thus hydraulic fluid is introduced through inlet 140 and this hydraulic fluid will serve to provide power for the piston in cylinder 102 and via the internal conduits 114 and 116 will provide power to the piston located in cylinder 104.

The end plate 120 is fastened to the caliper by means of a pair of bolts 131 which are outside of the O-ring 124 and a pair of bolts 130 which are to the interior of the O-ring. The bolts 130 also include their own O-ring seal 132. As can be appreciated, there will be an upper bolt 130 and a lower bolt 130 depending upon whether the caliper is being used for the front right or the front left wheel. The more elevated bolt is used as a bleed screw for allowing bleeding of the brake fluid lines. Basically, brake fluid is provided to the caliper through the inlet 140. The upper bolt 130 is loosened such that the hydraulic fluid can find its way through the lower conduit to the opposite piston and returned through the upper conduit to the bolt which has been loosened and now allows bleeding through the end plate. Once the air has been purged from the system, the bolt 130 can be tightened and the O-ring 132 provides a proper

seal. The brake is actuated by feeding hydraulic fluid under pressure through inlet 140 causing piston 106 in the first cylinder 102 to move the associated brake pad and also cause the piston 106 in the cylinder 104 to move
5 and causing the opposite brake pad to contact the inner and outer braking surfaces respectively. The caliper is fixed and therefore the pistons only move the brake pads.

The aluminum block 100 includes either side of the
10 recess 101 and at both the top and bottom surfaces, guide plates 150 fixed to the body 100. The brake pads include their own metal or reinforcing backing plate which have been recessed to receive the guides 150 to allow sliding movement of the brake pads to engage the brake surfaces.
15 These members serve to lock the brake pads against movement sideways within the recess 101.

With the arrangement as shown in Figure 4, a common shape caliper 48 is used for the front left wheel
20 and the front right wheel. This is possible as the caliper is basically symmetrical about a horizontal axis.

The mounting of the caliper 48 to the mounting bracket 40 such that it is fixed, allows each of the
25 pistons 106 to basically only act on the brake pads. When the hydraulic pressure is removed, the ring brake will encourage the brake pads to move to a clear position and the pistons are forced back. With this arrangement, the brake runs essentially without drag as the brake pads
30 have been moved away from the braking surface. A floating caliper arrangement does not operate as effectively as a fixed caliper as the pistons are also affected by the mass of the floating caliper. A fixed caliper has proven to work very effectively on small
35 racing vehicles such as shifter carts, go-carts and small diameter wheel formula cars. The ring caliper assembly allows a large braking surface to be provided on a relatively small diameter wheel. This is a great benefit

for small diameter wheels used in many different types of racing applications.

As shown in the sectional view of Figure 5, the
5 fixed caliper 48 preferably has internal conduits 114 and 116 easily machined into the aluminum block 100 by a series of drill holes which are appropriately plugged. Thus the internal porting of the aluminum block 100 is easily accomplished. Figure 5 also illustrates how the
10 conduits are connected to the cylinders at one end of the caliper through the enlarged ports 127 and 129.

Figure 5 also shows a one piece braking member and mounting tube 149. The mounting tube includes a machined
15 recess 151 for receiving bearings 153. Recess 151 is machined together with the braking surfaces 64 and 64, thereby providing an accurate relationship therebetween and relative to the mounting tube 149.

20 The modified ring brake 200 as shown in Figure 6, is secured to the live axle 204 and has a holding link 210 connecting the caliper 208 to the stationary frame 202. The caliper 208 is mounted by a pair of bearings 254, 256 such that it is supported by the live axle 204.
25 In this way the caliper and the ring brake member 206 are commonly supported by the live axle 204. With both the caliper 208 and the ring braking member 206 commonly supported by the live axle 204, any twisting of the frame 202 does not cause misalignment of the caliper 208 and
30 the ring braking member 206. The ring braking member 206 is cast with a series of long fan blades 214 and a series of short fan blades 216 which preferably do not extend to the center port 272. The long fan blades 214 are also used to support and engage the circular plate 218. This
35 plate is mechanically fastened to the long fan blades 214. The fan blades 214 and 216 are merely radial blades and the closing plate 218 has been found to increase the flow of air through the ring brake by forcing the air to

be discharged radially. As will be later described, the plate 208 can be cast as part of the ring braking member 206.

5 The connecting link 210 includes ball and socket connections at either end thereof for connecting the caliper 208 to the frame 202. This arrangement allows for slight misalignment between the frame and the caliper and also accommodates any racking of the frame. The
10 caliper is mounted relative to the shaft and slight rotational movement of the caliper about the shaft is not a problem. Such movement does not cause a significant change in the relationship of the brake pads to the ring braking surface.

15

Figures 7 through 10 show details of the mounting of the ring braking member to the live axle 204.

As shown in Figure 10, the live axle 204 includes
20 a key slot 230 which receives the key 232. The key 232 is also received in the key slot 252 of the ring braking member 206 such that the ring braking member 206 rotates with the live axle 204. As shown in Figure 9, the tapered sleeve 240 also has a key slot 242 for receiving
25 the key 232. The tapered sleeve 24 is inserted from the fin side of the ring braking member 206 and has an interference fit with the ring braking member. This provides a simple arrangement in combination with the key for securing of the ring braking member 206 to the live
30 axle in a desired location.

As shown in Figures 8 through 10, the brake caliper 208 has a finned mounting portion 270 with a center port 272 which receives the bearings 254 and 256.
35 The bearings 254 and 256 are mounted on the cylindrical fixed collar 246 which is fixed to the ring braking member 206. The interior surface of the fixed collar 246 is sized to receive the tapered sleeve 240 and

effectively secure the ring brake member 206 to the live axle 204 in a desired location.

5 In the preferred structure, the securing nut 260 is inserted on the live axle 204 and the caliper 270 is also inserted on the live axle. The ring braking member is then inserted on the live axle. The tapered sleeve 240 is then inserted on the axle and aligned with the key 232 of the axle. The ring brake member 206 can then be
10 inserted on the tapered sleeve such that the threads 244 of the tapered sleeve project through the center port 250 of the fixed cylindrical collar 246. Any adjustment of the position of the ring braking member 206 and sleeve 240 can be made whereafter the securing nut 260 is
15 threaded on the threads 244 of the sleeve 240. This further draws the sleeve through the port 250 and aligns the ring braking member 206 with the live axle 204. Once this step has been completed, the caliper 208 can then be mounted on the cylindrical fixed collar 246 of the ring
20 brake member 206. The finned mount 270 includes a center port 272 having a split gap 274. The center port is sized to receive the bearings 254 and 256 therein, as well as the spacer 255. Once so positioned, the caliper 208 can be secured to the bearings by a mechanical
25 fastener which passes through the ports generally shown as 276. With this arrangement, the caliper 208 is rotatably mounted on the cylindrical fixed collar 246 via the bearings 254 and 256.

30 The caliper 208 does not rotate with the live axle 204 as it is held by the connecting link 210. The ring braking member 206 rotates with the shaft and the braking surfaces of the ring braking member pass through the opposed brake pads of the caliper 208.

35

With the mounting of the caliper 208 to the live axle, the alignment of the caliper 208 and the ring braking member 206 is maintained. The caliper is merely

connected in a suitable manner to the frame such that it is non rotatable. Any racking of the frame does not translate to misalignment of the caliper and in particular, does not relate to misalignment of the brake pads and the braking surfaces of the ring braking member 206.

This brake assembly provided on the live axle is also useful for drive shaft brakes or other industrial applications. The mounting of the caliper on the ring braking member simplifies securement, making the brake suitable for many applications.

As clearly shown in Figure 10, the caliper 208 is mounted generally within the ring braking member and is partially protected by the ring braking member. Furthermore, the finned mount 270 acts as a heat sink for the braking pads of the caliper. The finned mount 270 is also located in the airflow which is passing through the center of the brake and out for radial discharge between the long and short blades 214 and 216 of the ring braking member 206. The brake pads and the internal conduits of the caliper preferably use the internal conduits as described with respect to Figures 1 through 5.

One of the issues associated with braking systems is associated with providing positive brake pad retraction. Some brake systems merely rely on the moving braking member scuffing the braking pads and causing the brake pads to retract. For some applications, it is desirable to provide positive retraction.

The embodiment shown in Figures 11 through 14 disclose an internal spring biased arrangement for positively retracting the actuating pistons. With this arrangement, each piston is positively withdrawn such that the associated brake pad is moved to a clear position relative to the ring braking member.

The embodiments as shown in Figures 11 through 14 provide a system where the actuating piston 302 which forces the brake pads 340 against the ring braking member 342, has as a positive retraction mechanism for pulling of these brake pads to the clear position as generally shown in Figure 12.

Figure 12 shows a spring washer 316 in a relaxed state which has pulled the brake pad 340 to a clear position relative to the ring braking member 342.

Figure 13 shows actuation of the brake where the piston 302 has been forced outwardly by hydraulic fluid to bring the braking pad 340 into engagement with the ring braking member 342. During brake actuation, the spring washer 316 has been forced to a flat state. When the hydraulic fluid pressure is removed, this spring washer will urge the piston 302 rearwardly to the clear position of Figure 12.

Figure 11 shows the piston 302 removed from the piston cylinder 300 of the caliper 208. The piston 302 includes an O-ring seal 308 such that hydraulic fluid can act on the rear face 310 of the piston during brake actuation. The piston 302 has a cylindrical closed cavity 320 which accommodates the fixed post 312 secured to the back plate 304. The fixed post includes an outwardly extending collar 318. This collar serves to capture the spring washer 316 and the split sleeve 314 on the fixed post 312. The fixed post is of greater length than the split sleeve 314 and the split sleeve and spring washer easily slide on the fixed post.

The split sleeve 314 is sized to form an interference fit with the sides of the cylindrical closed cavity 320 of the piston 302. During actuation of the brake, hydraulic fluid acts on the rear face 310 of the

piston and urges the piston 302 to force the brake pad into engagement with the ring braking member. Initially, the piston 302 is in engagement with the split sleeve 314 and compression of the spring washer 316 occurs as the
5 split sleeve 314 is compressing the spring washer. Once the spring washer bottoms out on the fixed collar 318, any further movement of the piston 302 required to actuate the brake pad, requires slippage of the split sleeve 314 with the walls of the cylindrical closed
10 cavity 320 of the piston 302. The hydraulic pressure is more than sufficient to cause this slippage during brake application.

Figure 13 shows full actuation of the brake where
15 piston 302 has urged the brake pad 340 into contact with the ring braking member 342. The washer 316 is flattened against the collar 318 and is trapped between the split sleeve 314 and the fixed collar 318. When the brake is released, the hydraulic pressure on the rear face 310 is
20 removed, and the spring washer 316 seeks to return to the uncompressed state of Figure 11 and Figure 12. Thus the spring washer 316 causes the sleeve 314 to move rearwardly on the fixed post 312 and in so doing, urges the piston 302 to the retracted position of Figure 12.
25 As the split sleeve 314 has an interference fit with the cylindrical closed cavity 320, the piston 302 moves rearwardly.

With the positive retraction of the piston 302,
30 the brake pads 340 are moved to the clear position. If there is wear with respect to the brake pads 340, this is addressed as actuation of the brake causes engagement of the brake pad and slippage of the split sleeve with respect to the piston. The release of the spring washer
35 member provides a positive generally fixed retraction of the piston which has been adjusted for wear. The hydraulic fluid pressure acting on the rear face 310 of the piston is more than sufficient to allow slippage of

the split sleeve 314 with the cylindrical closed cavity 320.

5 The positive retraction of the brake pads reduces wear and reduces drag, however, it also improves heat transfer to the surrounding air. Each pad is pulled away from the braking surface by 20/1000 of an inch. With this distance, a boundary air layer associated with the rotating brake member is believed to increase, regardless
10 of the reason more heat is efficiently dissipated to the air. Perhaps there is more mixing of this boundary layer with the axial airflow through the ring braking member and this leads to more effective heat transfer.

15 Furthermore, the substantial retraction also provides a high degree of clearance between the brake pad and the rotating brake member whereby dirt contamination of the pads is reduced. The higher clearance allows dirt to pass through the clearance gap rather than becoming
20 lodged in the pad. Positive brake pad retraction of about 10/1000 of an inch also provides significant improvements.

 The positive retraction of the pads also has
25 application in disc brake systems and can provide advantages with respect to less pad wear, less dirt contamination, and better heat dissipation. As can be appreciated, the above advantages extend the life, improve the performance, and reduces the maintenance
30 costs. The operating and wear characteristics of a brake system are generally adversely affected as average operating temperatures increase.

 In a preferred embodiment of the invention as
35 shown in Figure 14, the piston 302 includes a magnet 350 in the front face of the piston which is of a strength to positively engage the metal backing plate 344 of the brake pad 340. It has been found that this magnetic

attraction is sufficient to pull the brake pad rearwardly to the clear position of Figure 12. With this arrangement, the piston 302 is not fixed to the backing plate 344 but the brake pad will move rearwardly due to
5 the magnetic attraction.

The positive brake pad retraction as shown in Figures 11 through 14 has a number of advantages. Basically, the retraction mechanism is relatively simple
10 and reliable and reduces drag. Furthermore, the retraction mechanism is provided interior to the hydraulic braking system and as such, is not subject to dirt or contamination. Heat dissipation is also improved and increased life expectancy is realized. The lower
15 operating temperatures reduce the tendency of the seals to oppose retraction.

A further feature of the invention is shown in Figure 14. The front face 352 of the piston 302 has been
20 provided with two threaded blind ports 354 and 356. These blind threaded ports 354 and 356 are used to insert threaded members into the piston 302 to allow pulling of the piston out of the piston cylinder 300. This point can be better understood from a review of Figure 3. As
25 shown in Figure 3, the caliper 48 is a cast piece and has a closing plate 47 on one end of the caliper. The piston at that end of the caliper can be withdrawn through its piston cylinder by removing of the plate. The pad on that side of the caliper can be removed and force can be
30 applied against the face 52 of the piston to allow removal thereof. The piston on the opposite side of the caliper is preferably mounted in a blind piston cylinder. The brake pad on that side of the caliper can be removed exposing the front face of the piston. The
35 threaded ports 354 and 356 in that piston can be engaged and that piston can be withdrawn through the caliper using the piston cylinder which is now opened as plate 47 has been removed.

The preferred material of the ring braking member 60 is an aluminum alloy material having nickel coated graphite which is mixed with silicon carbide in the base aluminum material. Such a composite material is sold by Inco under the trade-name "GRA-NI". During the casting of this material, the nickel coated graphite effectively flakes off and mixes with the silicon carbide and the aluminum. One particular composite material includes approximately four percent of the nickel coated graphite particulate with ten percent silicon carbide.

During operation of the brake, the rotating ring member has a glaze formed on the braking surfaces and the pad works on the glaze. The glaze appears to provide a protective layer on the braking surface and is continuously forming as the braking surface does wear.

This brake has functioned extremely well and has found a particular application for small racing vehicles such as shifter carts. The wheels on the shifter carts are relatively small and a small diameter large width ring brake can be used to provide effective braking. As shown in Figure 1, the caliper is placed towards the front of the vehicle and is exposed to the cooling airflow. Also the positioning of the ring braking member to the inside of the wheel in a generally clear area further serves to remove heat from the ring braking member. The fan hub further produces an airflow through the system for removing heat.

The rear ring braking member can be made slightly larger in size and only a single rear braking member need be provided. As can be recognized, the more demanding braking application is provided at the front of the vehicle and thus separate wheel brakes are required.

The alternate ring brake member 400 shown in Figures 15, 16 and 17 is of a single piece casting where the ring braking surfaces 402, the radial fan blades 404 and the connecting plate 406 are all integral. This alternate ring braking member also includes a conical center recess 420 for mounting of the ring member on a stub shaft or axle. The piece is cast as a single component and the braking surfaces 402 would typically be machined.

One arrangement for mounting of this alternate ring brake member is shown in Figure 16. Here the alternate ring brake member 400 is mounted on a stub shaft 416 and the ring braking member would typically rotate on the stub shaft. The mounting arrangement includes a tapered sleeve 422 which has a press fit with the stub shaft 416. The taper sleeve 422 extends through the conical center recess 420 which is tapered outwardly from the inside of the ring brake member outwardly towards the connecting plate 406. The taper of the center recess mates with the taper of the taper sleeve 422. The end 426 of the taper sleeve is threaded and cooperates with the securing nut 424. This nut drives the ring brake member 400 against the taper sleeve 422 and fixes the ring braking member on the stub shaft 416. Other arrangements for securing of the ring braking member are possible, including a bearing mounting arrangement for the ring braking member.

The perspective view of Figure 17 shows the interior of the ring braking member 400 and a number of the radial fan blades 400 merely extend inwardly but stop short of the center portion of the ring brake member. This provides additional clearance and is of assistance in the casting of the member. It can also be appreciated from a review of Figure 17 that the center of the ring braking member is basically open and is easily cast.

It can also be appreciated from Figure 15 and the sectional view of Figure 16 that the connecting plate 406 is dished such that the radial fan blades are shorter towards the center of the ring braking member and
5 increase outwardly towards the edge of the ring braking member.

A bearing mounting of a further alternate form of the ring braking member 400a is shown in Figure 18. In
10 this case, the ring braking member 400a is varyingly mounted on the stub shaft 428 and the caliper can be mounted on this stub shaft for engaging with the ring braking surfaces 402. In this case, the center recess 420 is stepped to receive the bearings 421 and 423. The
15 wheel rim 450 is secured to the alternate ring brake member 400a by beams of a series of securing bolts 452. A center securing bolt 454 secures the alternate ring brake member 400a on the stub shaft 428.

Figure 19 shows a further possible arrangement for mounting of the one piece alternate ring brake member 400b. In this case, the wheel rim 450 is secured by a series of securing bolts and the ring braking member is secured by bolts 460 to the constant velocity shaft 462.
25 The alternate ring braking member 400b and the wheel rim 450 rotate with the rotation of the constant velocity shaft 462. The bearing 470 is for mounting of the caliper on the constant velocity shaft and this caliper will have a suitable retaining arm fixed to part of the
30 vehicle frame.

Figure 20 is a view of yet a further alternate ring brake member 400c where in this case, a spline rotating shaft 466 engages this alternate ring brake
35 member. In this case, the bearing 468 is mounted on an extension of the center portion of the ring braking member shown as 470.

All of the alternate designs shows in Figures 15 through 20 are easily cast as a single component where the mold cavities can split generally in a horizontal manner. The interior of the alternate ring brake member is open to allow the cores to be removed.

These designs are useful in providing a strong lightweight assembly for mounting of the wheel rims. The ring brake member uses the various components for effecting a strong connection. In particular, the fan blades are of a relatively short stubby design which connect the ring braking member to the center portion of the ring brake and to the end plate. The end plate serves to stiffen the ring braking member and also forms a restricting member causing the airflow to be forced out radially. The outwardly tapering of the connecting plate also tends to direct the airflow outwardly and improves the pumping action. Air is drawn from the inside of the brake and is forced outwardly to the exterior of the brake.

The simple straight design of the fan blades is preferred as it is easier to cast and provides a strong connection of the components.

Although the brake system is well suited for use with smaller racing vehicles such as shifter carts, it is also suitable for larger vehicles and for disc brake systems. For larger vehicles, larger pistons are needed for moving of the brake pads against the braking surfaces and a power assist arrangement is advantageously used as shown in Figure 21.

The power assist arrangement 500 includes a pump 502 feeding the accumulator 504 in communication with the servo valve 506. A brake actuator 508 (brake pedal) controls the push rod 509 of the servo valve and determines the pressure of the hydraulic fluid provided

to the brake system 510 via the brake line 511. This valve also serves to isolate or partially isolate the brake system 510 from the reservoir 512 when the brake actuator is on. When the brake actuator is off (Figure 22), the hydraulic fluid of the brake system 510 is allowed to flow back to the reservoir. Hydraulic fluid under pressure preferably in the range of 1500 psi to 2400 psi is provided by the pump and accumulator 504 to the servo valve 506 and is connected to the brake line. The pump and/or the accumulator provides this high pressure fluid to the servo valve and the servo valve modulates the fluid pressure provided to the brake system 510. The brake system 510 responds quickly and the user is able to modulate the pressure as a function of the position of the push rod 509.

With this power assist sytem, the retraction system is preferably designed to provide substantial retraction and a substantial retraction force. Larger spring washers or multiple spring washers can be used and the force thereof is easily overcome by the power assist arrangement.

Details of the general operation of the servo valve 506 are shown in Figures 22, 23 and 24. The servo valve has an outer body member 528 having high pressure hydraulic fluid inlet 530, a brake line outlet 532 and an outlet 534 to the reservoir. The center of the valve body includes connecting conduits 548 which allow hydraulic fluid to pass through the valve body connecting the hydraulic inlet 530 to the brake line 532 (see Figure 23) depending upon the position upon the push rod actuator 509. The ball valve 536 cooperates with the sliding sleeve 544 to selectively open and close the connecting conduits 548. The push rod actuator 509 has a center connecting conduit 546 which allows hydraulic fluid to pass through the push rod and out to the reservoir outlet 534. The connecting conduit 546 of the

push rod 509 can be closed when it engages the sleeve 544 as shown in Figure 23. The push rod actuator 509 has moved by application of a force on the brake actuator and the center connecting conduit 546 is closed. The push
5 rod has forced sleeve 544 to move and displace ball valve 536.

The ball valve 536 has moved to a clear position connecting the high pressure hydraulic fluid provided to
10 the servo through the inlet 530 to the brake line outlet 532 through the connecting conduits 548. The center connecting conduit 546 of the push rod 509 has been effectively closed due to engagement with the sleeve 544. Therefore, the high pressure hydraulic fluid is not
15 connected to the reservoir outlet 534. The brake line 511 is exposed to high pressure hydraulic fluid and the brake pad engages the braking member.

In Figure 23 the ball valve 536 has pushed the
20 sliding valve body 538 to the left and partially compressed the bias spring 542. The chamber 540 is essentially at the same hydraulic pressure as the inlet 530. With this arrangement, when the push rod 509 is effectively released by the user letting off on the brake
25 pedal, the ball valve 536 is forced to the closed position of Figure 22. In addition, the bias spring 560 has forced the push rod to the right and has opened the center conduit 546 to the reservoir outlet 534. Thus the brake line outlet 532 and the reservoir outlet 534 are at
30 the same hydraulic pressure and this is relatively low. In contrast, inlet 530 and chamber 540 is at the high hydraulic fluid pressure.

The position of the push rod 509 in Figure 24 is
35 effectively a balance point. The ball valve 536 has closed the connecting conduits 548 and the sleeve 544 has moved within the valve body 528 but remains in contact with the push rod 509. The valve body 538 is in a

position maintaining the ball valve 536 in a position closing the connecting conduits 548.

With the arrangement as shown in Figure 24, the center connecting conduit 546 of the push rod 509 is still closed as it is being engaged and closed by the sleeve 544. If the force shown as 570 on the push rod 509 is increased, the ball valve would move to a clear position and the brake line outlet port 532 would be exposed to higher hydraulic pressure. In contrast, if the force 570 is reduced, some of the pressure of the brake line outlet is allowed to bleed through the center connecting conduit 546 whereby the braking force is effectively reduced. With this arrangement, it is possible to effectively modulate the amount of pressure provided to the brake line outlet 532. In addition, whatever the pressure is at the outlet 532, it is this pressure which is acting on the push rod 509 urging it to a release position. This force on the push rod provides brake force feedback to the user through the push rod. The higher the actual pressure, the more force is exerted against the user's foot via the push rod 509. In this way, the user is provided with feedback of the power of the braking force indirectly through the pressure of the hydraulic fluid in the brake line. The user will also be provided with feedback regarding the rate that the vehicle is slowing. Therefore the power assist arrangement provides not only the ability to quickly actuate the brakes but it also allows the user to modulate the braking pressure by varying the position of the push rod actuator 509. The pump 502 cooperates with the accumulator 504 to always have hydraulic fluid pressure at a certain minimum pressure level available. For example, the hydraulic fluid pressure may be set such that it is always at 1500 psi or higher. The pump may be controlled to effectively turn on at 1500 psi and turn off at something over 2000 psi. This additional pressure will allow time for the pump to be started or to avoid

any condition where there is insufficient hydraulic pressure.

The above power assist arrangement has proven particularly effective for brake applications where additional power is required due to the size of the braking system 510. For example, for large vehicle applications such as passenger cars, a larger brake is required and the actuating piston in each brake system is larger. It is also possible that each braking system has two such pistons and the power assist arrangement shown here is particularly effective to provide the desired fast response in combination with the ease of brake application as well as the modulation of the braking force. This arrangement is quite simple and relatively inexpensive. Some power is required for running of the pump for the hydraulic fluid, however, the overall system remains more efficient as the brake pads can be fully retracted to a clear position. This reduces brake drag, improves the life of the brakes and improves the operation of the brakes.

The power assist arrangement is particularly effective for brake systems having larger sized pistons where more hydraulic fluid is required to cause movement thereof. The power assist allows for large brake pad retraction distances to be used while still allowing fast brake pad actuation. The power assist arrangement does not require substantial movement of the brake actuator to actuate the brake pad while still allowing the user to vary the position of the brake actuator to control the hydraulic pressure and provide feedback through the brake actuator of the hydraulic pressure.

Although various preferred embodiments of the present invention have been described herein in detail, it will be appreciated by those skilled in the art, that
5 variations may be made thereto without departing from the spirit of the invention or the scope of the appended claims.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A ring brake comprising a ring braking member having an interior braking surface and an exterior braking surface, a caliper arrangement with opposed brake pads, means for supporting said caliper relative to said ring brake member to position said brake pads to the inside and the outside of said ring braking member for engaging said braking surfaces, said caliper arrangement including piston means for selectively moving said brake pads into braking engagement with said surfaces, and wherein said caliper arrangement is rotatably mounted on said ring braking member by means of bearings supported by said ring braking member and said caliper arrangement includes a linkage for connecting said caliper to a structure to prevent rotation of said caliper with rotation of said ring braking member.

2. A ring brake as claimed in claim 1 wherein said ring braking member includes means for mounting said ring braking member to a live axle to be rotatable with said live axle.

3. A ring brake as claimed in claim 1 wherein said ring braking member is of an aluminum alloy and includes a series of fan blades for causing air to move through said ring brake member.

4. A ring brake as claimed in claim 1 wherein said ring braking member includes a center port and a tapered sleeve insertable in said center port, said tapered sleeve having threads at a narrow end of said tapered sleeve, said tapered sleeve being partially insertable through said center port until the sleeve forms an interference fit with said center port with said threads being partially exposed beyond said center port, said ring brake including a threaded nut member in engagement

with said threads of said sleeve for drawing said sleeve into said center port and locking said ring member to a live axle for braking thereof.

5. A ring brake as claimed in claim 4 wherein said ring brake is mounted to a live axle of a shifter cart.

6. A ring brake as claimed in claim 3 wherein each brake pad includes a positive retraction mechanism.

7. A ring brake as claimed in claim 6 wherein each brake pad is controlled by a piston actuator and said positive retraction mechanism includes a compression washer which compressed during movement of said brake pad against said ring braking member with said compression washer expanding and positively retracting said brake pad when said piston actuator is not actuated.

8. A ring brake as claimed in claim 7 including a power assist servo valve having a push rod actuator selectively connecting said piston actuator of said brake pad to a high pressure hydraulic fluid source to actuate said piston actuator and to connect said piston actuator to reduce hydraulic pressure during retraction of said brake pad.

9. A ring brake as claimed in claim 8 wherein said power assist servo valve operates as a function of the position of said push rod actuator to modulate the hydraulic fluid pressure provided to said piston actuator.

10. A ring brake as claimed in claim 9 wherein said push rod actuator is exposed to the hydraulic pressure provided to said piston actuator and produces a force urging said push rod actuator to retract said brake pad and thereby provides brake actuation feedback to a user through the push rod actuator.

11. A vehicle having a frame supporting two steerable front wheels and a pair of rear wheels at a rear portion of said frame, said vehicle including an engine and a drive arrangement for powering said rear wheels via a live axle, and wherein each front wheel has a ring brake with a rotating braking surface with a pair of opposed brake pads movable into and out of contact with said rotating braking surface for braking thereof, and said live axle includes a rear ring brake having a rear ring braking member mounted coaxial with said live axle, said rear ring braking member including a caliper mounted on bearings of said rear ring braking member and coaxial with said live axle, said caliper including a connecting link securing said caliper in position as said live axle rotates, said caliper including brake pads movable by a hydraulic arrangement between a braking position opposing rotation of said rear ring braking member and a release position allowing rotation of said rear ring braking member and said live axle.

12. A vehicle as claimed in claim 11 wherein said rear ring brake includes a brake pad retraction mechanism that positively moves said pads to a position out of contact with said rear ring braking member.

13. A vehicle as claimed in claim 12 wherein each ring brake member includes a fan arrangement for moving air through the center of the respective ring brake member with rotation thereof.

14. A vehicle comprising two front wheels and two rear wheels, each front wheel including a ring brake arrangement, each ring brake arrangement having a ring braking member rotatable with said wheel with braking surfaces either side of said ring braking member and a caliper with opposed braking pads actuatable to engage said

braking surfaces; said rear wheels including rear ring braking means for braking of said rear wheels.

15. A vehicle as claimed in claim 14 wherein said rear wheels are interconnected by a live axle and said live axle supporting said rear ring braking means.

16. A vehicle as claimed in claim 15 wherein said rear ring braking means includes a ring braking member secured in a coaxial manner to said live axle, said ring braking member having an interior braking surface and an exterior braking surface, a caliper arrangement with opposed brake pads, means for supporting said caliper relative to said ring brake member to position said brake pads to the inside and the outside of said ring braking member for engaging said braking surfaces, said caliper arrangement including piston means for selectively moving said brake pads into braking engagement with said surfaces, and wherein said caliper arrangement is rotatably mounted on said ring braking member by a bearing arrangement supported by said ring braking member and said caliper arrangement includes a linkage for connecting said caliper to a said racing vehicle to prevent rotation of said caliper with rotation of said ring braking member.

17. A vehicle as claimed in claim 16 wherein said piston means includes a piston actuator associated with each brake pad and said caliper arrangement includes a series of internal hydraulic conduits connecting said piston actuators.

18. A vehicle as claimed in claim 17 wherein said caliper arrangement includes a series of heat dissipation fins on the exterior thereof.

19. A vehicle as claimed in claim 18 wherein said ring braking member includes a series of radial members for moving of cooling air through the center of said ring braking member during rotation thereof.

20. A vehicle as claimed in claim 11 wherein said vehicle is a racing cart.

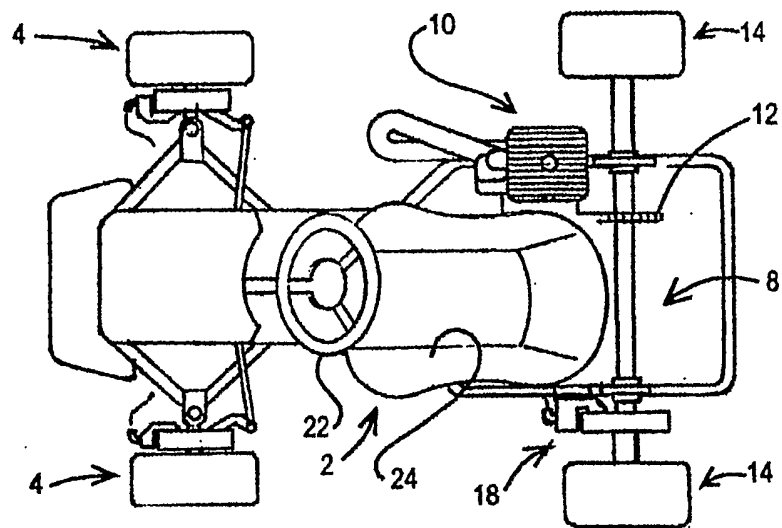


Fig. 1

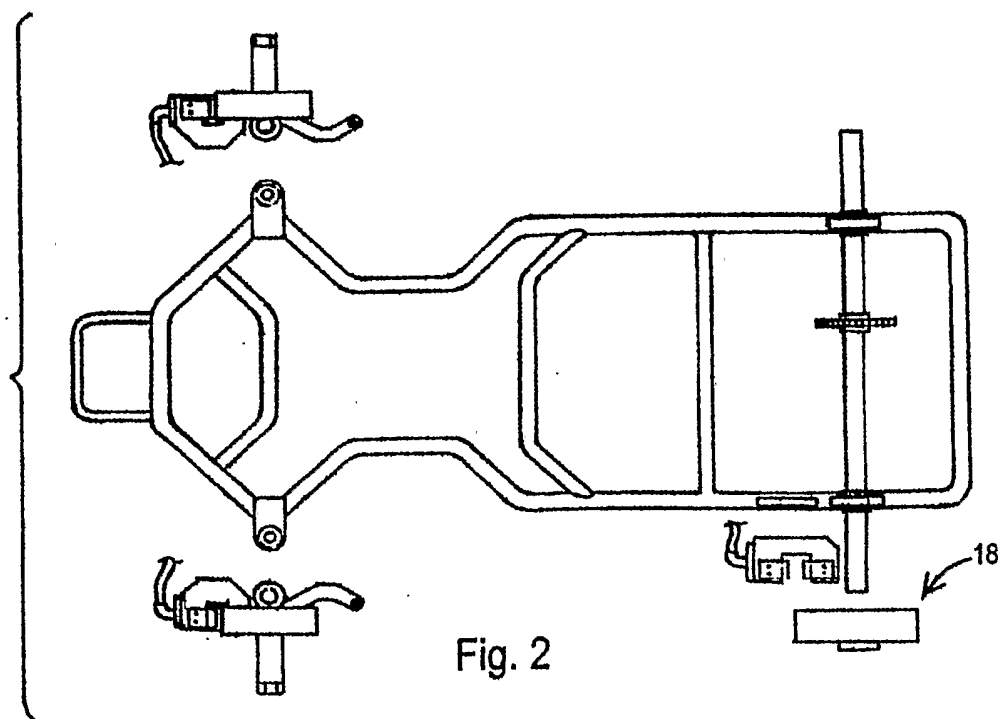


Fig. 2

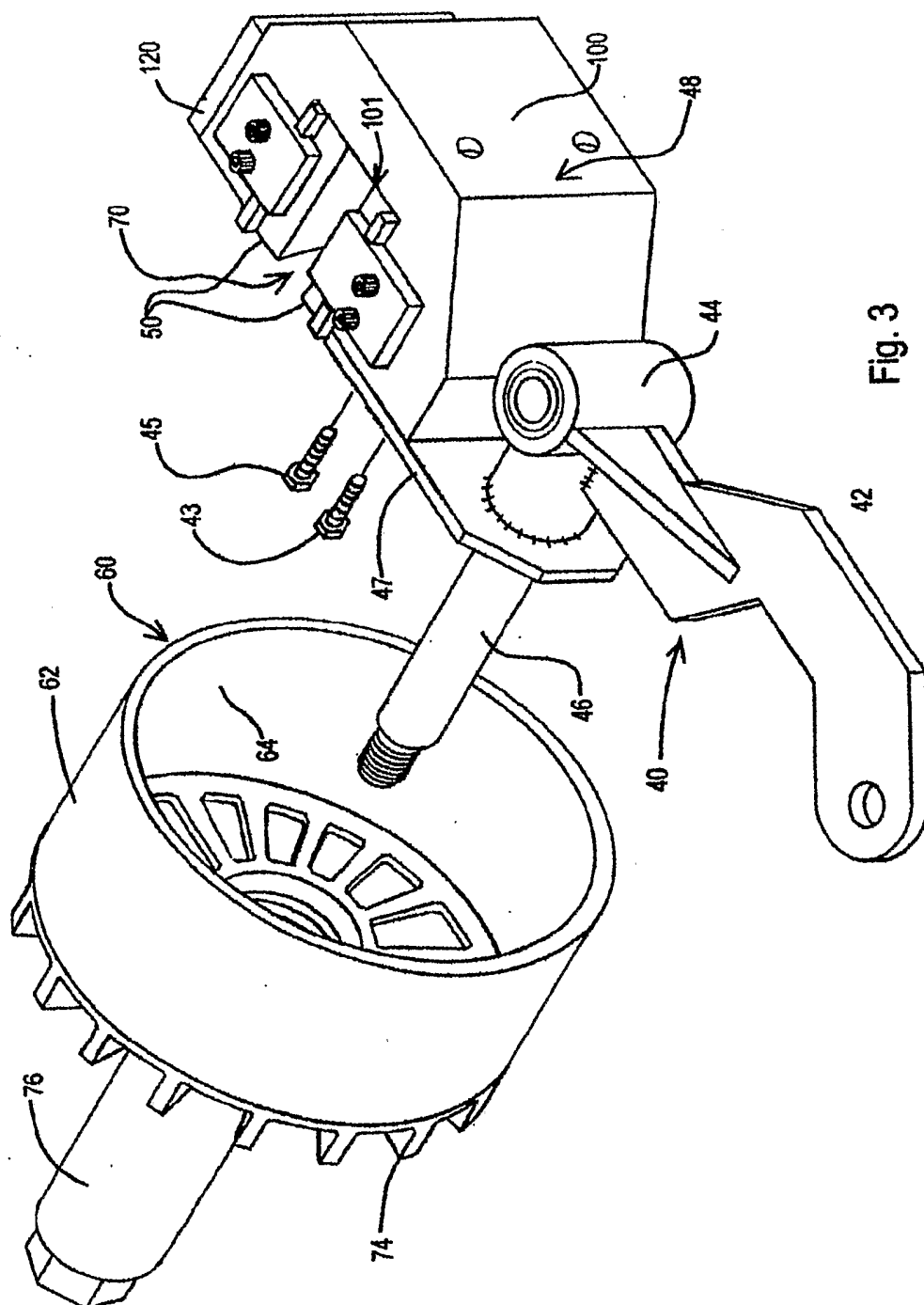
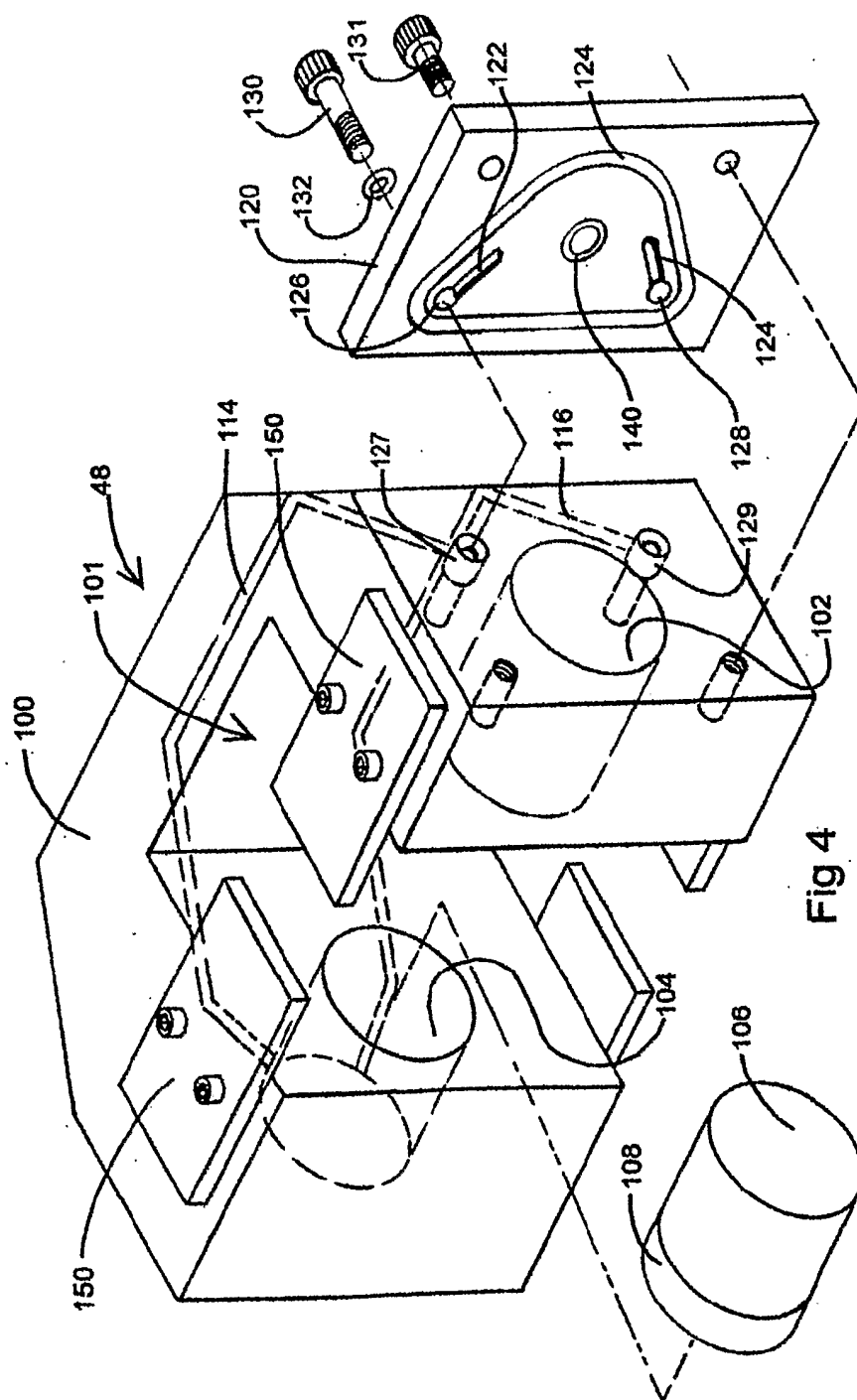


Fig. 3



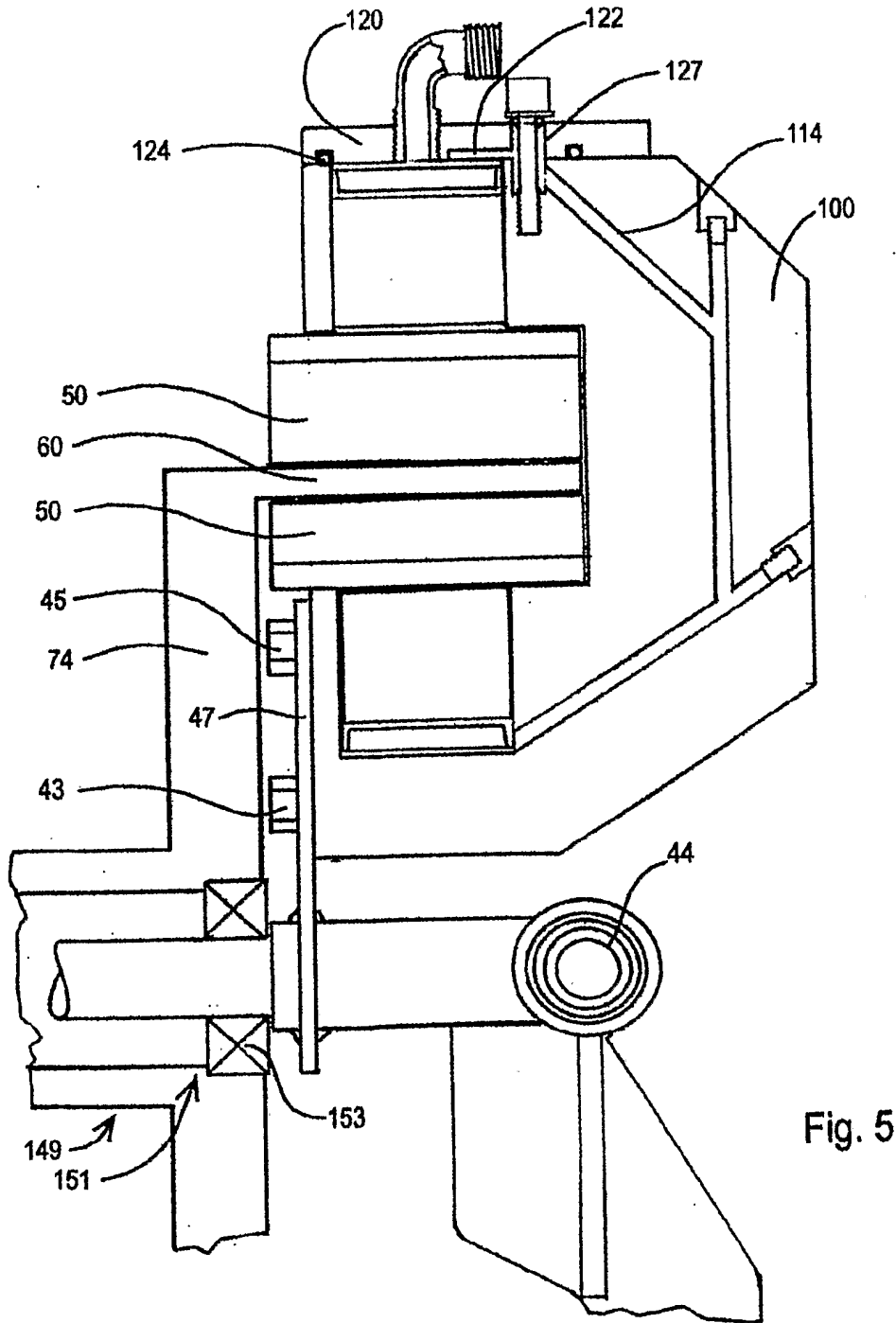
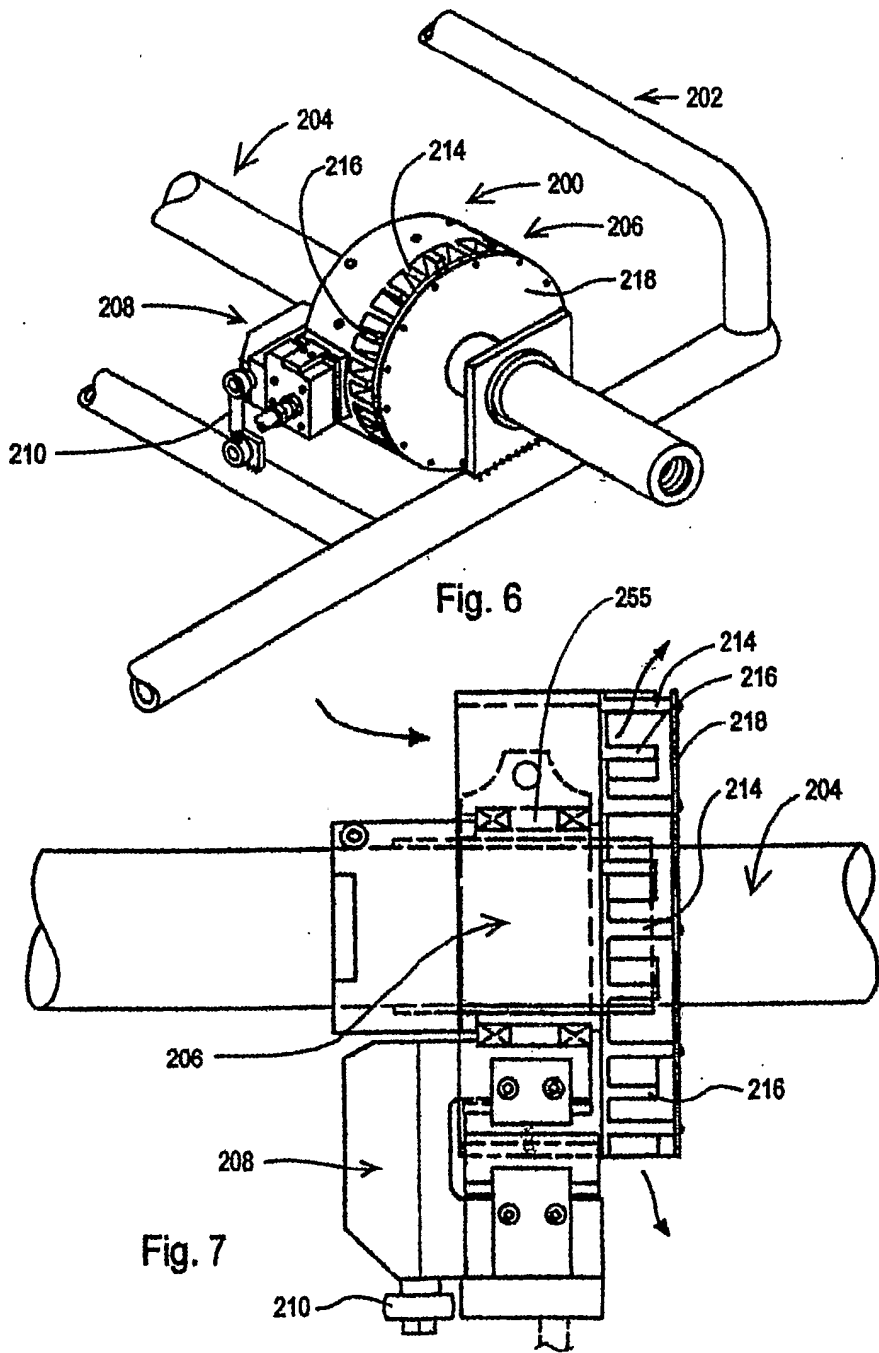


Fig. 5



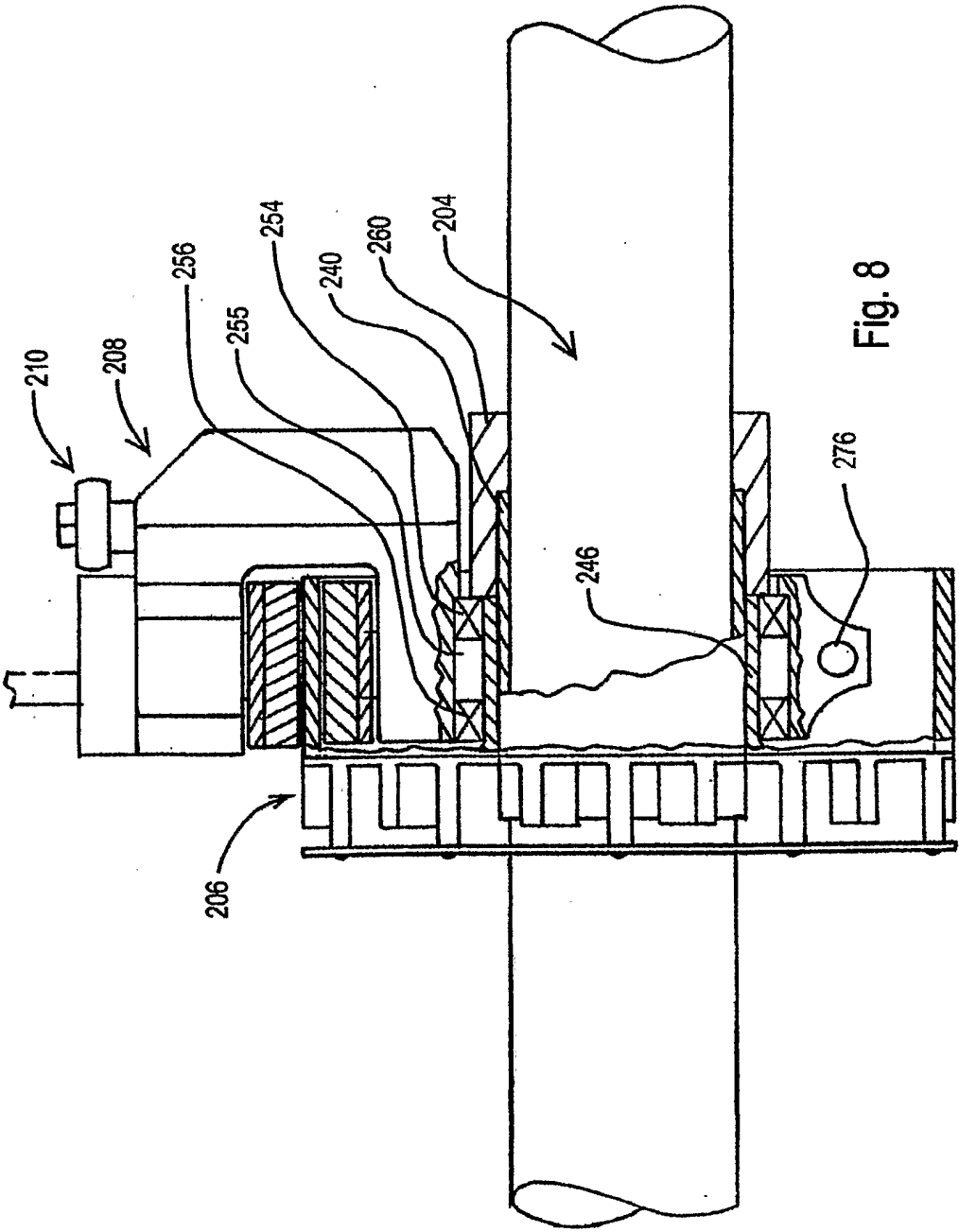
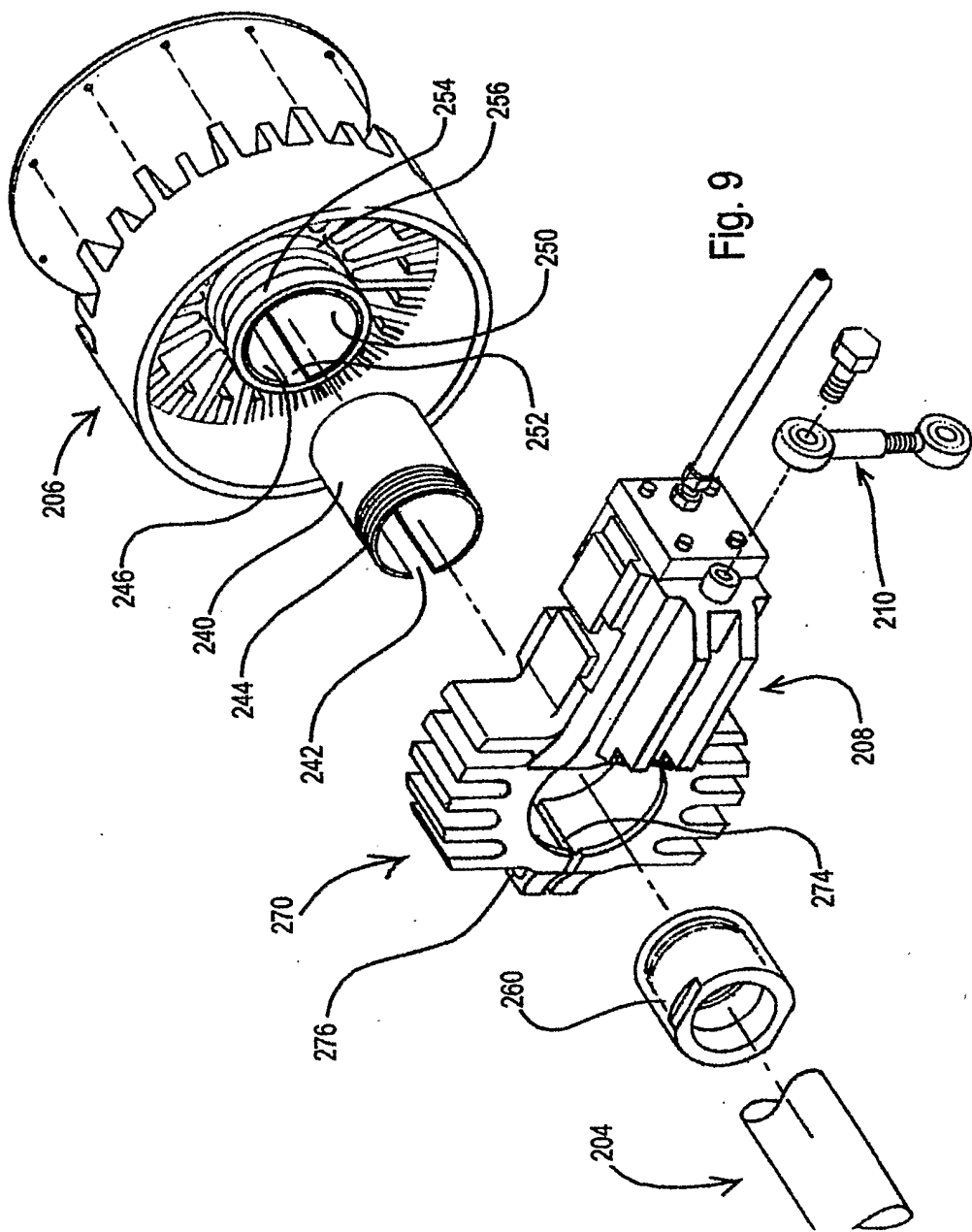
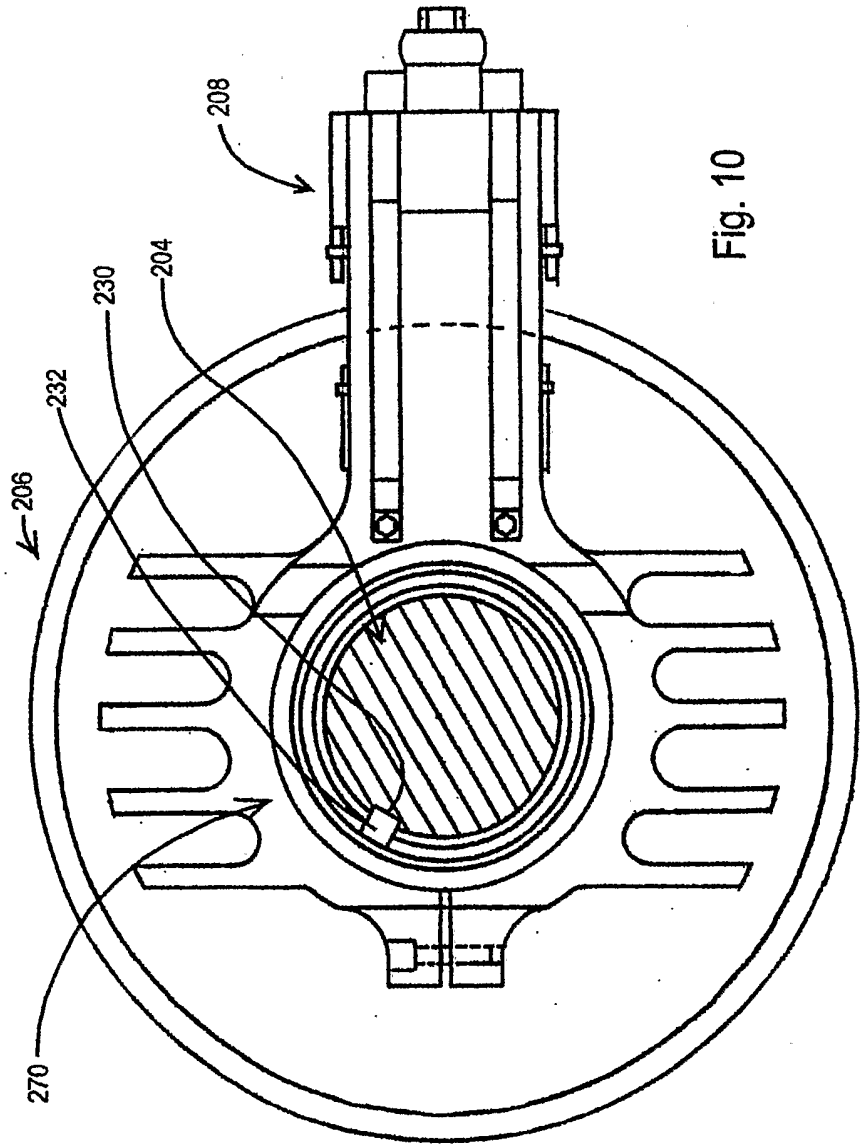


Fig. 8





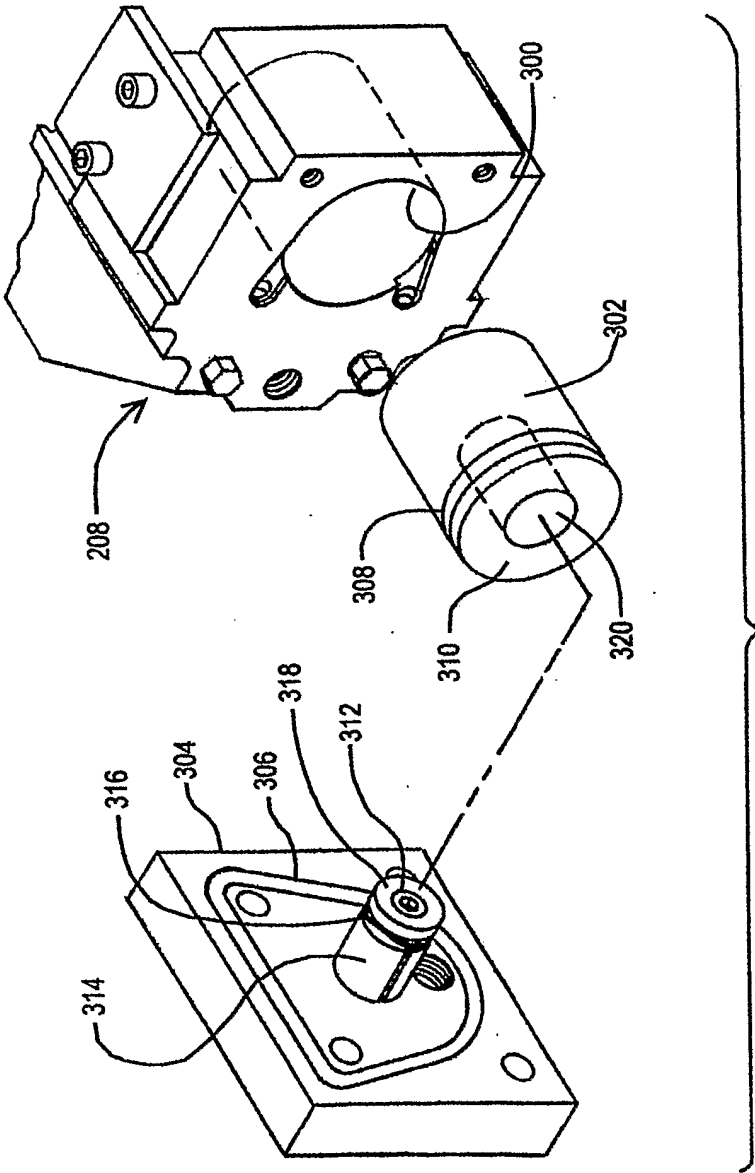
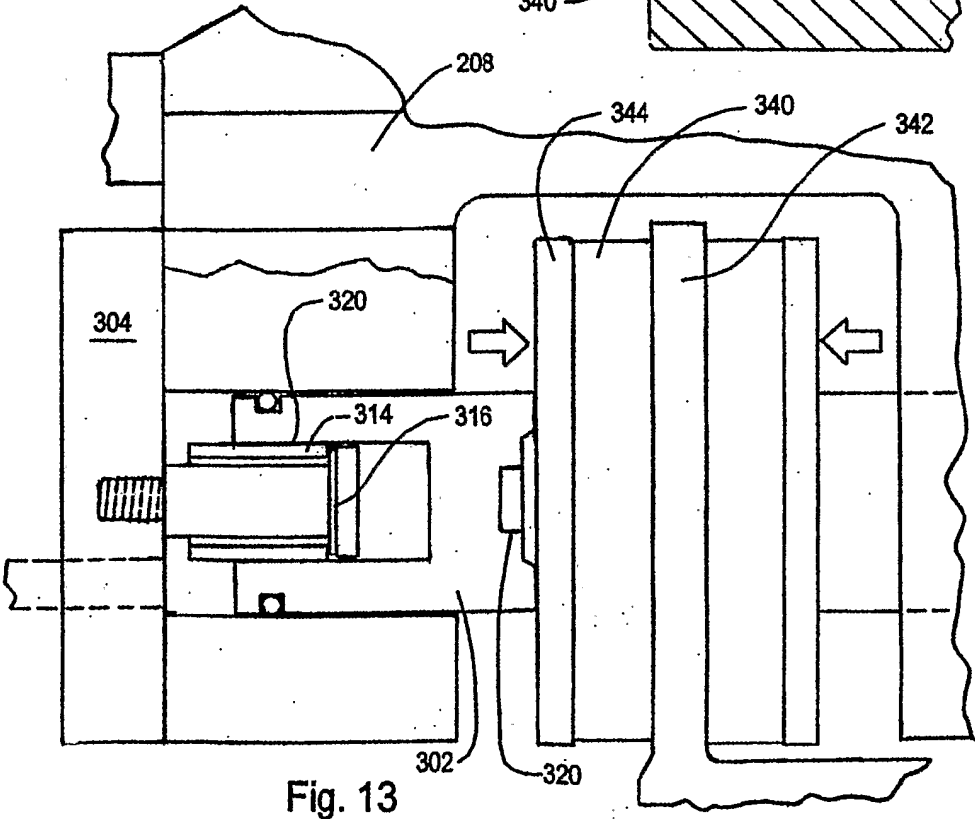
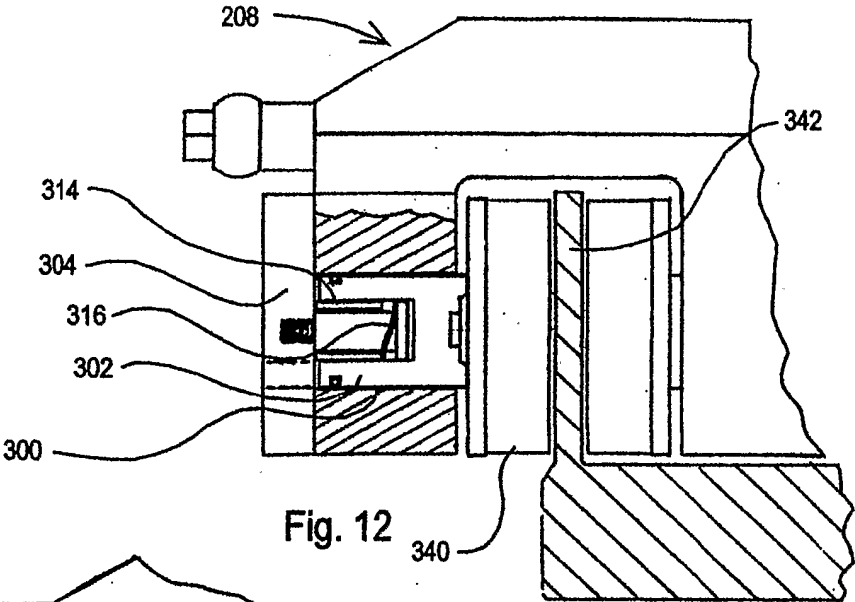
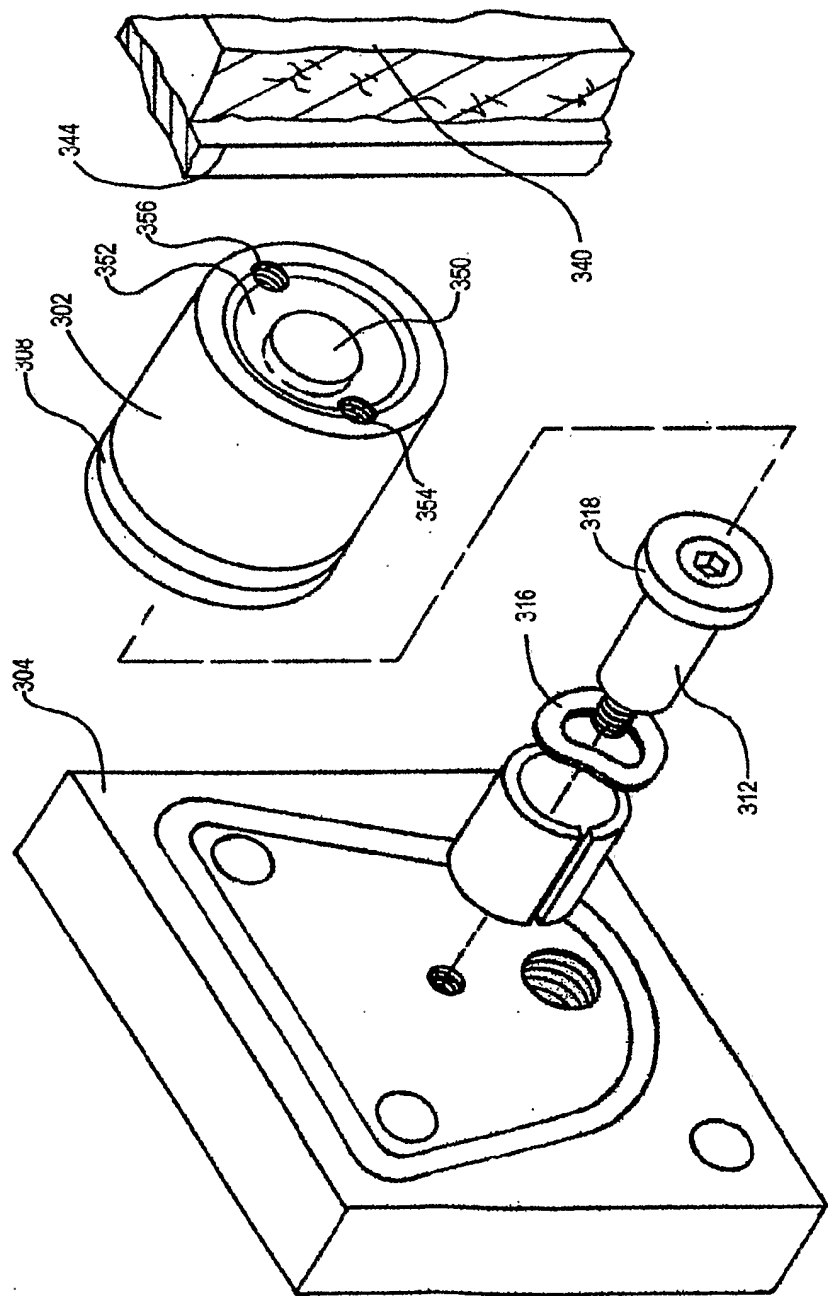


Fig. 11





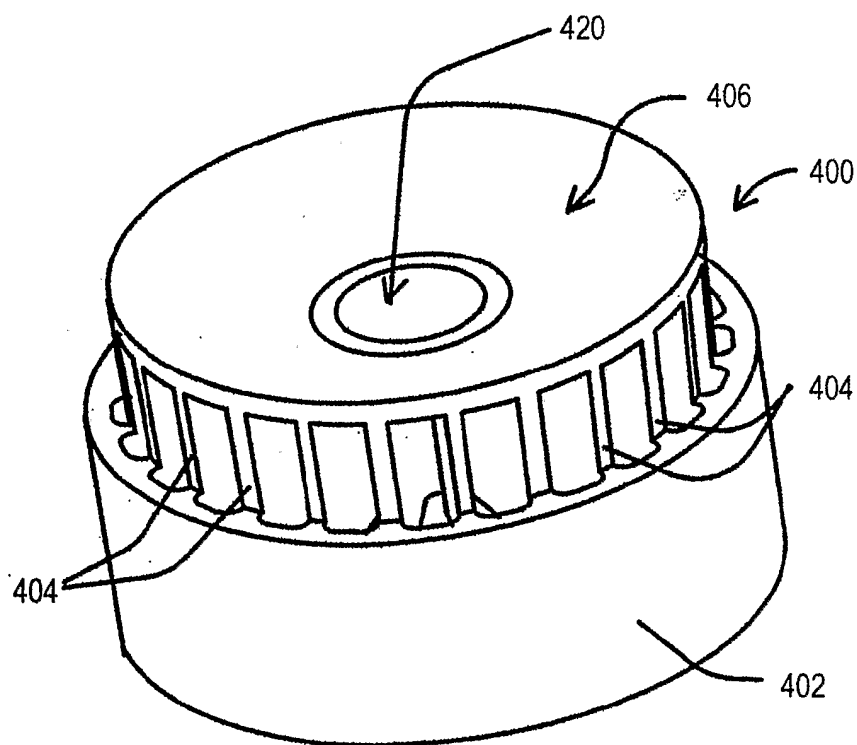


Fig. 15

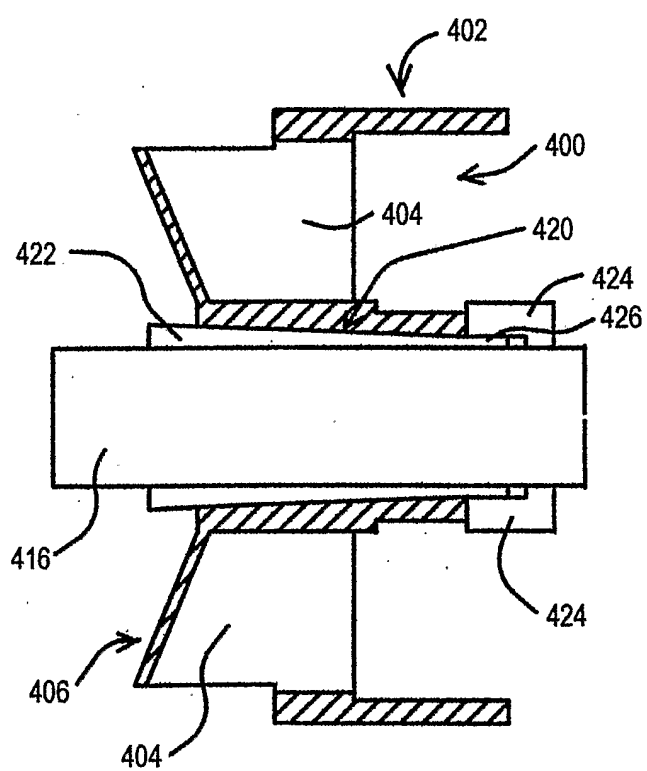


Fig. 16

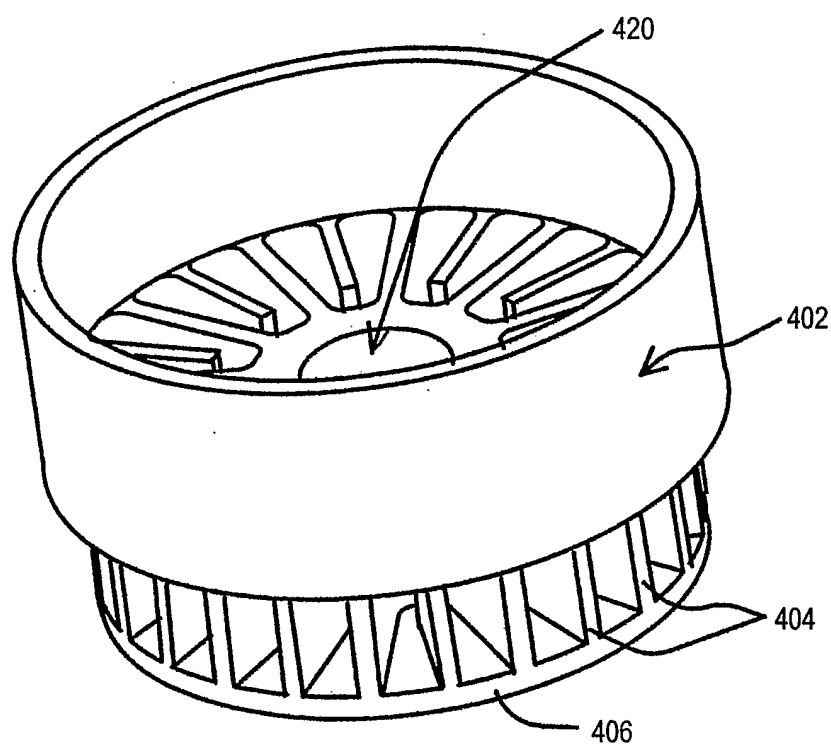


Fig. 17

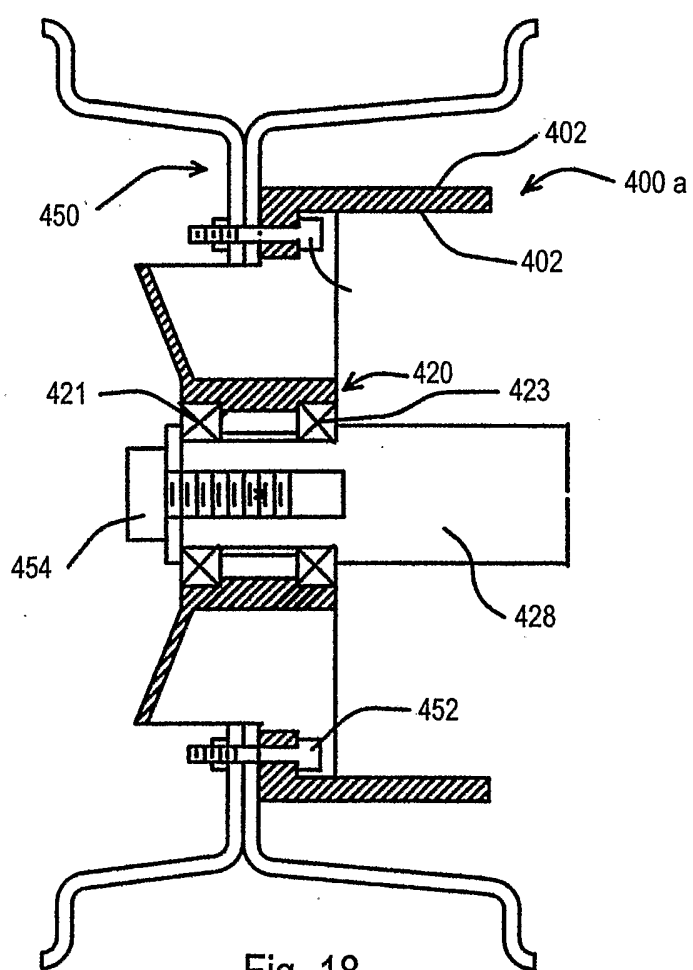
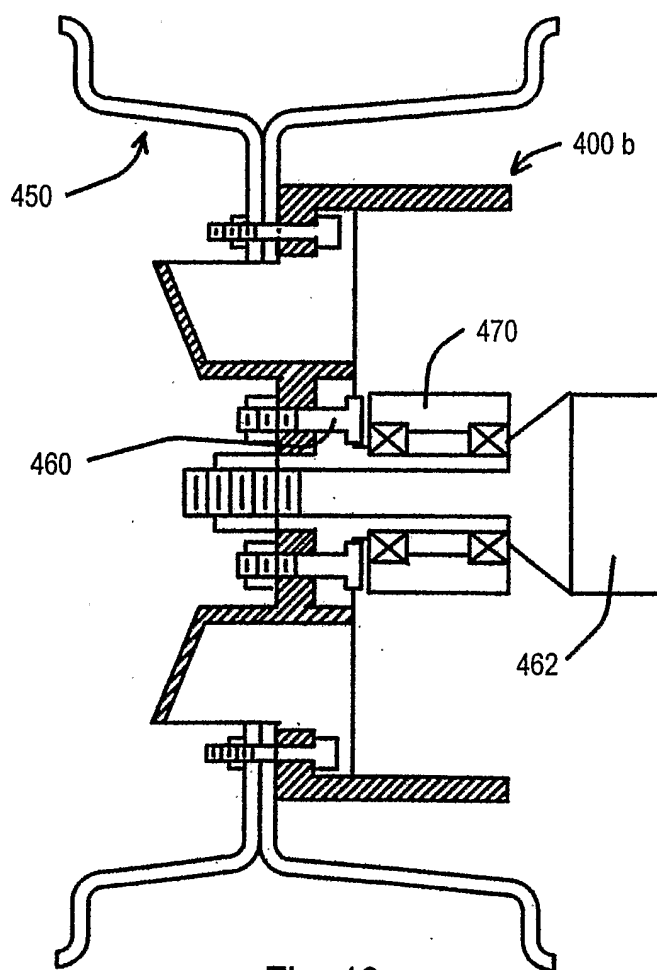


Fig. 18



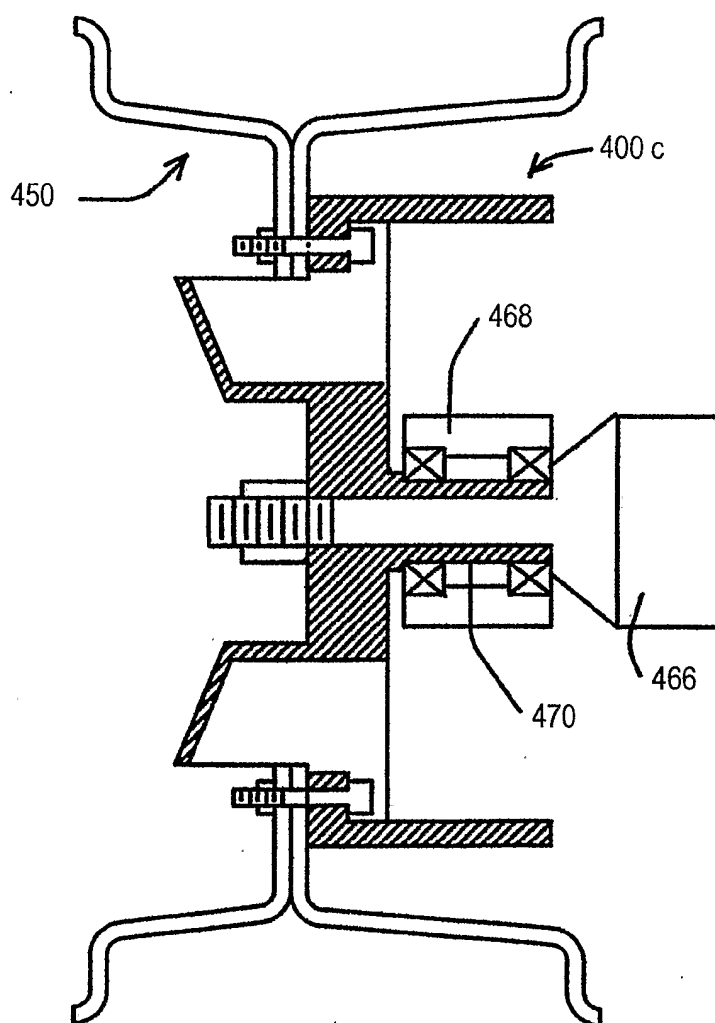


Fig. 20

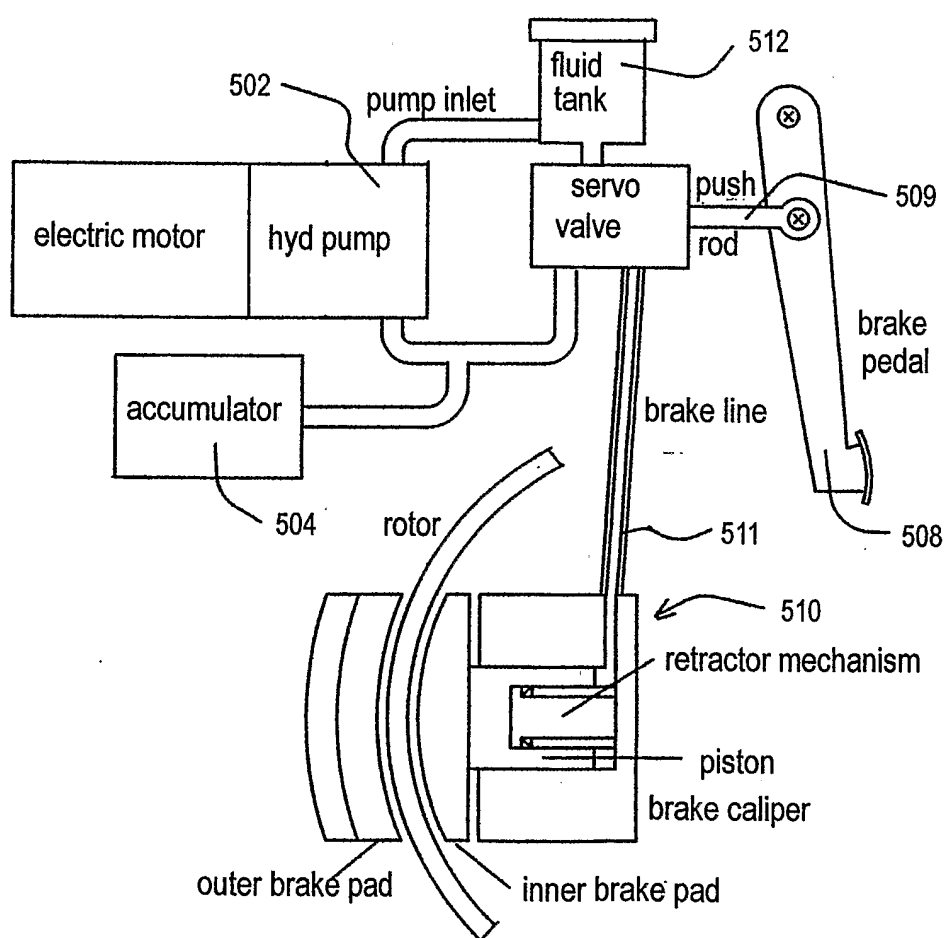


Fig. 21

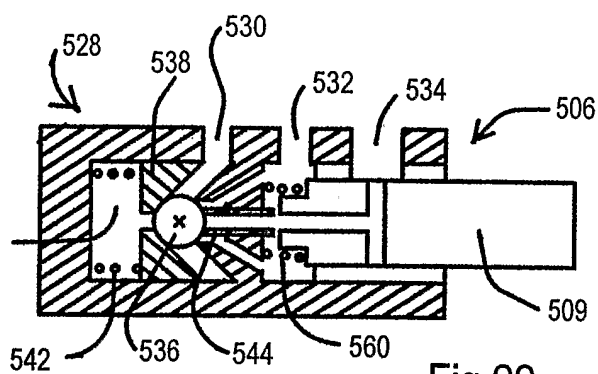


Fig. 22

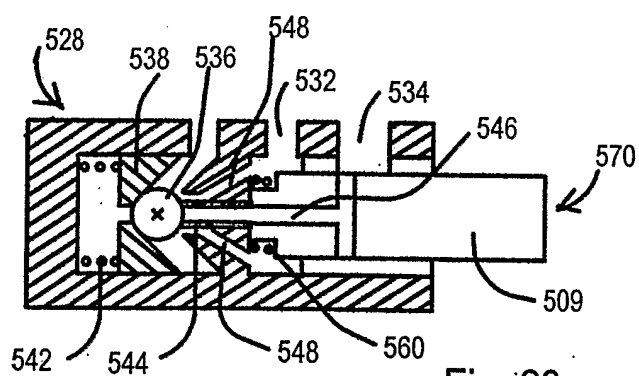


Fig. 23

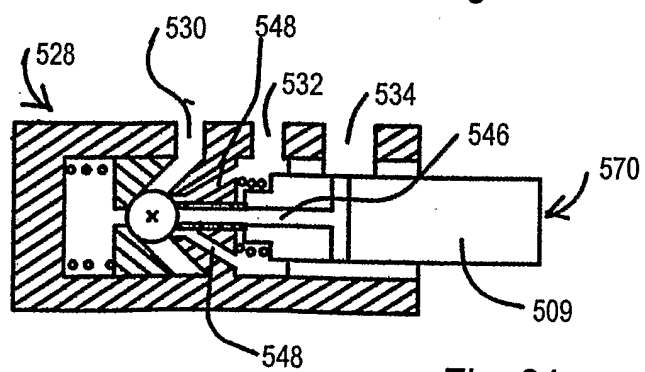


Fig. 24