

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number:

0 302 288
A1

(12)

EUROPEAN PATENT APPLICATION

(21) Application number: 88111487.0

(51) Int. Cl.4: F01L 13/06 , F01L 13/00

(22) Date of filing: 26.05.86

(30) Priority: 09.08.85 US 763962

(43) Date of publication of application:
08.02.89 Bulletin 89/06(60) Publication number of the earlier application in
accordance with Art.76 EPC: 0 211 170(84) Designated Contracting States:
AT BE CH DE FR GB IT LI LU NL SE(71) Applicant: **THE JACOBS MANUFACTURING
COMPANY**

22 East Dudleytown Road
Bloomfield Connecticut 06002(US)

(72) Inventor: **Meistrick, Zdenek Sidonius**
78 Adams Road
Bloomfield Connecticut 06002(US)(74) Representative: **Grättinger, Günter**
Wittelsbacherstrasse 5 Postfach 16 49
D-8130 Starnberg(DE)(54) **Disengageable valve drive means.**

(57) A disengageable valve drive means which may be employed in internal combustion engines having a retarding mode of the compression-release type additionally to the normal powering mode consists of at least two tubular members (258,288) which are engaged to each other in the normal powering mode and which are disengaged in the retarding mode so that the inner tubular member (280) may slide in the other tubular member (258) in order to disable or modify the normal valve motion. The disengageable valve drive means may be incorporated into the valve pushtube, the rocker arm adjusters crew, rocker arm, rocker arm shaft or crosshead.

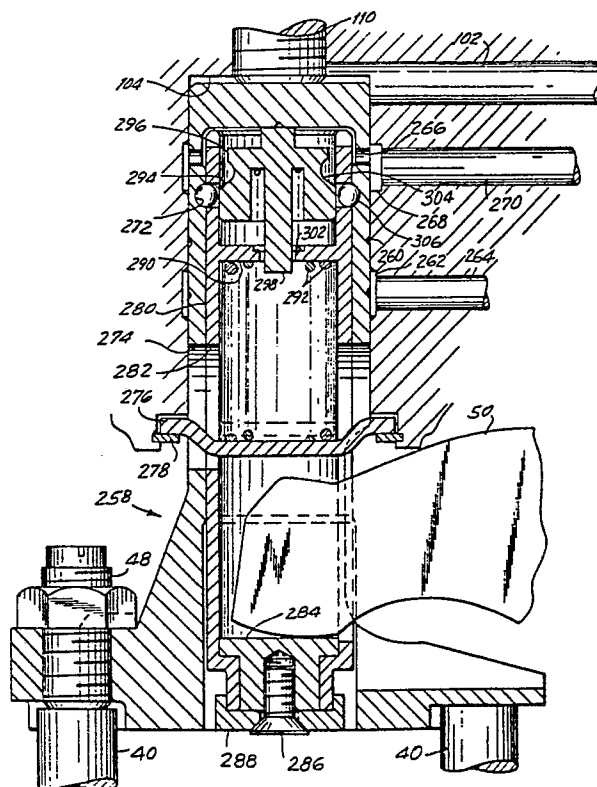


FIG. 1A

EP 0 302 288 A1

Disengageable valve drive means

This invention relates to disengageable valve drive means. In particular it relates to hydraulically and mechanically disengageable valve drive means which are employed in internal combustion engines which may be switched from the normal powering mode to a retarding mode of the compression-release type.

In internal combustion engines which may be switched from a powering mode to a retarding mode of the compression release-type, the normal motion of at least one exhaust valve has to be substituted by a modified valve motion. An improved engine retarding method of the named type with an advantageous valve motion in the retarding mode has been disclosed in the European Patent Application 86 107 117.3 which is the parent application to this divisional application.

While known engine retarding methods of the compression release type (eg. US-PS 32 20 392) merely provide an additional exhaust valve opening event at the end of the stroke corresponding to the compression stroke in the powering mode, said additional opening event not interfering with the normal exhaust valve motion, in an improved engine retarding method according to the parent application to this application (EP-A 0 211 170) the normal valve motion has to be modified in the retarding mode.

Thus it is necessary to disable the exhaust valves from the opening at the time they would normally open during the positive power mode of engine operation. Two mechanisms which accomplish this result are disclosed in U.S. Patent 4 572 114 which is owned by the assignee of the present invention. One of these mechanisms involves a modification of the exhaust valve crosshead to temporarily prevent its actuation by the rocker arm 50 while enabling actuation by the slave piston. The other mechanism involves a modification of the rocker arm 50 wherein the portion of the rocker arm which contacts the crosshead is temporarily disconnected from the portion of the rocker arm actuated by the pushtube 52.

A further alternative way to disable the exhaust valve is to provide an eccentric bushing in the rocker arm pivot so as to raise the pivot or fulcrum and thereby introduce a lost motion in the valve train. Such a device is shown, for example in U.S. Patent 3 367 312. As noted above, other lost motion mechanisms may also be used; see for example U.S. Patent 3 786 792.

A further device for disabling the normal valve motion is known from EP-A 0 037 269 which concerns engine cylinder cutout systems in which for the cutout cylinders the exhaust valves are kept

open while the intake valves are kept closed. The disengageability of the intake valve train is accomplished by a two-part pushtube, the two parts being telescopically sidable with respect to each other and having locking means to prevent telescopic sliding in the normal powering mode of the engine. The locking means are controlled by means of a hydraulically actuated piston accommodated between the outer portion of the two-part pushtube and a housing. A very high accuracy is necessary in the production of this assembly, since three separate chambers for control-fluid are required for operation. The high-precision production, however, result in high production cost.

It is the object of this invention to provide a reliable and simple mechanism for disabling the normal valve motion which may be incorporated into the valve pushtube, the rocker arm adjusting screw, rocker arm, rocker arm shaft or crosshead.

According to the present invention this problem is solved in the case of mechanisms which are incorporated into crossheads by the features listed in the characterizing clause of claim 1. In the case of incorporation of the disabling mechanism into the valve pushtube, the rocker arm adjusting screw or the like the problem is solved by the features as listed in the characterizing clause of claim 2.

In general the mechanisms consist of a plurality of tubular members which are engaged to each other by locking means in the positive powering mode of the engine and which are disengaged in the retarding mode in order to allow the inner tubular member to slide in the outer tubular member whereby the normal valve motion is disconnected.

Further objects and advantages of the invention will be come apparent from the following detailed description of the invention and the accompanying drawings in which:

Fig. 1A is a cross-sectional view of a combined slave piston and cross-head mechanism capable of disabling the exhaust valve and showing the mechanism in the positive powering mode.

Fig. 1B is a cross-sectional view of the mechanism of Fig. 1 in the retarding mode of operation.

Fig. 2A is a cross-sectional view of an alternative mechanism for disabling the exhaust valve and showing the mechanism in the positive powering mode.

Fig. 2B is a cross-sectional view of the mechanism of Fig. 2A in the retarding mode of operation.

Fig. 3A is a cross-sectional view of a mechanism for delaying the opening of the intake valve and showing the mechanism in the positive powering mode.

Fig. 3B is a cross-sectional view of the mechanism of Fig. 3A in the retarding mode of operation.

A mechanism in accordance with the invention for disabling the exhaust valves is shown in Figs. 1A and 1B which comprises a unitary slave piston and crosshead 258. The unitary slave piston and crosshead 258 is mounted for reciprocating motion in the slave cylinder 104. The slave piston portion is generally tubular in shape but open at the lower end which comprises the crosshead portion. For convenience of lubrication, a series of annular grooves 260 may be formed in the circumferential surface of the slave piston portion of the unitary slave piston and crosshead 258. A circumferential annular channel 262 may also be formed in the slave cylinder 104 which communicates with a lubricating oil duct 264 and the low pressure oil supply duct. A series of radial ports 266 is formed through the skirt of the slave piston portion of the unitary structure 258 near the head of the piston portion. When the unitary structure 258 is in its rest position against the adjustable stop 110, the radial ports 266 register with a circumferential channel 268 that communicates through duct 270 with the low pressure feed duct for the control valve. A circumferential raceway 272 is formed on the inner surface of the slave piston portion of the unitary slave piston and crosshead 258 adjacent the radial ports 266. Windows 274 are formed through the slave piston portion of the unitary structure to clear retainer 276 which is positioned in the windows and located by a retainer ring 278 seated in a groove formed in the slave cylinder 104.

A slider 280, generally tubular in shape, is sized to reciprocate within the slave piston portion of the unitary slave piston and crosshead 258 when duct 270 is pressurized. Windows 282 are formed in the slider 280 to register with the windows 274. A rocker arm 284 is affixed to the lower portion of the slider 280 by a screw 286 and locking cap 288. The rocker arm contact 284 should be provided with an appropriately hardened surface suitable for activation by the exhaust rocker arm 50. A transverse wall 290 is formed in the slider 290 near the upper end thereof. Slave piston return springs 292 are positioned between the retainer 276 and the transverse wall 290 of the slider 280 to bias the slider 280 upwardly and, in turn, bias the slave piston and crosshead 258 against the adjustable stop 110. A series of radial ports 294 are formed in the upper end of the slider 280 above the transverse wall 290 so as to register with the raceway 272 when the slider 280 is in its uppermost position.

tion.

A piston 296 is located within the slider 280 above the transverse wall 290. The piston 296 is provided with an axial shaft 298 to guide spring 302 which biases the piston 296 away from the transverse wall 290. The lower circumferential portion of the piston 296 has substantially the same diameter as the inside of the slider 280 within which it can be reciprocated. The upper circumferential portion of the piston 296 is relieved to form a raceway 304. A plurality of balls 306, which may, for example, be ball bearings, is positioned in the series of radial ports 294. The balls 306 have a diameter greater than the wall thickness of the slider 280 so that the balls 306 extend into the raceway 272 and lock the slider 280 and the unitary slave piston and crosshead 258 together. When the slider 280 and the slave piston and crosshead 258 are locked together, oscillation of the rocker arm 50 will result in reciprocation of the crosshead so as to activate the exhaust valves 38.

However, when duct 270 is pressurized, piston 296 is forced downwardly against the bias of spring 302 so that the raceway 304 comes into registry with the radial ports 294 and the balls 306 are cammed out of raceway 272 and toward raceway 304. This action unlocks the slider 280 from the unitary slave piston and crosshead 258 so that actuation of the slider 280 by the exhaust rocker arm 50 will not result in opening the exhaust valves. However, when duct 102 is pressurized the unitary slave piston and crosshead 258 will be activated and the exhaust valves opened.

Fig. 1B illustrates the mechanism of Fig. 1A during the retarding mode of operation wherein the exhaust valves have been disabled by unlocking the slider 280 from the unitary slave piston and crosshead 258. It will be appreciated from Fig. 1B that when the exhaust valves have been disabled by this mechanism the exhaust valve springs have, in effect been removed from the remainder of the exhaust valve train. If the slave piston return spring 292 exerts insufficient force to avoid play in the valve train and maintain contact among the rocker arm, pushrod, cam follower and cam, a supplemental spring mechanism may be provided.

In the event that it is desired to employ separate crossheads and slave pistons in accordance with conventional practice, an alternative exhaust valve disabling mechanism according to the present invention may be used in place of the rocker arm adjusting screw and locknut.

Fig. 2A shows such a mechanism during the powering mode of engine operation wherein it performs the function of the adjusting screw. Fig. 2B shows the same mechanism during the retarding mode of engine operation wherein it disables the rocker arm 50 and, therefore, the exhaust valves.

Point 308 represents the point about which rocker arm 50 pivots when actuated by the push-tube 52. The mechanism comprises a tubular adjusting screw 310 which replaces the solid adjusting screw and which is locked in its adjusted position by locknut 312. The tubular adjusting screw is provided with three concentric bores. A large bore 314 extends a short distance from the pushtube end of the adjusting screw 310. An intermediate bore 316 extends from the large bore 316 substantially to the top of the adjusting screw 310. A small bore 318 extends through the top of the adjusting screw 310. A sloping shoulder 320 is formed between the large bore 314 and the intermediate bore 316 while a horizontal shoulder 322 is formed between the intermediate bore 316 and the small bore 318.

A drive pin 324 is positioned within the adjusting screw 310. The maximum diameter of the drive pin 324 is slightly less than the diameter of the intermediate bore 316 to permit reciprocation of the drive pin 324 relative to the adjusting screw 310. One end of the drive pin 324 is adapted to mate with, and be driven by, the pushtube 52. A snap ring 326 limits the down ward (as shown in Figs. 2A and 2B) movement of the drive pin 324 relative to the adjusting screw 310. The upper portion of the drive pin 324 has an outside diameter 328 which is slightly smaller than the small bore 318 of the adjusting screw 310 so as to permit relative reciprocation of the drive pin and adjusting screw 310. A shoulder 330 is defined by the diameter 328 of the upper portion of the drive pin 324 and the maximum diameter of the drive pin. A compression spring 332 is located within the adjusting screw 310 between shoulders 322 and 330 so as to bias the drive pin 324 downwardly (as shown in Figs. 2A and 2B) relative to the adjusting screw 310. A plurality of ports 334 are disposed around the circumference of the drive pin 324 in the region of its largest diameter. The ports 334 are directed angularly downwardly (as shown in Figs. 2A and 2B) from the outside of the drive pin 324 toward the axis of the drive pin. A stepped cavity 336 is formed within the drive pin 324. The largest diameter 338 of the stepped cavity 336 communicates at its upper region with the plurality of ports 334, and with an intermediate diameter 340 through a sloping shoulder 342. The intermediate diameter 340 terminates at a shoulder 344 while a smaller diameter section 346 extends from the shoulder 344 through the top of the drive pin 324.

A stepped actuator pin 348 is mounted for reciprocating motion with respect to the drive pin 324 and includes a large diameter section 350, an intermediate diameter section 352 and a small diameter section 354. A sloping shoulder 356 joins the larger diameter section 350 and the intermedi-

ate diameter section 352 while a horizontal shoulder 358 is located between the intermediate and small diameter sections of the actuator pin 348. When the actuator pin 348 is in its uppermost position (as shown in Fig. 2A) the horizontal shoulder 358 in the actuator pin abuts the shoulder 344 of the drive pin 324 and the small diameter section 354 of the actuator pin 348 extends beyond the upper end of the drive pin 324. The actuator pin 348 is biased toward its uppermost position by a compression spring 360 located within the cavity 336. A ball 362 is located in each of the ports 334. The balls 362 are larger in diameter than the wall thickness of the drive pin 324 in the region of the ports 334 so that when the actuator pin is in its uppermost position (as shown in Fig. 2B) the balls 362 extend outside the drive pin 324 and engage the shoulder 320 of the adjusting screw 310. However, whenever the actuator pin 348 is depressed as shown in Fig. 2B, the sloping shoulder 320 cams the balls 362 inwardly so that the balls 362 rest, at least partially, on the sloping shoulder 356 of the actuator pin 348. In this position (Fig. 2B), the balls 362 clear the shoulder 320 and the adjusting screw 310 is free to reciprocate with respect to the drive pin 324 so that no movement is imparted to pushtube 52.

Point 364 (Fig. 2B) represents the maximum upward excursion of the drive pin 324 as a result of the upward movement of the exhaust valve push-tube 52. The distance 366 (Fig. 2B) represents a clearance (which should be a minimum of about 0.100") between point 364 and the rest position of the master piston 66" (or 224).

The master piston 66" (or 224) is biased toward its rest position by the leaf spring 120" (or 236). Whenever the engine retarder is turned on, the hydraulic circuit will be pressurized by the low pressure pump and the master piston 66" will be driven downwardly (as viewed in Figs. 2A and 2B) until it contacts the end of the drive pin 324 against the bias of leaf spring 120" and compression spring 360. Under these conditions, the motion of the pushtube 52 will be transmitted through the drive pin 324 to the master piston 66" but the rocker arm 50 will remain at rest since the drive pin 324 will be disengaged from the adjusting screw 310. However, the bias of compression spring 332 will maintain the rocker arm 50 in contact with the exhaust valve crosshead (not shown). It will be seen, therefore, that the exhaust valves are automatically disabled by the mechanism of Fig. 2A and 2B whenever the engine retarder is switched on.

Figs. 3A and 3B illustrate a mechanism which is very similar to the mechanism shown in Figs. 2A and 2B but which is designed to delay but not entirely disable the motion of the intake valve. For

purposes of clarity and brevity, parts which are common to both mechanisms carry the same designators. It will be understood, however, that the rocker arm 232 is an intake valve rocker arm, the pushtube 228 is an intake valve pushtube and the master piston 224 is located in alignment with the intake valve pushtube 228 within a master cylinder 226 located in the retarder housing.

The only significant difference in the mechanisms shown in Figs. 3A and 3B over the mechanisms shown in Figs. 3A and 3B is that an extra step is provided between the intermediate bore 316 and the small bore 318 so as to form a shoulder 364 between the intermediate bore 316 and an intervening bore 366. The diameter of the intervening bore 366 is smaller than the maximum diameter 328 of the drive pin 324. The distance 368 between shoulders 330 and 364 is directly proportional to the delay introduced into the motion of the rocker arm and valve associated therewith. It will be appreciated that any desired delay may be built into the mechanism. When the distance 368 is equal to or greater than the travel of the pushtube 228, the mechanism of Figs. 3A and 3B will function exactly like the mechanism of Figs. 2A and 2B.

Although the mechanism of Figs. 3A and 3B is intended principally to provide the intake valve delay, it will be appreciated that this mechanism may be used whenever a delay in the intake or exhaust valve motion is required. Similarly, the mechanism of Figs. 2A and 2B may be used whenever the intake or exhaust valves are required to be disabled.

The terms and expressions which have been employed are used as terms of description and not of limitation and there is no intention in the use of such terms and expressions of excluding any equivalent of the features shown and described or portions thereof, but it is recognized that various modifications are possible within the scope of the invention claimed.

Claims

1. A unitary slave piston and crosshead mechanism for an internal combustion engine equipped with a compression release engine retarder comprising crosshead means adapted to contact the stems of dual exhaust valves, characterized in that said crosshead means is integrally formed with slave piston means (258) adapted to reciprocate within a slave cylinder (104) formed in said compression release retarder, said crosshead means also having formed therein an internal bore, a first circumferential raceway (272) formed in said internal bore, a plurality of first transverse radial ports (266), and first transverse windows (274) commu-

nicating between said bore and the outer surface of said integral slave piston means, tubular slider means (280) positioned within said internal bore for reciprocating movement therein, second transverse window means (282) adapted to register with said slave piston transverse windows, contact means (284) associated with a first end of said slider means, a plurality of second transverse radial ports (294) and a transverse wall (290) formed adjacent the second end of said tubular slider means, retainer means (276) located within said first and second transverse windows and affixed to said slave cylinder, biasing means (292) positioned between said retainer means and first side of said transverse wall, piston means (296) positioned for reciprocation within said tubular slider means in the region between said transverse wall and said second end of said tubular slider means, said piston means having a second circumferential raceway - (304) formed thereon, biasing means (302) adapted to bias said piston away from said transverse wall, and locking means (306) loosely located in said radial ports of said tubular slider means and adapted in their locking mode of register with said first circumferential raceway, whereby said tubular slider means is locked to said crosshead means, and in their unlocked mode to register with said second circumferential raceway (304) to permit said tubular slider means to reciprocate within said internal bore of said crosshead.

2. A valve disabling mechanism for an internal combustion engine having a valve train mechanism comprising tubular driven means (310) affixed to the valve train mechanism (50) and having first - (320) and second (322) shoulder means, tubular drive pin means (324) coaxially disposed within said tubular driven means and communicating at one end with said valve train mechanism, said tubular drive pin means having third (330) and fourth (342) shoulder means and a plurality of transverse radial ports (334), actuating pin means - (348) coaxially disposed within said tubular drive pin means and adapted to reciprocate between first and second positions within said tubular drive pin means, said actuating pin means having fifth (356) and sixth shoulder means (358), first biasing means (360) interposed between said actuating pin means (348) and said tubular drive pin means (324) and adapted to bias said drive pin means towards said first position, second biasing means (332) disposed between said second (322) and third (330) shoulder means, and locking means (362) loosely disposed within said transverse radial ports and being moveable between a first position in engagement with said first shoulder for conjoint movement of said tubular driven means and said tubular drive pin means (324) and a second position in engage-

ment with said fifth shoulder for enabling reciprocating motion of said tubular driven means relative to said tubular drive pin means.

3. The mechanism of claim 2 characterized in that said tubular driven means includes a seventh shoulder (364) intermediate said first (320) and second (322) shoulders engageable with said third shoulder (330).

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4. The mechanism of claim 2 or 3, characterized in that said tubular driven means is adjustable with respect to said valve train mechanism.

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5. The mechanism of claim 2 or 3 characterized in that said first (320) and fifth (356) shoulders are sloped in a direction to cam said locking means away from whichever one of said first and fifth shoulders said locking means may be in engagement with.

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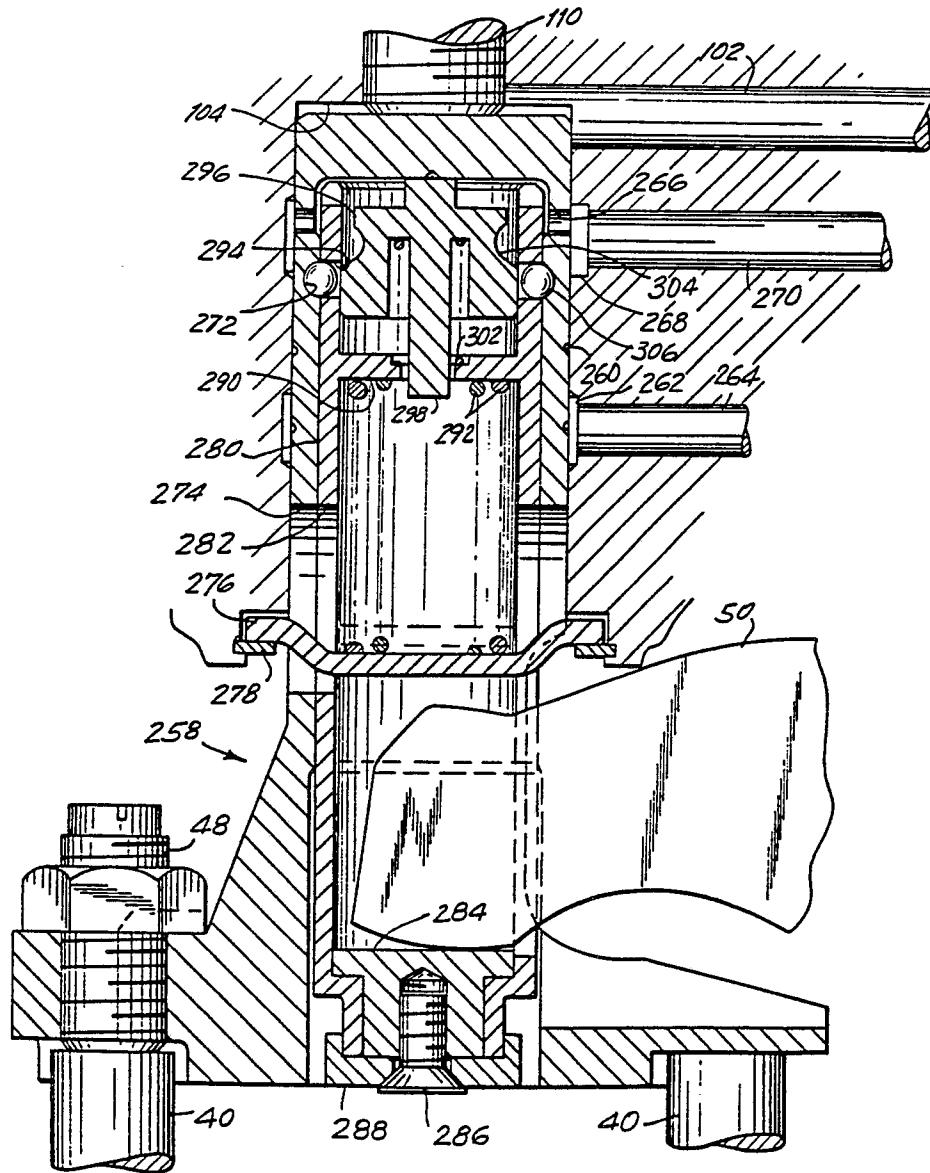
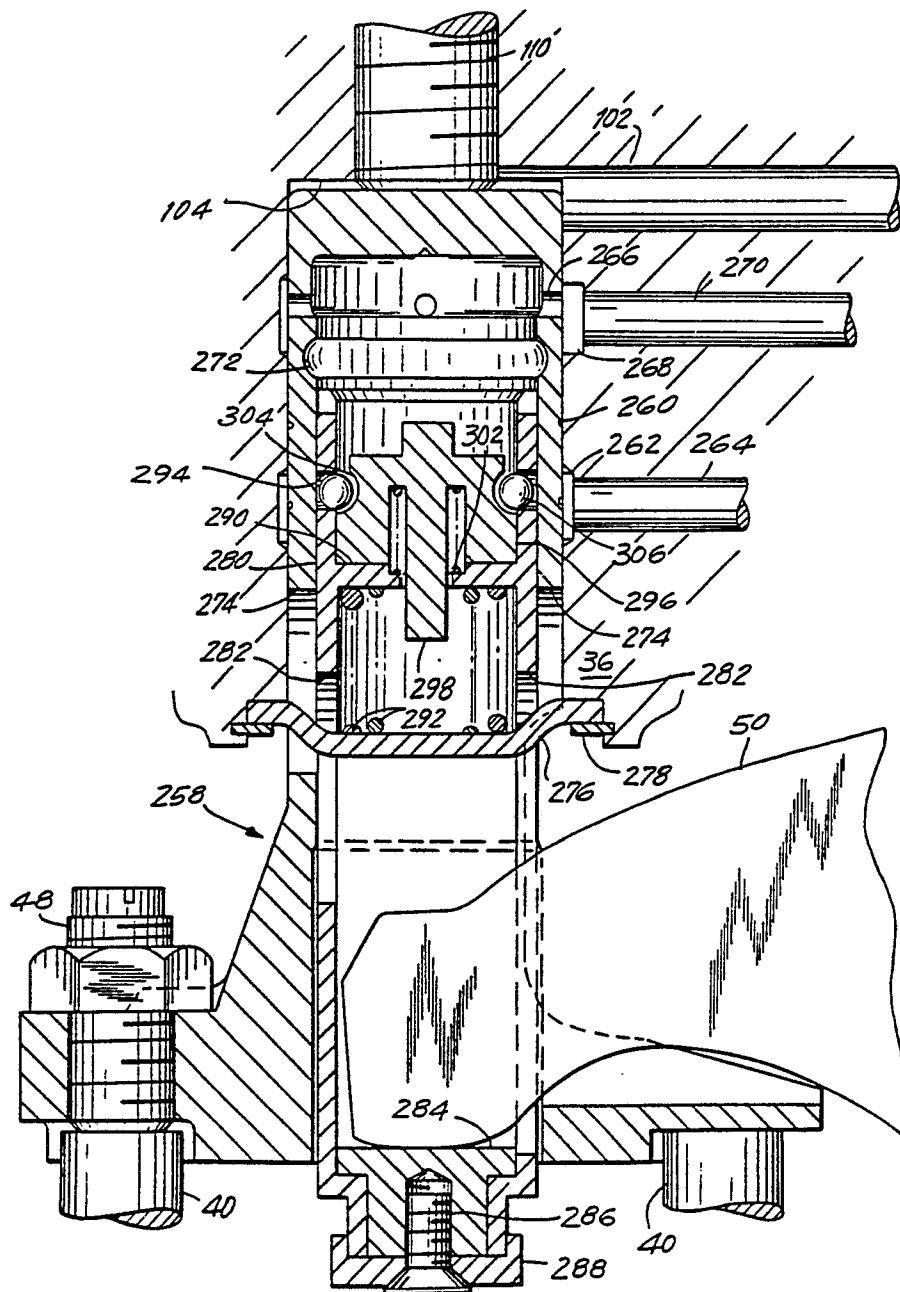
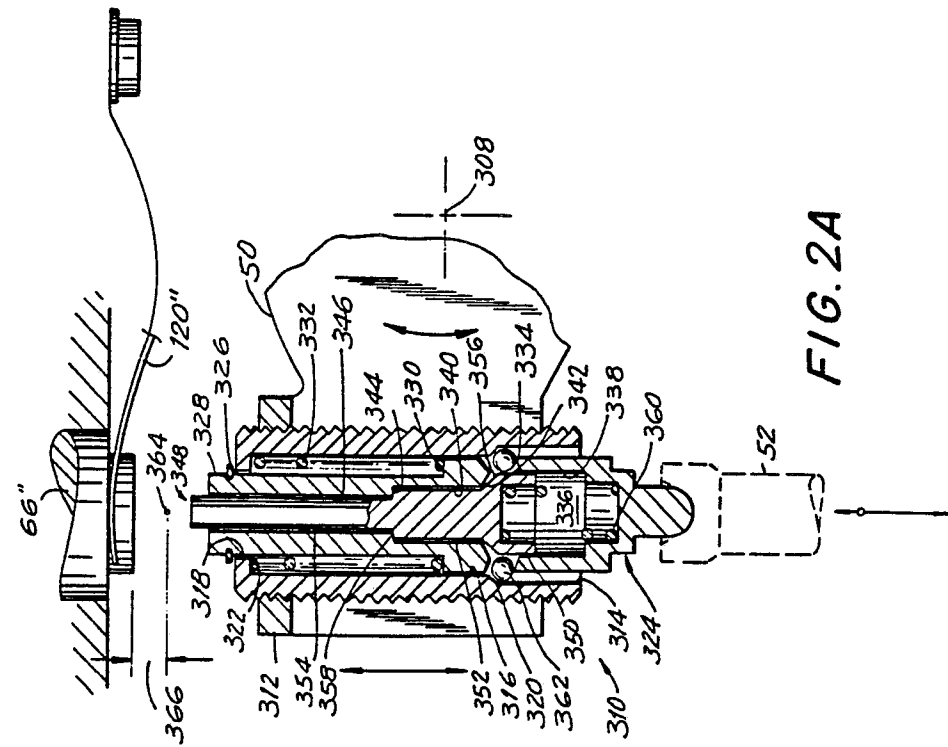
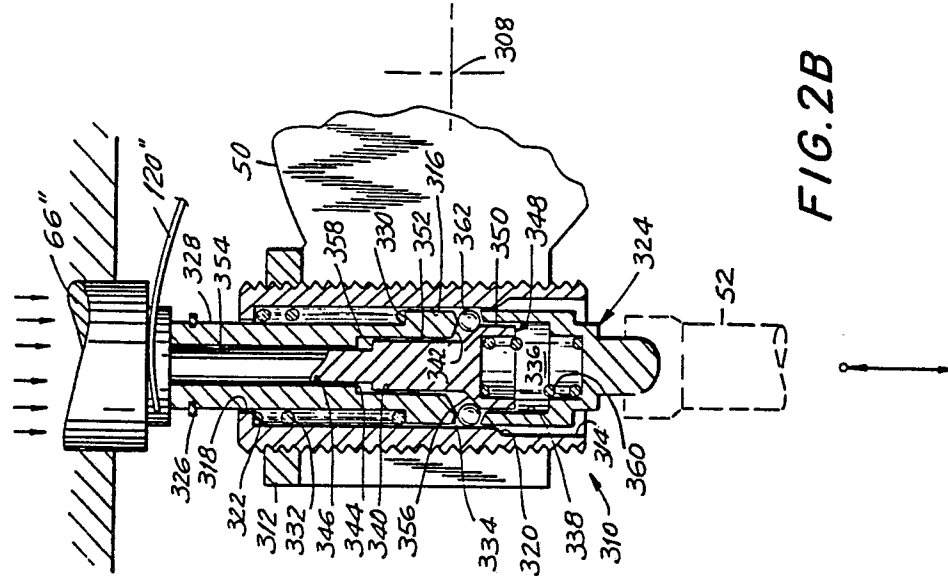


FIG. 1B





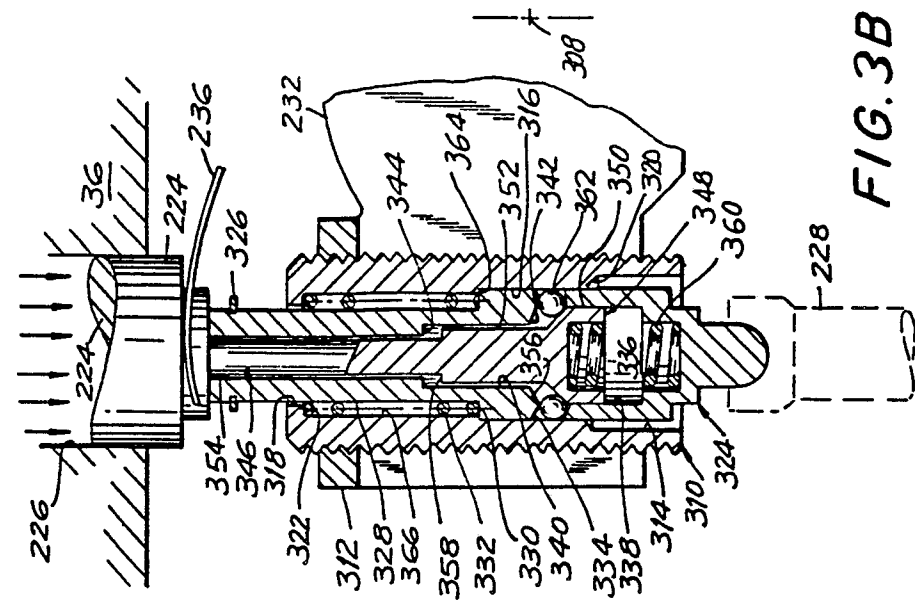


FIG. 3B

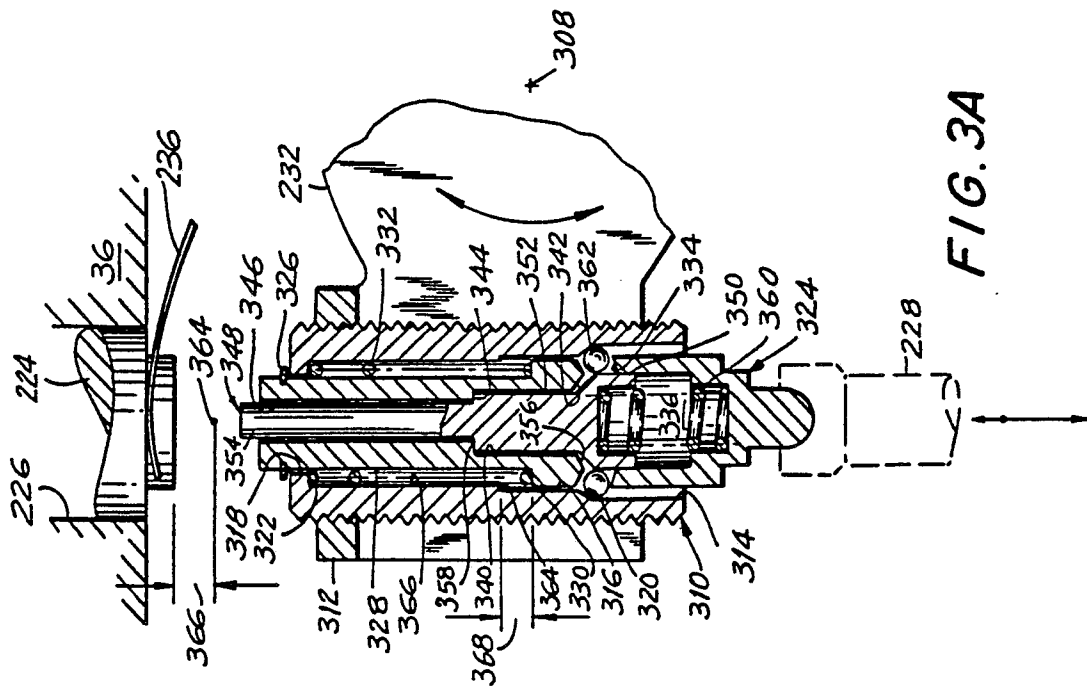


FIG. 3A



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
D,A	US-A-3 220 392 (CUMMINS) * Column 15, lines 14-38; figures 2,5 * ---	1	F 01 L 13/06 F 01 L 13/00
D,A	EP-A-0 037 269 (TAMAS) * Page 16, line 10 - page 17, line 14; figures 3,5 * ---	2	
A	US-A-4 411 229 (CURTIS) * Column 4, line 49 - column 5, line 39; figures 1,2A,2B * -----	2	
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
			F 01 L
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 07-11-1988	Examiner LEFEBVRE L.J.F.
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			
T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			