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(54) **VALVE TRAIN ASSEMBLY**

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- **PATENT ABSTRACTS OF JAPAN vol. 7, no. 187, 16 August 1983 (1983-08-16) & JP 58 088412 A (HONDA GIKEN KOGYO KK), 26 May 1983 (1983-05-26)**

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Description

[0001] The present invention relates to a valve train assembly for an internal combustion engine, and to rocker arms for such an assembly. As can be seen for example in US,4,762,099. The invention is particularly but not exclusively related to arrangements in which the number of parts in the assembly is reduced, in which various parts can be pre-assembled to facilitate engine assembly, and in which various pans are made more simply.

[0002] Various aspects of the invention are intended to deal with a number of separate problems in existing arrangements. For example, internal combustion engines which have a plurality of valves for each cylinder tend to use rocker arms which are mounted on a common pivot or axle and which therefore need to have differing lengths in order to match the differing positions of the valves. It is therefore necessary to manufacture two different types of rocker arms.

[0003] It is also common. particularly for centre-pivoted rocker arms, to have an hydraulic lash compensation device mounted at the valve end of the rocker arm, the device therefore being continually reciprocated. This requires a complex machined oil distribution path and makes it more difficult to feed oil to the lash adjuster. Furthermore, the components of the rocker arm are heavy and therefore strong valve return springs are required, and the rocker shaft has to be strong and therefore of large diameter. and heat-treated to harden the surface in order to resist wear.

JP58-88412 describes a valve train assembly comprising: a valve train carrier having a plurality of individual rocker arm fulcra each of which forms part of a hydraulic lash adjuster; and a plurality of rocker arms, each rocker arm being attached to a respective fulcrum to form a self-supporting assembly and being pivotable about the fulcrum; wherein the assembly has been manufactured and then pre-assembled separately from, but is operatively attachable to, an internal combustion engine having a camshaft such that the rocker arms are movable by cams of the camshaft in order to operate valves of the engine, wherein each rocker arm has a part-spherical surface for mating with a corresponding surface of the fulcrum to which it is attached.

[0004] According to the invention there is provided the valve train assembly of claim 1.

[0005] According to the invention there is provided the method of claim 13.

[0006] Various aspects of the present invention are set out in the accompanying claims.

[0007] In a preferred embodiment, a valve train assembly for a internal combustion engine comprises a valve train carrier having a plurality of individual rocker arm fulcra, and a rocker arm attached to each fulcrum. The carrier may also have one or more camshafts mounted thereto.

[0008] Such an arrangement can be provided as a pre-assembled unit for fitting to a cylinder head having valves mounted therein. thus substantially facilitating the assembly of an engine.

[0009] Each fulcrum may form part of a hydraulic lash adjuster. Accordingly, since the lash adjusters would be fixedly mounted to the carrier, they are more easily supplied with oil, so that a smaller oil pump producing relatively low pressure can be used.

[0010] In a particularly advantageous arrangement, each rocker arm and its associated fulcrum have co-operating part-spherical surfaces which permit not only the pivoting motion required for operating the valves, but also a degree of rotation about the length of the rocker arm, to provide a self-adjusting function. Preferably, the rocker arm has a part-spherical recess into which a part-spherical projection is located. (In practice the profile of the recess may comprise several, e.g. three, spherical segments of slightly different diameter tangential to each other, sometimes referred to as a gothic socket.) The rocker arm may be attached to the projection by means of a clip, possibly made of spring steel. which is fitted over the head of the projection. As the rocker arms do not need to be fitted to rocker axles, they may be made smaller and lighter compared to existing aluminium or steel rockers. In a preferred embodiment, the rockers are made of pressed sheet metal (with the final thickness possibly increased or decreased by the pressing operation to provide suitable weight/strength properties), and their lightness enables the use of lighter valve springs resulting in lower energy consumption.

[0011] Because of the self-adjusting arrangement mentioned above, it is possible to arrange for contact between a driving cam and the rocker arm to extend laterally over a large distance, for example by having mounted on the rocker a roller with a wide surface which is flat in a direction parallel to the roller axis. This provides a greater area of contact than existing rockers which rotate about an axle, and which need a roller having a convex surface to ensure proper contact. As a result of the reduction in stress by increasing the area of contact, the camshaft need not be so strong, and indeed it is possible to use cast iron instead of more expensive steel.

[0012] By appropriate positioning of the individual rocker arm fulcra, it is possible to use rockers of equal length for all the valves. Accordingly, the rockers can be substantially identical, thereby reducing manufacturing costs.

[0013] Arrangements embodying the invention will now be described by way of example with reference to the accompanying drawings, in which:

Fig. 1 is a side view of a prior art rocker arm;
Fig. 2 is a side view, partly in section, of a rocker arm arrangement according to the invention applied to a valve;
Fig. 3 is a side view of the rocker arm of Figure 2;
Fig. 4 is a plan view of the rocker arm shown in Fig. 3;
Fig. 5 is a section along the line V-V of Fig. 3;
Fig. 6 shows is a section along the line VI-VI in Fig. 3;

Fig. 7 is a section through a hydraulic tappet forming a fulcrum of the rocker arm;

Fig. 8 is a transverse section showing a valve train carrier of the present invention, for controlling two rows of valves with a single central camshaft;

Fig. 9 is a plan view of the valve train carrier as shown in Fig. 7;

Fig. 10 is a side view showing another embodiment of a valve train assembly in accordance with the invention; and

Fig. 11 is a perspective view, from below, of a valve train carrier of the assembly of Fig. 10.

[0014] Fig. 1 shows a prior art rocker (B') made of pressed aluminium, and comprising a lever of the first order mounted on a fixed axle (70), which also carries other rockers arranged in a row. One end of the rocker (B') is in contact with a cam (C) by means of a roller (R'), while the other end has a reciprocating and pivoting hydraulic lash adjuster, referred to also as a tappet (80). The tappet has a spigot or projection (81) at the base acting on the head of a valve (V). A double row of camshafts (A') acts on convex surfaces of rollers (R').

[0015] Fig. 2 shows an example of a rocker arm arrangement according to the present invention.

[0016] The rocker (B) of the present invention is again a lever of the first order, i.e. it is a centre-pivoted rocker arm. However, the rocker (B) is mounted on a tappet (4) placed between a first end of the rocker (B), which is fitted with a roller (R) displaced and pushed against a cam (C) on the camshaft, and a second end, which transmits the pressure to open the poppet valve (V) against the resilient force of a spring (M).

[0017] The rocker (B) shown in Figs. 3 to 6 is made up of two lateral flanges (12) and (12'), linked by an upper plate (13), with which it forms a U-shaped section, and is formed by bending or stamping a sheet of steel.

[0018] In the process of pressing the rocker from sheet steel, a hemispherical recess (14) is formed in the plate (13), suitable for mating with the hemispherical head (41) of a spigot or projection (42) which is part of a lash adjuster or tappet (4). The tappet (4) is fitted in its own fixed seat (45, Fig. 7) formed by boring an aluminium cover (L) of the engine head. The cover (L) constitutes a valve train carrier, and is discussed further below.

[0019] Because of the co-operation of the part-spherical surfaces of the recess (14) and the end (41) of the spigot (42) this spigot forms a fulcrum about which the rocker arm (B) can reciprocate in order to operate the valve (V), and around which the rocker arm may be laterally turned. It will be noted in particular that the rocker arm can rotate about an axis X (Fig. 4) and about the axis of the spigot (42), to provide a degree of self-adjustment for the purposes set out below.

[0020] Rocker (B) comprises at one end a transverse opening (15) into which a pivoting trunnion (16) is fitted, the trunnion (16) having opposing recesses (17), one of which presses onto the head of the stem of the valve (V), adjusting itself in accordance with the relative movement of the rocker arm (B) of the valve shaft, which may vary depending on the type of engine.

[0021] At the other end is fitted roller (R) having needle bearings and located on an axle (20) extending through openings (22) provided in flanges (12) and (12').

[0022] Roller (R) is very simple, with a straight cylindrical outside surface which closely fits the outside surface of cam (C) since as described above the rocker, with its fulcrum on the hemispherical recess (14), automatically compensates for any imperfection in transverse movement, thus making a convex outside surface, as required in customary design, unnecessary.

[0023] In order to keep the trunnion (16) fixed in place at the first end of the rocker, a resilient sheet (25) is used with flanges (26) folded back on themselves so that the lower section can be attached to the rocker flanges (see Fig. 5). The resilient sheet has an inlet (27) at the top for the purpose of lubricating the trunnion (16).

[0024] A second resilient sheet (30), with flanges (31) folded back on themselves, is fitted over the hemispherical recess (14) to restrict relative transverse movement of the spigot (42) of tappet (4). The sheet (30) may be made of spring steel, and has an aperture which allows the rocker arm (B) to be easily snap-fitted over the head (41) of the spigot (42) and thus attached to the cover (L). The sheet (30) thus retains the rocker arm (B) on the cover (L) without inhibiting any intended operational movement of the rocker arm.

[0025] In this embodiment, the projection or spigot (42) has a relatively narrow neck leading to the enlarged, part-spherical head (41), so that the aperture in the sheet (30), which has a diameter slightly larger than that of the neck, can be used to hold the rocker arm in place. Preferably, as shown in Fig. 4, the aperture is elongate, with its longitudinal axis extended substantially parallel to the length of the rocker arm, so as to facilitate fitting the rocker arm to the tappet (4), and to permit a degree of freedom of movement in the longitudinal direction to ensure proper engagement with the cam shaft and valve. However, alternative arrangements are possible. For example, the rocker arm could be fastened to the head (41) by means of a rivet or other member extending through the rocker arm into a recess at the end of the head (41), possibly engaging therein by means of a screw thread or by a resilient enlarged portion which engages in an annular ridge within the recess. In any event, it is desired that the means attaching the rocker arm to the fulcrum be fairly loose, and arranged so as not to inhibit the intended operational movement of the rocker arm.

[0026] Fig. 7 is a detailed view of the tappet (4), which keeps rocker (B) pressed against one end of the valve head (V) by means of the pivoting trunnion (16), and at the other end against the cam (C) by means of roller (R). The spigot (42), carrying the hemispherical head (41) which forms the rocker fulcrum, forms a plunger which is attached to a chamber (43) which slides in a sleeve (44) inserted precisely into the seat (45) formed by boring

in the cover (L) of the engine block. Within the lower part of the chamber (43) is a high pressure tappet chamber (47), whilst above is a plunger (48) which houses a low-pressure oil reservoir (49). The oil is supplied through the inlet (50) and channels (51) in the cover (L).

[0027] Inlets (46) and (46') are provided in the spigot (42) for the purpose of lubricating the hemispherical end (41) which acts as the fulcrum.

[0028] By way of example, Figs. 8 and 9 show from the side and from above, respectively, the arrangement of a valve control train using rockers (B1), (B2), ... as described above, for operating valves V1, V2, ... in an internal combustion engine with a single central camshaft (A).

[0029] Using such an arrangement facilitates the assembly of an engine. The engine cylinder head has a lower head part (65) into which the valves (V1) and (V2) are installed. Their springs (M) are located in recesses (60) of the lower head (65).

[0030] In a separate operation, the valve train carrier formed by the cover (L) has fitted thereto the rocker arms (B1) and (B2), together with any other rocker arms required for the engine (see Fig. 9). This therefore forms a self-supporting assembly which can be manufactured and sold separately from the rest of the engine and provided in a pre-assembled state ready for fitting to the engine. Thus, not only is the overall assembly facilitated by pre-assembling the valve carrier, but the individual fitting of the rocker arms can be carried out as a separate operation, so the final assembly of the engine is significantly simpler.

[0031] If desired, a manufacturer can supply different versions of the valve carrier, all for fitting to the same engine head, but made to different specifications. For example, one version may have hydraulic lash adjusters and rocker arms provided with rollers, and another, less-expensive one may have mechanical lash adjusters and a fixed cam-engaging surface on the rocker arms rather than rollers. This facilitates the production of different types of engines, suited to the customer, while still enabling a simple assembly procedure.

[0032] The location of the respective fulcra on the cover (L) can be selected such that all the rocker arms may have the same length, and therefore can if desired be constructed identically.

[0033] Preferably, the camshaft is also fitted to the cover (L) during pre-assembly.

[0034] Figs. 10 and 11, in which like reference signs represent like integers, show an alternative embodiment of the invention, in which twin camshafts (A1, A2) drive respective rows of rocker arms (B). The aluminium valve train carrier (L) is best illustrated in Fig. 11, which shows identical rocker arms (B) mounted in two lines, the arms within each line being positioned in a staggered arrangement so that they are suitably located for driving the inlet and outlet exhaust valves. Although not shown in Fig. 11. the camshafts (A1, A2) are also preferably mounted to the carrier (L) before the entire assembly is fitted to the lower cylinder head of the engine.

[0035] The carriers (L) of either embodiment may have channels for distributing oil to the valve trains; indeed, all the required oil channels may be located in the carrier.

Claims

1. A valve train assembly comprising:

a valve train carrier having a plurality of individual rocker arm fulcra each of which forms part of a hydraulic lash adjuster; and
a plurality of rocker arms, each rocker arm being attached to a respective fulcrum by means of an apertured resilient sheet which is snap-fitted over the fulcrum, to form a self-supporting assembly and being pivotable about the fulcrum, the attachment being arranged not to inhibit pivoting reciprocation about a first axis to enable valve operation or rotation about a second axis along the length of the rocker arm to permit self-adjustment, wherein each rocker arm has a part spherical surface for mating with a corresponding surface of the fulcrum to which it is attached;
wherein the assembly has been manufactured and then pre-assembled separately from, but is operatively attachable to, an internal combustion engine such that the rocker arms are movable by cams in order to operate valves of the engine.

2. An assembly as claimed in claim 1, wherein each rocker arm constitutes a lever of the first order.

3. An assembly as claimed in any preceding claim, wherein each rocker arm has been formed by deformation of a sheet.

4. An assembly as claimed in claim 1 or claim 2, wherein each rocker arm has been formed by deformation of a sheet, said deformation also forming the part-spherical surface for mating with the corresponding surface of the fulcrum to which the rocker arm is attached.

5. An assembly as claimed in any preceding claim, wherein the rocker arms are all of substantially the same length.

6. An assembly as claimed in claim 5, wherein the rocker arms are substantially identical.

7. An assembly as claimed in any preceding claim, wherein each rocker arm has a pivoting-member for engaging a valve.

8. An assembly as claimed in any preceding claim, the

assembly also having mounted thereto at least one camshaft.

9. An assembly as claimed in any preceding claim, the carrier having formed therein channels for conveying oil to the fulcra.

10. An assembly as claimed in any preceding claim, wherein each rocker arm carries a roller for engagement with a cam of a camshaft, and wherein each roller has a substantially flat cylindrical outer surface.

11. An assembly as claimed in any preceding claim, the carrier supporting rocker arms for inlet and exhaust valves for a plurality of cylinders.

12. An internal combustion engine having a valve train assembly as claimed in any preceding claim, the engine comprising a plurality of cylinders each having inlet and exhaust valves, said carrier supporting rocker arms for said inlet and exhaust valves.

13. A method of assembling an internal combustion engine, the method comprising:

(a) providing a valve train assembly which has been manufactured and pre-assembled separately from the internal combustion engine, the providing step comprising:

(i) providing a valve train carrier having a plurality of individual rocker arm fulcra each of which forms part of a hydraulic lash adjuster; and
(ii) attaching a rocker arm to each fulcrum by means of an apertured resilient sheet which is snap-fitted over the fulcrum, to obtain a self-supporting assembly, the attachment being arranged not to inhibit pivoting reciprocation about a first axis to enable valve operation or rotation about a second axis along the length of the rocker arm to permit self-adjustment and wherein said rocker arm has a part-spherical surface for mating with a corresponding surface of the fulcrum to which it is attached, and

(b) subsequently mounting the carrier with the attached rocker arm on a cylinder head of the internal combustion engine such that each rocker arm is brought into functional relationship with a respective engine valve.

14. A method as claimed in claim 13, the method including the step of mounting at least one camshaft to the carrier before mounting the carrier on the cylinder head.

15. A method as claimed in any one of claims 13 to 14 including forming each rocker arm by deformation of a sheet.

16. A method as claimed in claim 15, including forming the part- spherical surface on each rocker arm by deformation of said sheet for mating with the corresponding part of a fulcrum.

Patentansprüche

1. Ventiltriebanordnung, die Folgendes aufweist:

einen Ventiltriebträger mit einer Vielzahl von individuellen Kipphebeldrehpunkten, von denen jeder einen Teil einer hydraulischen Spieleinstellvorrichtung bildet; und
eine Vielzahl von Kipphebeln, von denen jeder mittels eines mit Öffnungen versehenen elastischen Flächenelementes an einem entsprechenden Drehpunkt angebracht ist, welches über den Drehpunkt durch Einschnappen befestigt ist, um eine selbsttragende Anordnung zu bilden, und jeder um den Drehpunkt schwenkbar ist, wobei die Anordnung derart angeordnet ist, dass sie nicht eine schwenkende Hin- und Herbewegung um die erste Achse verhindert, um einen Ventilbetrieb oder eine Drehung um eine zweite Achse entlang der Länge des Kipphebels zu ermöglichen, um eine Selbsteinstellung zu gestatten, wobei jeder Kipphebel eine teilweise kugelförmige Oberfläche hat, die mit einer entsprechenden Oberfläche des Drehpunktes zusammenpasst, an dem er angebracht ist;
wobei die Anordnung gesondert von einem Verbrennungsmotor hergestellt und dann getrennt von diesem vormontiert wurde, jedoch betriebsmäßig an dem Verbrennungsmotor anbringbar ist, so dass die Kipphebel durch Nocken bewegbar sind, um Ventile des Motors zu betätigen.

2. Anordnung nach Anspruch 1, wobei jeder Kipphebel einen Hebel erster Ordnung bildet.

3. Anordnung nach einem vorhergehenden Anspruch, wobei jeder Kipphebel durch Umformen eines Bleches geformt wird.

4. Anordnung nach Anspruch 1 oder 2, wobei jeder Kipphebel durch Umformen eines Bleches geformt ist, wobei die Umformung auch die teilweise kugelförmige Oberfläche zum Zusammenpassen mit der entsprechenden Oberfläche des Drehpunktes bildet, an dem der Kipphebel angebracht ist.

5. Anordnung nach einem vorhergehenden Anspruch,

wobei die Kipphebel alle im Wesentlichen die gleiche Länge besitzen.

6. Anordnung nach Anspruch 5, wobei die Kipphebel im Wesentlichen identisch sind.

7. Anordnung nach einem vorhergehenden Anspruch, wobei jeder Kipphebel ein Schwenkglied zum Eingriff mit einem Ventil besitzt.

8. Anordnung nach einem vorhergehenden Anspruch, wobei an der Anordnung mindestens eine Nockenwelle angebracht ist.

9. Anordnung nach einem vorhergehenden Anspruch, wobei der Träger darin ausgebildete Kanäle zum Transport von Öl zu den Drehpunkten aufweist.

10. Anordnung nach einem vorhergehenden Anspruch, wobei jeder Kipphebel eine Rolle zum Eingriff mit einer Nocke einer Nockenwelle trägt, und wobei jede Rolle eine im Wesentlichen flache zylindrische Außenfläche besitzt.

11. Anordnung nach einem vorhergehenden Anspruch, wobei der Träger Kipphebel für Einlass- und Auslassventile für eine Vielzahl von Zylindern trägt.

12. Verbrennungsmotor mit einer Ventiltriebanordnung nach einem vorhergehenden Anspruch, wobei der Motor eine Vielzahl von Zylindern aufweist, von denen jeder Einlass- und Auslassventile besitzt, und wobei der Träger Kipphebel für die Einlass- und Auslassventile trägt.

13. Verfahren zum Zusammenbau eines Verbrennungsmotors, wobei das Verfahren Folgendes aufweist:

a) Vorsehen einer Ventiltriebanordnung, die gesondert vom Verbrennungsmotor hergestellt und vormontiert wurde, wobei der Schritt des Vorsehens Folgendes aufweist:

i) Vorsehen eines Ventiltriebträgers mit einer Vielzahl von individuellen Kipphebeldrehpunkten, von denen jeder einen Teil einer hydraulischen Spieleinstellvorrichtung bildet; und

ii) Anbringen eines Kipphebels an jedem Drehpunkt mittels eines mit Öffnungen versehenen elastischen Flächenelementes, welches über den Drehpunkt durch Einschnappen eingepasst ist, um eine selbsttragende Anordnung zu erhalten, wobei die Anordnung derart angeordnet ist, dass sie nicht eine schwenkende Hin- und Herbewegung um eine erste Achse verhindert, um einen Ventilbetrieb oder eine Drehung um die zweite Achse entlang der Länge des Kipphebels zu ermöglichen, um eine Selbsteinstellung zu gestatten, und wobei der Kipphebel eine teilweise kugelförmige Oberfläche hat, um mit einer entsprechenden Oberfläche des Drehpunktes zusammenzupassen, an dem er angebracht ist, und

b) darauf folgendes Anbringen des Trägers mit dem daran angebrachten Kipphebel an einem Zylinderkopf des Verbrennungsmotors derart, dass jeder Kipphebel in funktionelle Beziehung mit einem entsprechenden Motorventil gebracht wird.

14. Verfahren nach Anspruch 13, wobei das Verfahren den Schritt des Anbringens von mindestens einer Nockenwelle an dem Träger aufweist, bevor der Träger an dem Zylinderkopf befestigt wird.

15. Verfahren nach einem der Ansprüche 13 oder 14, wobei das Formen jedes Kipphebels durch Umformung eines Flächenelementes bzw. Blechs erfolgt.

16. Verfahren nach Anspruch 15, welches das Formen der teilweise kuppelförmigen Oberfläche an jedem Kipphebel durch Umformen des Flächenelementes bzw. Bleches aufweist, so dass diese mit dem entsprechenden Teil des Drehpunktes zusammenpasst.

Revendications

1. Un assemblage constitutif d'un train de soupapes comportant :

- un support de train de soupapes présentant une pluralité d'axes individuels de culbuteurs dont chacun fait partie d'un dispositif de rattrapage de jeu hydraulique ; et
- une pluralité de culbuteurs, chaque culbuteur étant respectivement fixé sur un axe respectif au moyen d'une feuille élastique perforée qui est montée par pression sur l'axe, afin de former un assemblage autoporteur et pouvant pivoter autour dudit axe, la fixation étant agencée pour ne pas empêcher le mouvement réciproque de pivotement autour d'un premier axe pour permettre le fonctionnement ou la rotation de la soupape autour d'un second axe le long de la longueur du culbuteur pour permettre l'auto-ajustement, dans lequel chaque culbuteur a une surface partiellement sphérique pour correspondre à une surface correspondante de l'axe sur lequel il est fixé dans lequel l'assemblage a été fabriqué et pré-assemblé séparément d'un moteur à

combustion interne, mais est fixable opérationnellement à celui-ci, de telle sorte que les culbuteurs soient mis en mouvement par les cames pour actionner les soupapes du moteur.

2. Assemblage selon la revendication 1, dans lequel chaque culbuteur constitue un levier de premier ordre.

3. Assemblage selon l'une quelconque des revendications précédentes, dans lequel chaque culbuteur a été formé par déformation d'une feuille.

4. Assemblage selon la revendication 1 ou la revendication 2, dans lequel chaque culbuteur a été formé par la déformation d'une feuille, ladite déformation formant également la surface partiellement sphérique pour correspondre à la surface correspondante de l'axe sur lequel le culbuteur est fixé.

5. Assemblage selon l'une quelconque des revendications précédentes, dans lequel les culbuteurs sont sensiblement tous de la même longueur.

6. Assemblage selon la revendication 5, dans lequel les culbuteurs sont sensiblement identiques.

7. Assemblage selon l'une quelconque des revendications précédentes, dans lequel chaque culbuteur a un élément pivotant pour la mise en prise d'une soupape.

8. Assemblage selon l'une quelconque des revendications précédentes, l'assemblage ayant également monté sur celui-ci au moins un arbre à cames.

9. Assemblage selon l'une quelconque des revendications précédentes, le support ayant formé à l'intérieur de celui-ci des canaux pour transporter de l'huile jusqu'aux axes.

10. Assemblage selon l'une quelconque des revendications précédentes, dans lequel chaque culbuteur supporte un rouleau pour la mise en prise avec une came d'un arbre à cames, et dans lequel chaque rouleau a une surface externe cylindrique sensiblement plate.

11. Assemblage selon l'une quelconque des revendications précédentes, le support supportant des culbuteurs pour les soupapes d'entrée et d'échappement pour une pluralité de cylindres.

12. Moteur à combustion interne ayant un assemblage constitutif de train de soupapes selon l'une quelconque des revendications précédentes, le moteur comprenant une pluralité de cylindres ayant chacun des soupapes d'entrée et d'échappement, ledit support supportant des culbuteurs pour lesdites soupapes d'entrée et d'échappement.

13. Procédé pour assembler un moteur à combustion interne, le procédé comprenant les étapes consistant à :

(a) prévoir un assemblage constitutif de train de soupapes qui a été fabriqué et préassemblé séparément du moteur à combustion interne, l'étape consistant à :

(i) prévoir un support de train de soupapes ayant une pluralité d'axes individuels de culbuteur, dont chacun fait partie d'un dispositif de rattrapage de jeu hydraulique ; et
(ii) fixer un culbuteur sur chaque axe au moyen d'une feuille élastique perforée qui est montée par pression sur l'axe afin d'obtenir un assemblage autoporteur, la fixation étant agencée pour ne pas empêcher le mouvement réciproque de pivotement autour d'un premier axe pour permettre le fonctionnement et la rotation de la soupape autour d'un second axe le long de la longueur du culbuteur pour permettre l'autoajustement et dans lequel chaque culbuteur a une première surface partellement sphérique pour correspondre à une surface correspondante de l'axe sur lequel il est fixé, et

(b) monter ensuite le support avec le culbuteur fixé sur une culasse du moteur à combustion interne de sorte que chaque culbuteur est amené en relation fonctionnelle avec une soupape de moteur respective.

14. Procédé selon la revendication 13, le procédé comprenant l'étape consistant à monter au moins un arbre à cames sur le support avant de monter le support sur la culasse.

15. Procédé selon l'une quelconque des revendications 13 à 14, comprenant l'étape consistant à former chaque culbuteur par déformation d'une feuille.

16. Procédé selon la revendication 15, comprenant l'étape consistant à former la surface partiellement sphérique sur chaque culbuteur par déformation de ladite feuille pour correspondre à la surface correspondante d'un axe.

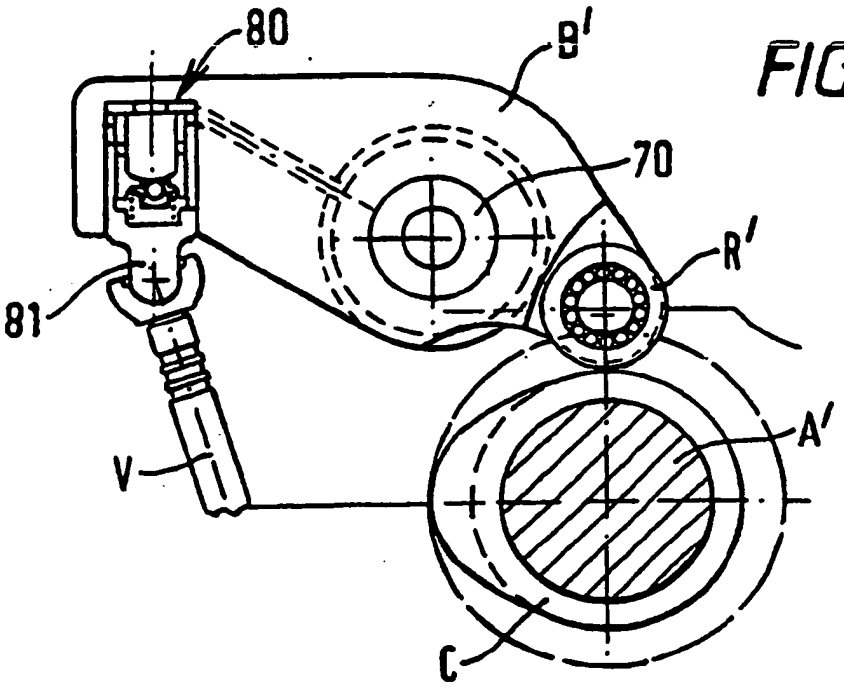


FIG.1

FIG.7

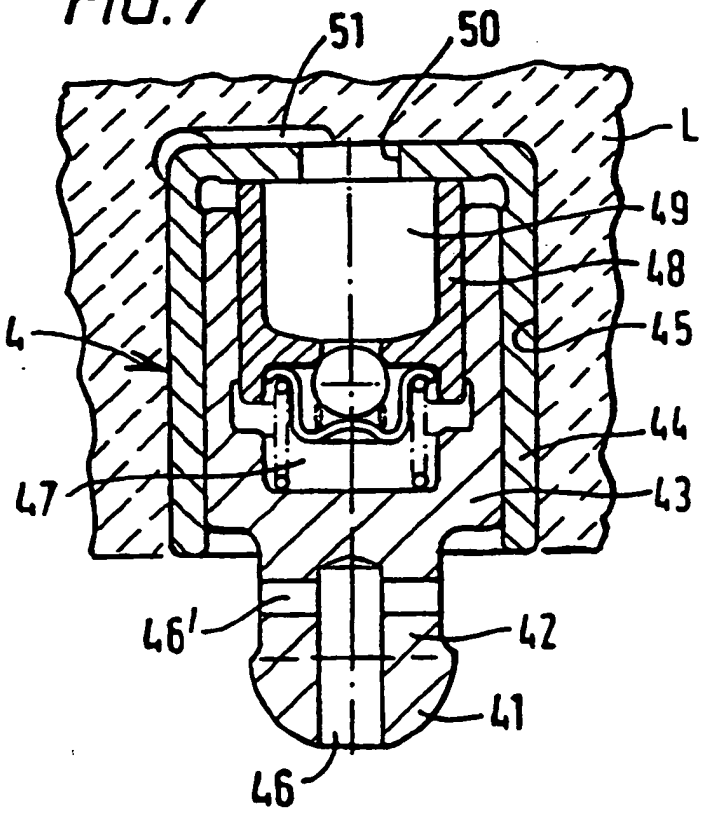


FIG. 2

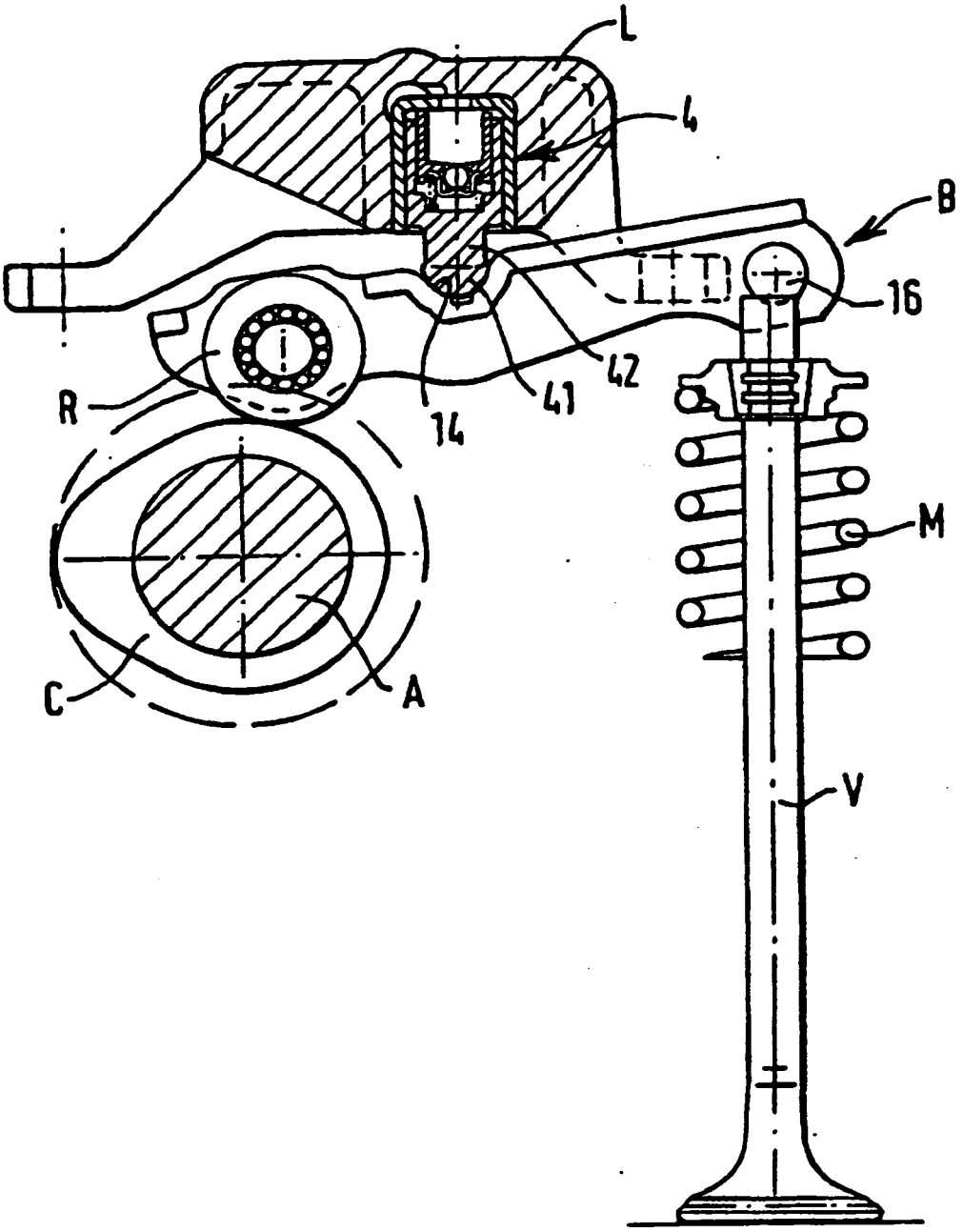


FIG.3

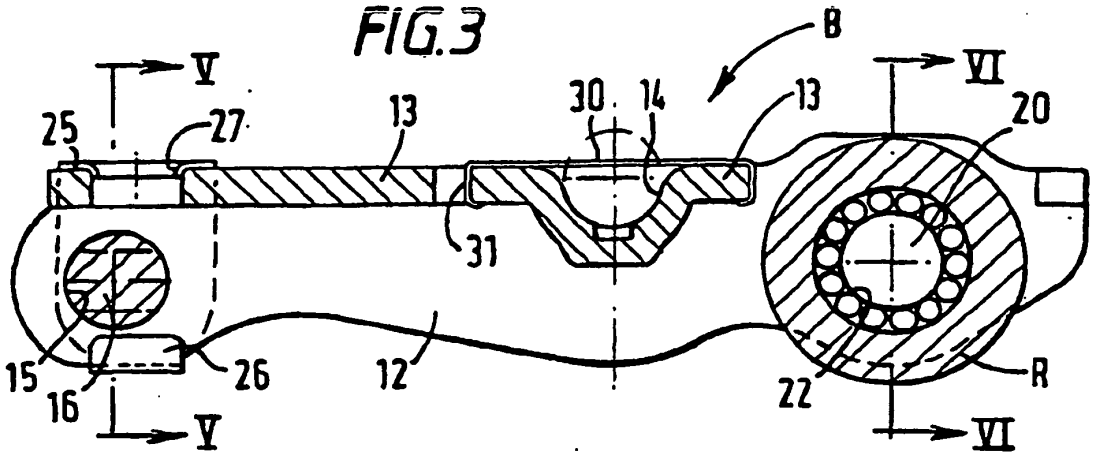


FIG.4

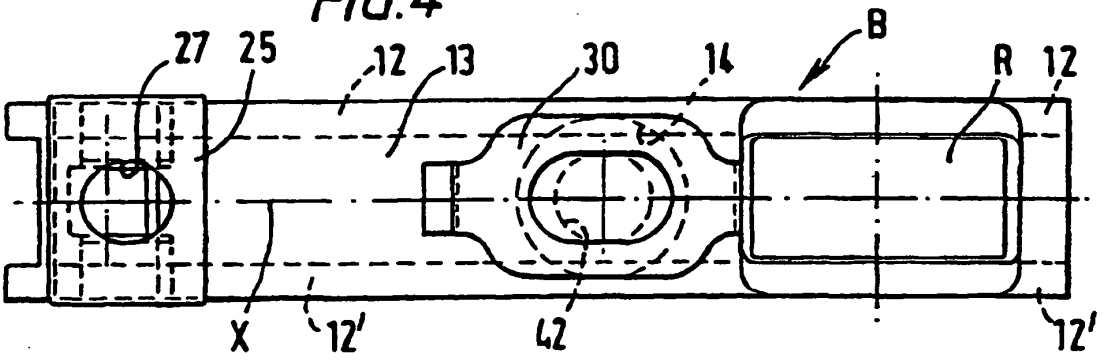


FIG.5

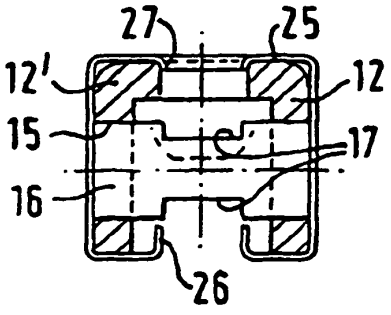


FIG.6

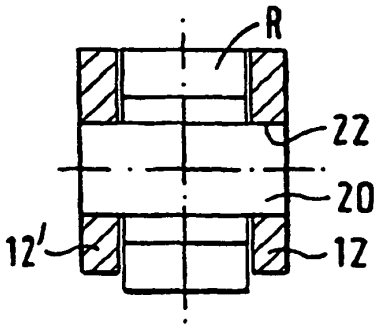


FIG. 8

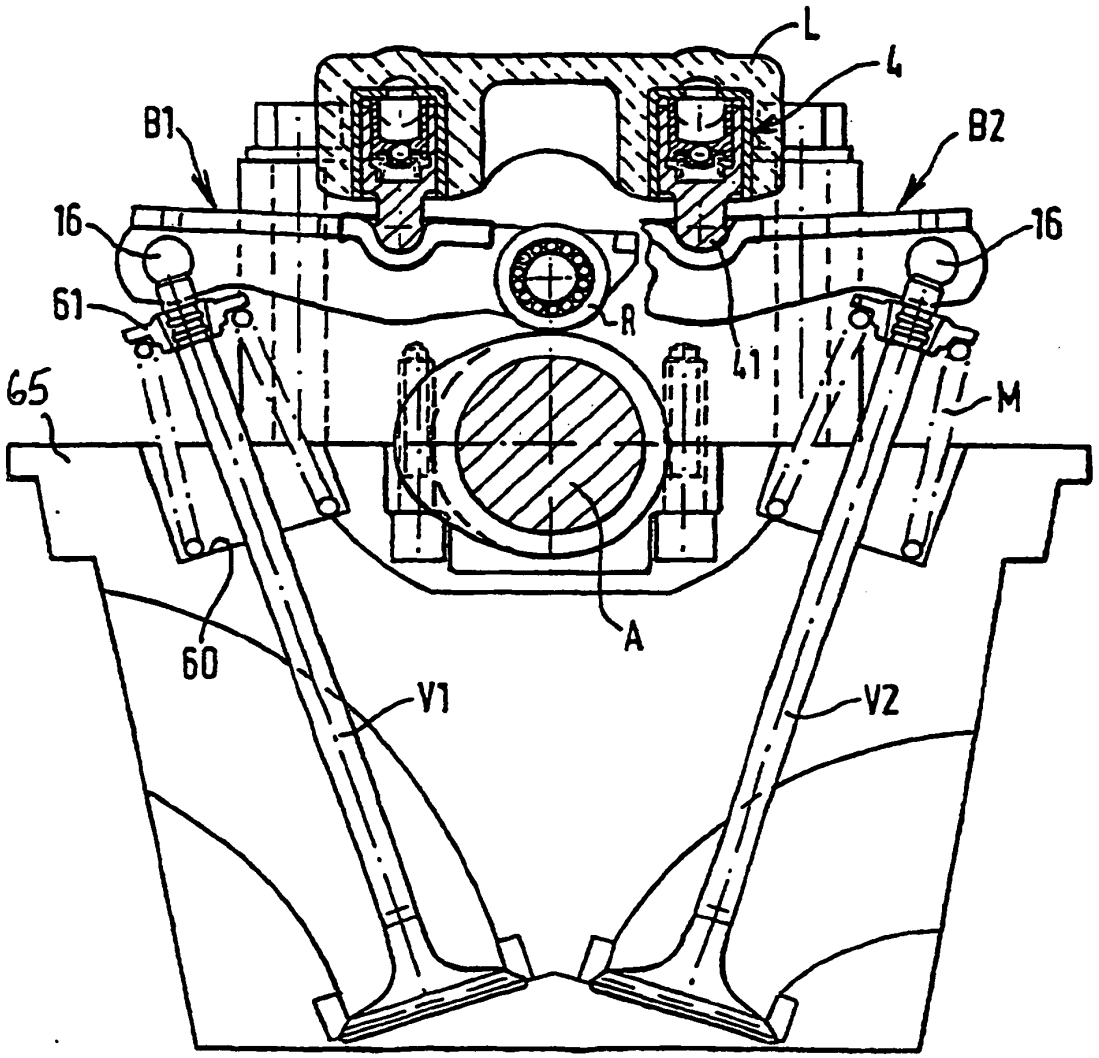


FIG.9

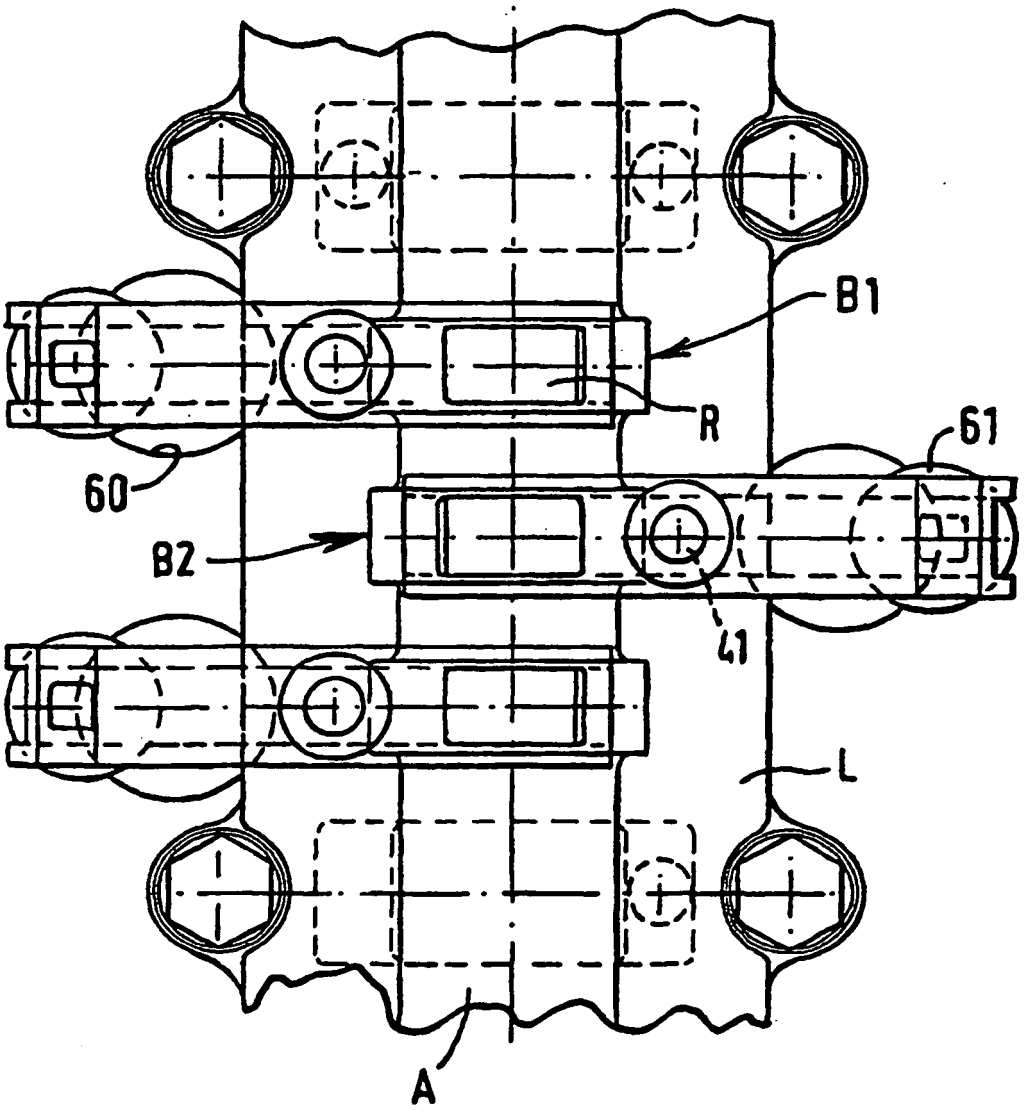


FIG. 10

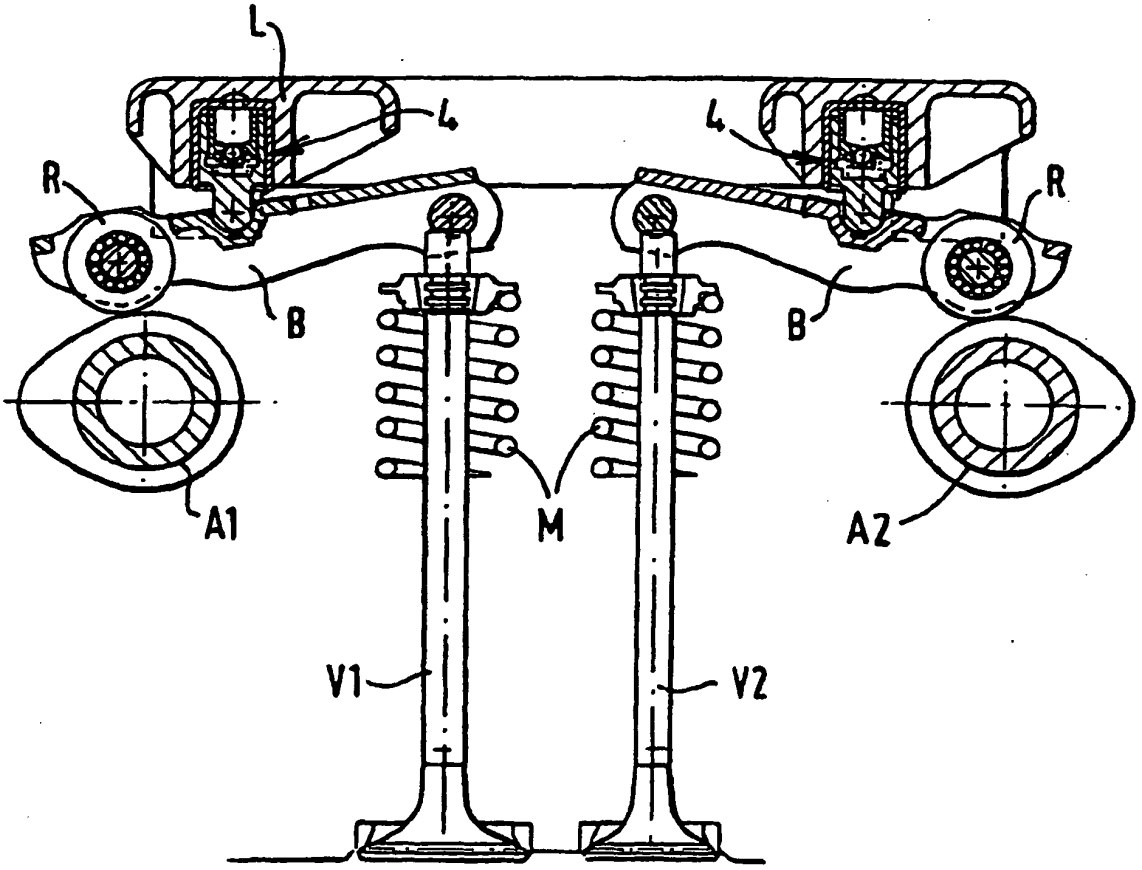
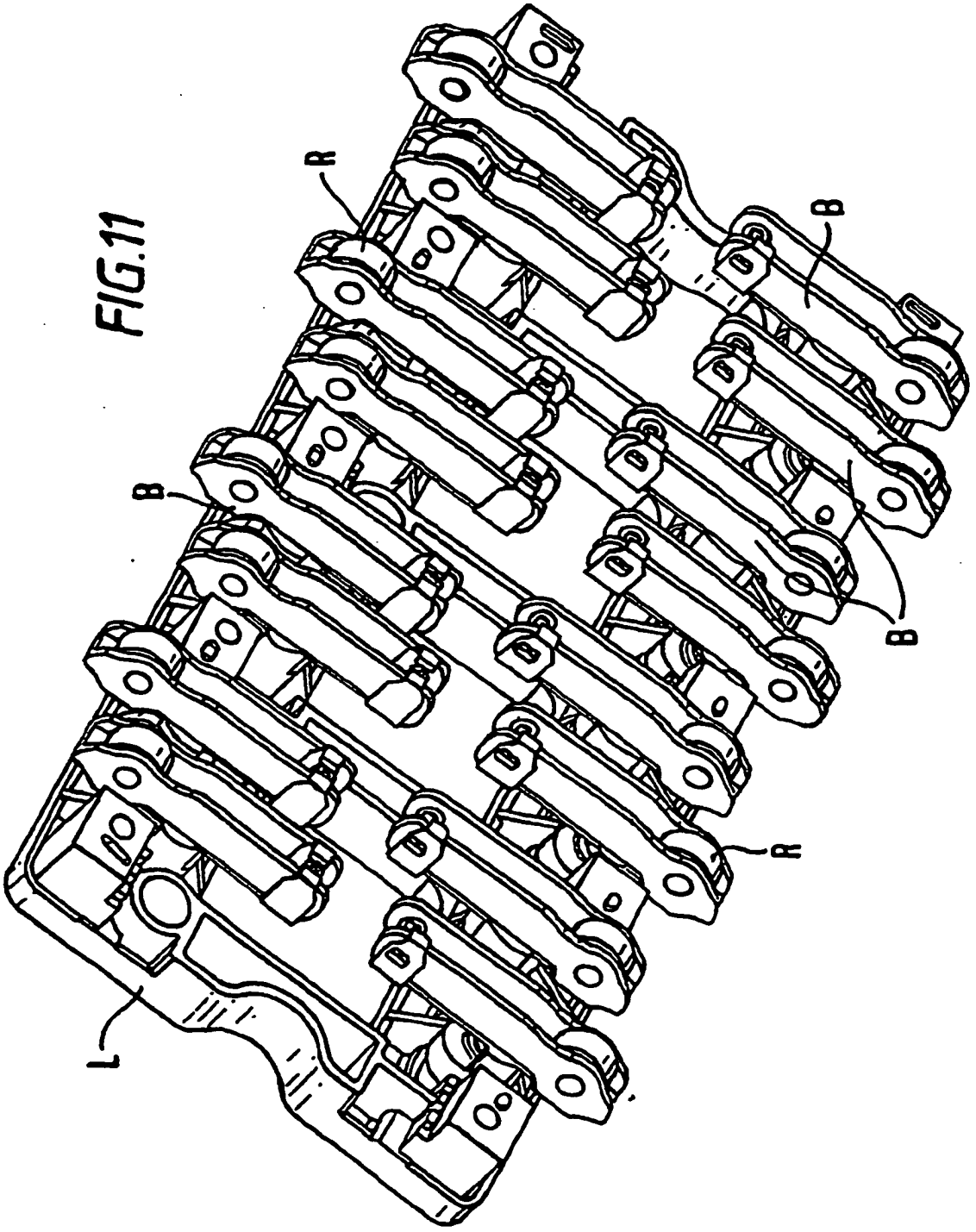


FIG.11



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 4762099 A **[0001]**
- JP 58088412 A **[0003]**