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Kuhn

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[54] ROCKER-ARM ASSEMBLY FOR INTERNAL COMBUSTION ENGINES

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[30] **Foreign Application Priority Data**

Nov. 27, 1970 France.....7042648

[52] **U.S. Cl.** **123/90.39**, 123/90.4, 123/90.41, 74/519, 123/189

[51] **Int. Cl.**.....**F01l 1/18**, F01l 1/26

[58] **Field of Search**....123/90.39, 90.4, 90.47, 90.41, 123/189; 74/519, 559, 522

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[57] **ABSTRACT**

A valve-operating rocker-arm for internal combustion engines at least partially displaceable or deformable selectively from its operative position in its mounted condition on the engine without any removal, so as to move at least its portion co-operating with at least one valve away from the clearing space and the path of travel for taking each associated valve out when removing same, releasable locking means being provided to prevent such a displacement or deformation in normal service or use.

11 Claims, 8 Drawing Figures

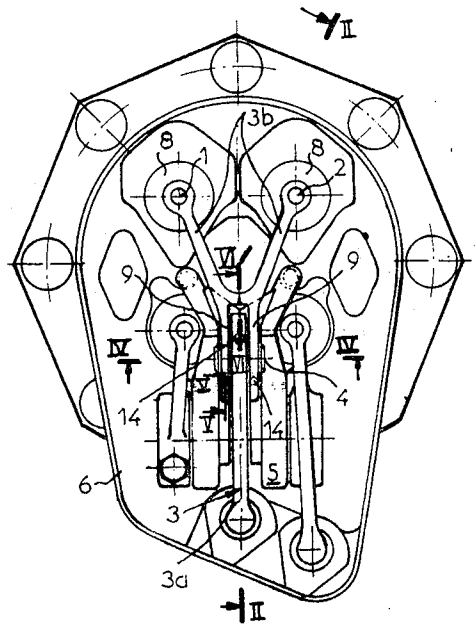


Fig. 1.

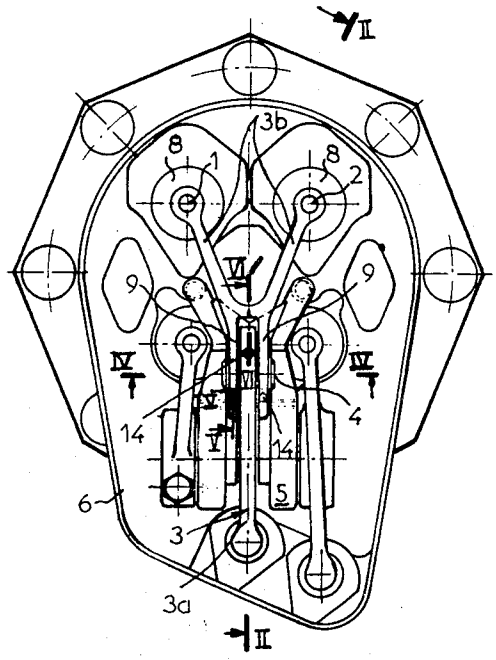


Fig. 5.

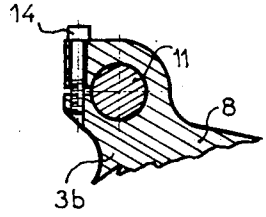


Fig. 6.

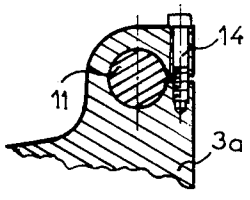


Fig. 4.

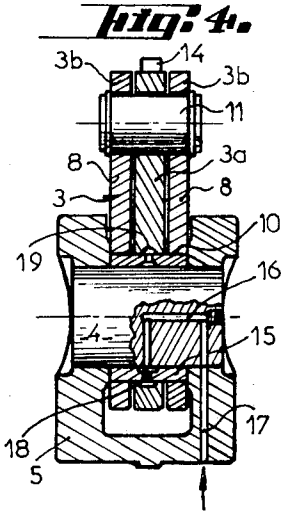


Fig: 2.

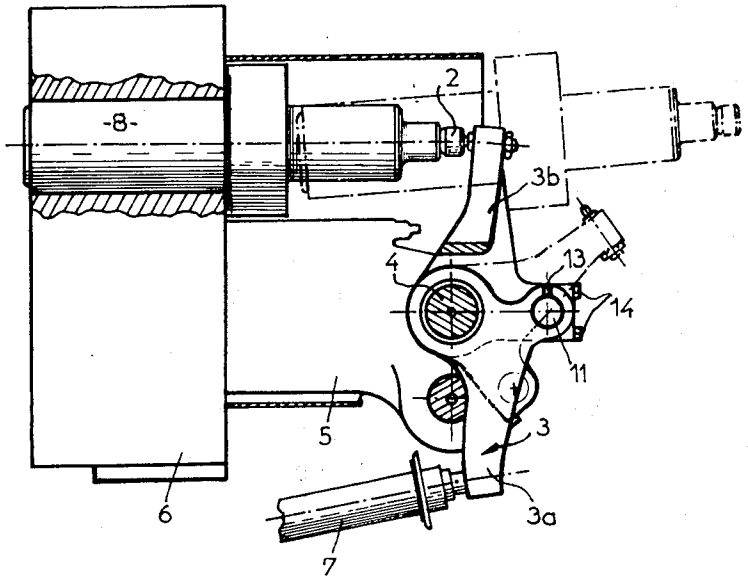


Fig: 3.

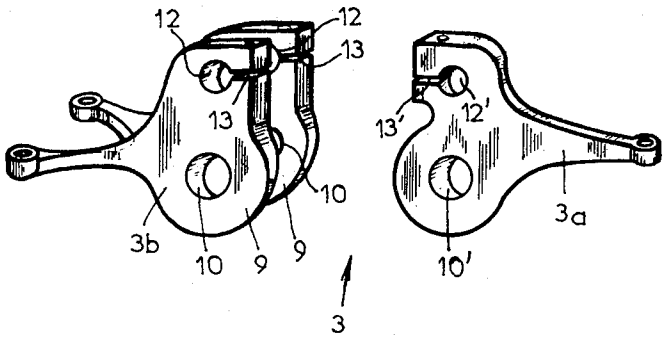
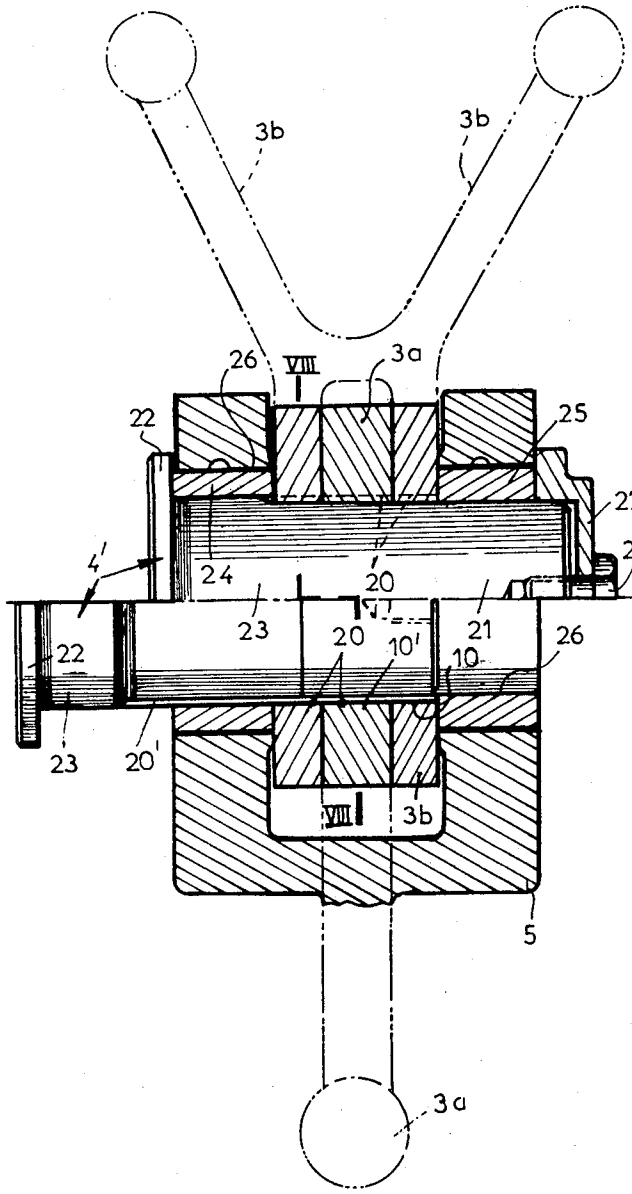


Fig: 7.


3b
3b
26
VIII
3a
22
25
27
28
4'
24
20
23
20
10'
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10
26
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20'
VIII
3b
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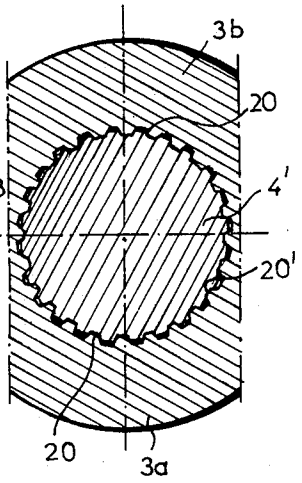
3a

Fig: 8.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ROCKER-ARM ASSEMBLY FOR INTERNAL COMBUSTION ENGINES

The present invention relates generally to a device forming a rocker-arm assembly for operating in particular overhead valves provided in the cylinder heads of an internal combustion engine or the like as well as the various applications resulting from its use and the systems, arrangements, apparatus, machines, equipments and installations provided with such devices.

It is presently known that in particular with large internal combustion engines for instance of the Diesel type comprising a valve-control mechanism or timing gear for overhead valves provided in the cylinder heads, the lifting-stroke or travel of which is positively operated by a rocker-arm assembly, the removal of for instance an exhaust valve requires the relatively heavy associated rocker-arm assembly to be removed beforehand together with its supporting holder or carrier and this, due to the high weight of such an assembly, has to be carried out by means of a suitable hoisting tackle or handling apparatus such as a pulley-block or like purchase thereby setting awkward constraints and resulting in an attendant loss of time.

A main object of the invention is to obviate said drawback by providing a device enabling to remove the valves without any previous dismantling of the rocker-arms or of their supports. For this purpose, the rocker-arm according to the invention is characterized in that in its mounted condition on the engine, it is at least partially displaceable or deformable selectively from its operating position without any removal thereof, so as to move at least its portion, co-operating with at least one valve, away from the clearing space and the path of outward travel of each associated valve when removing same, releasable locking means being provided for preventing such a displacement or deformation in normal use or service.

In the prior state of the art is already known a two-piece pivotally interconnected rocker arm assembly for internal combustion engines with a self-acting clearance take-up unit connected between said pieces to eliminate objectionable clearances between the push-rod and the valve stem, said rocker-arm assembly being supported at its pivotal horizontally extending transverse connection in coaxial relationship therewith and being removable for servicing or replacement. A significant drawback of such a known construction is a relative lack of rigidity or stiffness of said pivotally interconnected rocker-arm assembly so that a defective valve operation may result therefrom and on the other hand the presence of the aforesaid clearance take-up unit prevents the rocker-arm from being easily and quickly moved away from the valve stem for disengaging same to allow ready removal of the valve since such a dismantling would require the clearance take-up unit to be previously disassembled from the rocker-arm. Such difficulties are avoided with the present invention which, as known per se, provides a rocker-arm consisting of two parts co-operating the one with at least one valve stem and the other with the push-rod or like actuating member for said rocker-arm, both parts being connected in at least approximately aligned registering relationship substantially in extension of each other by connecting means. According to an aspect of the invention, said connecting means provide a rigid connection which is selectively releasable or variable to allow said relative displacement of the valve operating rocker-arm part.

Both aforesaid parts are preferably pivotally or hingedly connected to each other to allow a swinging or rotary motion of the valve operating part of the rocker-arm and according to a further characterizing feature of the invention, said releasable locking means consist preferably of at least one removable locking element rigidly interconnecting both parts at a point either distinct and separated from their pivotal connection or in coincident relation thereto.

The significant advantage provided by such an arrangement is readily appreciated since to remove an overhead valve from the top, it is just necessary to unlock the pivotal connection between both parts forming the rocker-arm and to move then the valve operating part away by raising or lifting it off and folding it sidewise back about its connecting pin or axis of rotation, depending upon the relative orientation of the latter, so as to clear or free the space required for moving the valve to be removed upwards out and later for moving it inwards down when refitting same. The solution suggested by the present invention is therefore very simple hence economical in manufacture and efficient in operation.

Instead of forming the rocker-arm with a pair of pivotally interconnected parts adapted to be mutually locked with respect to each other, it is also possible to design a rocker-arm or rocker-arm assembly together with its support or holder with a view to be bodily displaceable according to a translatory or rotary motion enough to fully clear the space required for the free removal of the valve involved.

The invention will be better understood and further objects, characterizing features, details and advantages thereof will appear more clearly when reading the following explanatory description with reference to the accompanying diagrammatic drawings given by way of example only to illustrate one form of embodiment of the invention and wherein :

FIG. 1 shows a fragmentary top view of the system for operating in particular exhaust valves together with their rocker-arm assembly corresponding to one cylinder of an internal combustion engine ;

FIG. 2 is a view in cross-section taken upon the line II—II of FIG. 1 with parts broken partially away ;

FIG. 3 is an exploded detail perspective view of a separate rocker-arm ;

FIG. 4 is a fragmentary view at a larger scale in cross-section taken upon the line IV—IV of FIG. 1 ;

FIG. 5 is a partial enlarged view in cross-section taken upon the line V—V of FIG. 1 ;

FIG. 6 is an enlarged fragmentary view in cross-section taken upon the line VI—VI of FIG. 1 ;

FIG. 7 is a view similar to FIG. 4 showing an alternative embodiment or modification of the locking arrangement for the pivotal connection between both elements of the rocker-arm, shown in half-section in the locked and unlocked positions, respectively ; and

FIG. 8 is a cross-section taken upon the broken line VIII—VIII of FIG. 7.

The invention is applicable in particular to exhaust valves of the type wherein the valve seat is rigidly connected or integral with a valve cage, chest or box with which it is made in one removable piece adjacent to the

member forming a valve stem guide thereby enabling to remove the seat, i.e., the valve cage by exerting an upward pull or tractive effort upon the top of the body forming the valve stem guide which transmits such a tractive effort either directly to the valve cage in the case where said body is connected thereto or to the valve stem or spindle through the valve spring and its bearing cup; in the latter case, the mushroom-like or tulip-shaped poppet valve disk exerts a pull upon the valve seat it is bearing against.

According to the examplary embodiment of FIG. 1 which shows the rocker-arm or lever assembly for one cylinder of a large internal combustion engine in particular of the Diesel type, which cylinder comprises a pair of inlet valves and a pair of exhaust valves, both exhaust valves 1, 2 are operated simultaneously by a same rocker-arm or lever actuator 3 common to both valves. This rocker-arm is pivotally mounted on a substantially horizontal pin 4 forming an axis of rotation and fitted in a rocker-arm support, bracket or pedestal 5 secured to the cylinder head 6 (see FIG. 2). The rocker-arm or lever 3 is actuated by means of the engine cam shaft through the medium of a push-rod 7 acting upon the operating lever arm 3*a* of the rocker. The opposite lever arm 3*b* of the rocker, which acts upon the exhaust valves 1, 2, exhibits a bifurcated or fork-like configuration both sides or legs of which bear upon the stems of the exhaust valves 1, 2, respectively. As shown in the fragmentary view of FIG. 2, the stem of each exhaust valve such as 2, the free top end of which only is seen in FIG. 2, extends through the body or valve stem guide 8 mounted in the cylinder head 6 and provided with a collar or the like serving as an abutment cup or bearing chair or pad for the corresponding valve spring (not shown).

According to the invention, the rocker-arm 3 consists of two parts pivotally connected to each other desirably so that their pivot axis is directed transversely of and at least approximatively at right angles to the axis of each associated valve and coincides for example with the pivot axis 4 of the rocker-arm or is formed of the latter axis through which said rocker-arm is mounted for swinging or tilting motion on its support 5. Thus both component parts 3*a* and 3*b* forming the rocker-arm 3 are the rocker actuating lever arm and the valve actuating lever arm, respectively. As shown in particular in FIGS. 1 and 3, one of said two parts, for example the member 3*b*, has its end for pivotal connection substantially in the shape of a clevis or yoke with two substantially parallel web-like flanges or cheeks 9 formed with two registering holes 10 extending therethrough for the passage of the pivot pin 4 whereas the other part for example 3*a* has its end for pivotal connection in the shape of a tongue through which extends a hole 10′ for the passage of the pivot pin 4, which tongue is adapted to be inserted into the clevis or fork-like portion of the member 3*b* between the cheeks 9 thereof, so that its hole 10′ is coaxially aligned with the holes 10. The rocker-arm element 3*b* is thus rotatable upwards about the pin 4 with respect to the rocker element 3*a* thereby lifting off entirely the valve stems it is operating.

Both rocker parts 3*a*, 3*b* may be rigidly locked or secured with respect to each other by means of a locking element desirably consisting of a lock pin, bolt or the like 11 insertable into at least two coaxially aligned holes, respectively, of both parts 3*a* and 3*b*, which holes are spaced from the corresponding holes 10, 10′ for the passage of the pivot pin 4. These holes consist for example of two holes 12 extending coaxially through the upper portion of the cheeks 9 of the end clevis portion of the part 3*b* and of a hole 12′ extending through the corresponding upper portion of the tongue at the end of the part 3*a*. These holes 12, 12′ are arranged so that when both rocker-arm elements 3 are substantially aligned in operating position about their common pivot axis 4, the hole 12′ of the part 3*a* is coaxially aligned with the holes 12 of the part 3*b*, so that the locking pin 11 may be inserted therein to extend through these three holes for rigidly locking both elements together.

Retaining means are desirably provided to keep the removable locking pin 11 in place for example by being held tightly. For this purpose, at least one and for example each one of the holes 12, 12′ for the passage of the locking pin 11 is resiliently compressible, that is expandable and contractable by being formed in an at least partially ring-shaped portion slit at 13, 13′ along a substantially axial plane so as to form a kind of clamping collar adapted to be clamped or tightened for example by means of a screw or the like 14 (see FIGS. 5 and 6) directed at right angles to the plane of the slotted joint while extending freely through the upper end of said joint to be screw-threaded into the lower end thereof so as to cause the edges of said joint to be drawn near by turning the screw thereby causing the locking pin 11 to be clamped or tightly held against motion.

As shown in FIG. 4, the rocker-arm 3 is mounted on its pivot pin 4 desirably through the medium of a bushing 15 forming a journal bearing or the like known per se and force-fitted at least into one of the two members 3*a*, 3*b* so that the other member is rotatably mounted on said bushing which is itself rotatably mounted on the stationary pivot pin 4. In FIG. 4, the bushing 15 is tightly fitted into the member 3*b* and the member 3*a* is rotatable about the bushing. The lubrication is effected through a duct 16 bored in the pin and fed under pressure by a corresponding duct 17 provided in the rocker-arm support 5. The duct 16 opens at the side surface of the pin 4 in front of an annular distribution groove 18 formed in the inner surface of the bushing 15 and communicating through one or several holes extending through the bushing with a corresponding distributing groove 19 provided in the bore 10′ of the member 3*a*.

The operative process for removing and refitting an exhaust valve of the type having a cage with a valve seat is very simple : the rocker-arm being assumed to be in active operative position, the three screws 14 are loosened sufficiently for enabling to remove the locking pin 11 thereby disconnecting both elements 3*a*, 3*b* of the rocker-arm 3 from each other. The valve operating element 3*b* of the rocker-arm is then raised by hand by swinging it upwards about the pivot pin 4 to bring it from the position shown in solid lines in FIG. 2 to the position drawn in dash-dotted lines in the same Figure thereby clearing entirely the passageway enabling to take out and to remove each one of the two exhaust valves 1, 2 as shown by their intermediate

removing position drawn in dash-dotted lines in FIG. 2. After having refitted the complete exhaust valves, the rocker-arm element 3*b* is moved or swung downwards by hand until the holes 12 of the rocker-arm element 3*b* are coaxially aligned with the hole 12' of the rocker-arm element 3*a*; then the locking pin 11 is inserted into the three holes thus aligned and this locking pin is held against motion in its mounted position by tightening the screw 14.

Instead of the locking system with the pin 11 and the clamping screws 14 for the slotted holes 12, 12', it is possible alternatively, according to FIGS. 7 and 8 to provide the holes 10, 10' of the respective parts 3*b*, 3*a* with splines, flutes, serrations, teeth, corrugations and ribs or like feathers 20 and to provide on the pin 4' a fluted or splined portion 20' mating with or complementary of the flutes or splines 20 of said holes as well, possibly, as a plain or smooth coaxial end portion 21 of smaller diameter while causing said pin to be slidingly movable in axial translation, so as to lock the pivotal connection and rigidly fasten both members 3*a*, 3*b* to each other by bringing the flutes or splines of their respective holes in mutually registering coincidence in their aligned position and by causing them to mesh with those of the pin 4' inserted or driven into the locking position. The pin 4' desirably comprises a radially projecting head 22 at the opposite end of the smooth portion 21 and a for example, smooth stepped portion 23 forming a neck below the head 22. The neck diameter is preferably greater than that of the holes 10, 10' whereas the diameter of the smooth end is smaller than that of the holes 10, 10'. The link pin 4' is slidably mounted with its smooth neck 23 and with its smooth end portion 21 into two corresponding rings or bushings 24, 25, respectively, forming journal bearings desirably faced on their outer side face with an anti-friction lining and rotatably mounted into the coaxial bores 26 of both clevis sides of the support 5 while preferably projecting inwards and outwards thereof. In its locking position shown by the top half-section of the hinge pin 4' in FIG. 7, the hinge pin 4' is completely driven into the support 5 so as to bear with its neck 23 and its tip or end portion 21 within the rings or bushings 24, 25. A cover or like cap 27 is slidably mounted endwise of the smooth portion 21 and secured by a central screw 28 to the hinge pin 4' while bearing against the adjacent projecting end of the ring 25, so as to leave a clearance between the end face of the hinge pin 4' and the inner wall of the cover 27. This cover thereby achieves a tight fit such that the head 22 of the hinge pin 4' bears against the outer adjacent projecting edge of the ring 24 and the respective inner projecting end edges of the rings 24 and 25 are in pressed engagement with the rocker-arm element 3*b* so as to secure rigidly together for rotation the assembly of parts 3*b*, 4', 24, 25, 27 which may rotate freely within the bores 26 of the support 5 through the medium of the rings 24, 25. To unlock the pivotal connection, it suffices to remove the screw 28 and the cover 27 and to withdraw the pivot pin 4' sufficiently for having its flutes moving out of the holes 10, 10' of the parts 3*a*, 3*b* which each one may then turn freely about the corresponding smooth portion 21 of the pivot pin 4' (see lower half-section of pivot pin 4' in FIG. 7). The flutes or splines formed in the holes 10, 10' and on the pin 4' may of course be replaced by one or several keyways or keyslots and one or several keys, ribs, feathers or like projecting portions, respectively. The pivot pin may be held against axial translation by other suitable retaining means than the cover 27 secured by the screw 28 (which may for example be replaced by a possibly locked nut screw-threading on a corresponding screw-threaded portion of the end of the pin 4').

It should be understood that the invention is not at all limited to the forms of embodiment described and shown which have been given by way of example only. In particular it comprises all the means forming technical equivalents to the means described as well as their combinations if same are carried out according to the gist of the invention as defined in the appended claims.

What is claimed is :

1. A rocker-arm assembly for operating upwardly removable overhead valves provided in the cylinder heads of an internal combustion engine, wherein the improvement consists in that in its mounted condition on said engine, it is at least partially displaceable selectively without any removal thereof, from its operative position so as to move at least that portion thereof which co-operates with at least one valve away from the clearing space and path of travel of each associated valve when taking out and removing said latter, releasable locking means being provided to prevent such a displacement in normal service, said rocker-arm consisting of two parts co-operating the one with at least one valve and the other with the rocker actuating member, both parts being connected in at least approximately aligned relationship substantially in extension of each other and wherein the improvement consists of substantially rigid connecting means adapted to be selectively rendered movable to enable a relative displacement of said valve operating part.

2. A device according to claim 1, with both aforesaid parts pivotally connected to each other and wherein the improvement consists in that said valve operating part is pivotally movable about its pivotal connection whereas said releasable locking means consists of at least one removable locking element rigidly connecting both parts.

3. A device according to claim 2, wherein said removable locking element is located in spaced relation to the pivotal connection of said parts.

4. A device according to claim 2, wherein said removable locking element is positioned in coinciding relation to the pivotal connection between said parts.

5. A device according to claim 2, wherein said pivot pin is directed transversely of and at least approximately at right angles to the center line of each associated valve and coincides with the axis of rotation of the rocker-arm through which the latter is rotatably mounted on its support.

6. A device according to claim 5, wherein one of both aforesaid parts has substantially the shape of a clevis and the other one forms a tongue insertable in said clevis.

7. A device according to claim 5, wherein said locking element consists of a pin insertable in at least two coaxially aligned holes of said two parts, respectively, in spaced relation to the corresponding holes receiving said pivot pin.

8. A device according to claim 7, comprising means for retaining said locking pin.

9. A device according to claim 8, wherein at least one of said holes receiving said locking pin is resiliently compressible and formed in an at least partially ring-shaped portion slit along a substantially axial plane so as to form a clamping collar adapted to be tightened by means of a screw extending through the plane of the slit joint so as to draw near the edges thereof.

10. A device according to claim 5, wherein the holes receiving said pivot pin for the two parts of the rocker-arm comprise at least one longitudinal spline-like groove engageable in the aligned registering position of said parts by a complementary radially projecting rib-like portion of said pivot pin which is slidably movable through axial translation and is formed with a smooth portion provided in coaxial extension thereof for free rotation of at least one of said parts with respect to the other.

11. A device according to claim 8, comprising retaining means co-operating with said pivot pin for holding it against axial translatory motion.

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