# United States Patent [19]

**Straub**

[11] **3,828,179**

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[54] **HYDRAULIC SYSTEM FOR AUTOMATICALLY ADJUSTING THE POSITIONS OF HEADLIGHTS OF AN AUTOMOBILE**


[75] Inventor: **Steffen Straub**, Stuttgart, Germany

[73] Assignee: **Robert Bosch GmbH**, Stuttgart, Germany



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[52] **U.S. Cl.** ........... **240/7.1 LJ,** 240/62.3, 240/61.1

[51] **Int. Cl.** ................................................ **B60q 1/10**

[58] **Field of Search** .............. 240/62.3, 7.1 LJ, 61.1



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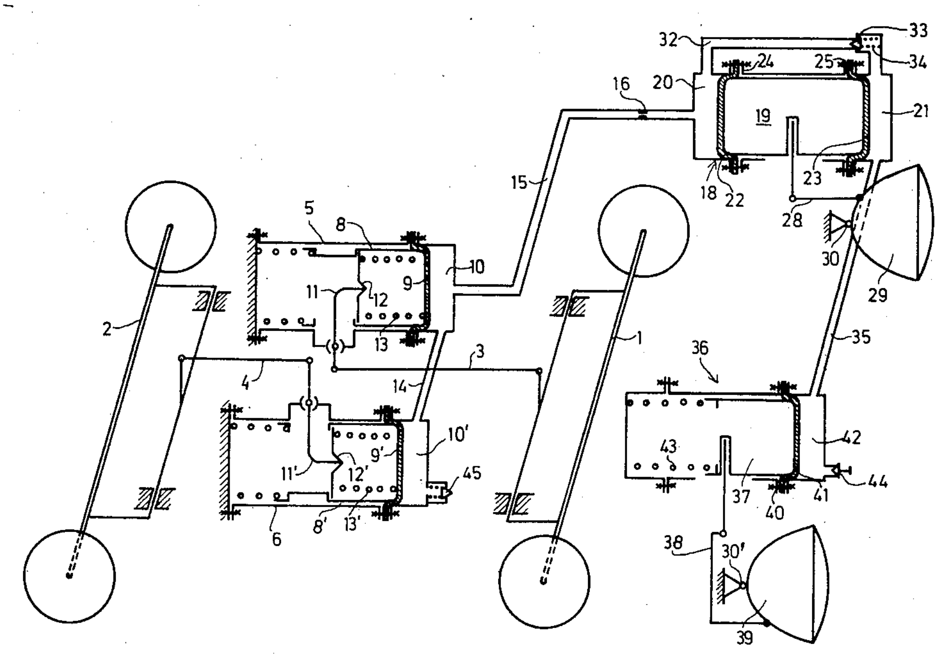
*Primary Examiner*—Robert P. Greiner
*Attorney, Agent, or Firm*—Edwin E. Greigg


[57] **ABSTRACT**


What follows is the description of an improved hydraulic system for automatically adjusting the positions of headlights of an automobile. The hydraulic system includes two component hydraulic systems, the first of which is provided with a mechanical linkage structure associated with spring-suspended parts at the front and rear of the automobile, two measuring cylinders having pistons displaceable therein and connected to the linkage structure, and a conduit which connects the two measuring cylinders with one another and with the work space of a common working cylinder of the hydraulic system. The second component system is provided with a second working cylinder having a piston displaceable therein and a work space which is connected by a conduit to the common working cylinder, as well as a pair of headlight position adjusting linkages connected to the pistons of the two working cylinders on the one hand and adapted for mechanical connection to pivotably mounted headlights of the automobile, on the other hand. This hydraulic system is improved by providing it with a fill-up valve in one, and a vent valve in the other of the component systems, and with a hydraulic conduit interconnecting the two systems in which conduit there is interposed a shut-off structure which can be opened in the direction of liquid flow from the fill-up valve to the vent valve, while the entire hydraulic system is being filled.


**8 Claims, 3 Drawing Figures**



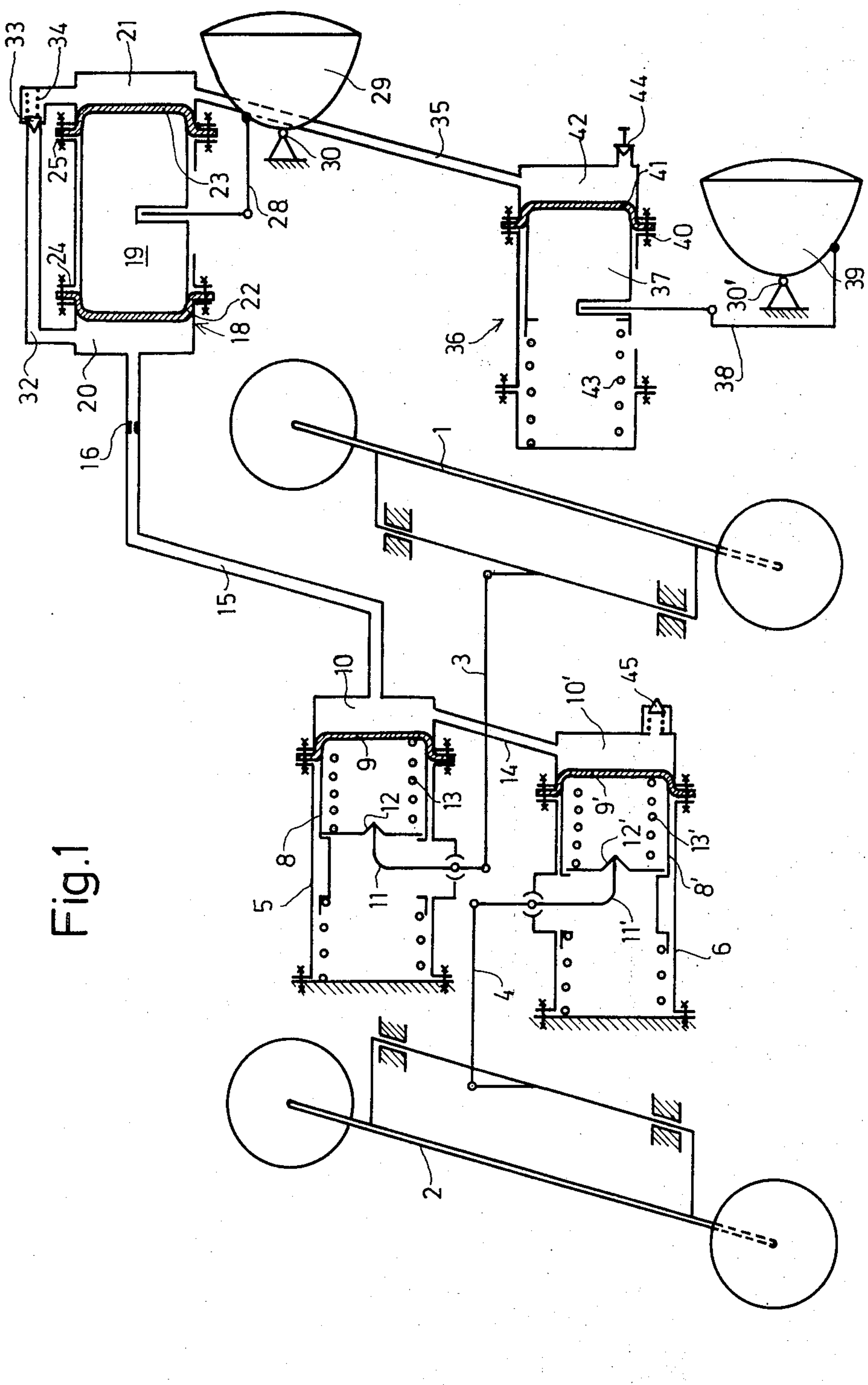


Fig.1

Fig.2

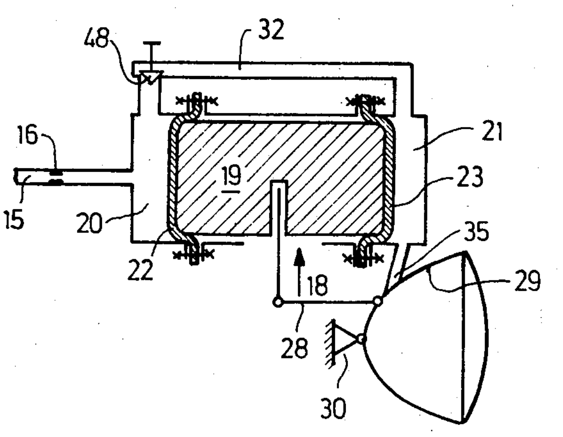

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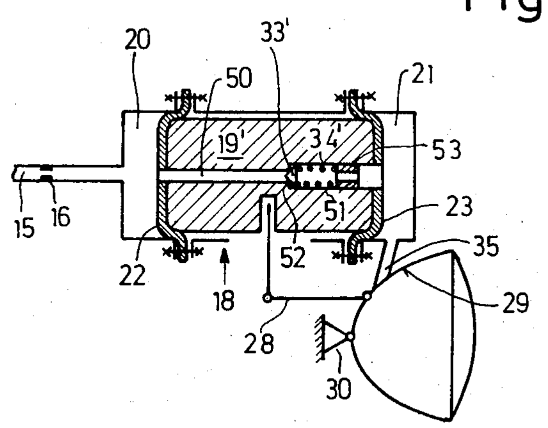
Fig.3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# HYDRAULIC SYSTEM FOR AUTOMATICALLY ADJUSTING THE POSITIONS OF HEADLIGHTS OF AN AUTOMOBILE

## BACKGROUND OF THE INVENTION

This invention relates to a hydraulic system for automatically adjusting the positions of headlights of an automobile, and is of the type comprising two hydraulic component systems, each of which is closed upon itself during operation, and of which component systems one serves as the "actuating" and the other as the "responsive" system; common to both systems is a first working cylinder housing a piston displaceably and sealingly therein, which piston separates a first and a second work chamber in the said cylinder from one another.

This hydraulic system further comprises in the first component system thereof mechanical motion-transmitting means which are associated with preferably spring-suspended, movable elements at the front part of the vehicle, and other such motion-transmitting means associated with similar movable elements at the rear part of the vehicle; these motion-transmitting means are actuated by the movements of the respective spring-suspended elements, for instance, the front and the rear axle, respectively, of the automobile, and are connected each to a piston displaceably housed in a measuring cylinder, while both these measuring cylinders are connected with one another and with one of the two work spaces, pertaining to this component system, of the aforesaid first working cylinder.

In the second or "responsive" component system of the hydraulic system, the other work space of the first working cylinder is connected via additional hydraulic conduit means to the work space of a second working cylinder having a second work piston housed sealingly therein, which second work piston is displaceable against the force of a return spring. The work pistons of the first and second working cylinders are connected by means of mechanical headlight position-adjusting linkage means each with a pivotably mounted headlight of the automobile.

In operation, the total volume of hydraulic liquid in the work spaces of the two measuring cylinders will only change when the suspended front and rear elements of the automobile carry out movements relative to each other in an opposite sense, whereby the said total volume is either decreased or increased. In the case of a decrease of this total volume of liquid in the measuring cylinders, the hydraulic liquid forced out of the measuring cylinders serves to displace the work piston in the said first working cylinder and thereby cause this piston to shift the position-adjusting mechanical means to adjust the position of the headlight associated therewith, and force hydraulic liquid in the second component system out of the work space of the first working cylinder pertaining thereto into the work space of the second working cylinder, causing displacement of the piston therein which is transmitted via the position-adjusting mechanical means to the other headlight which is associated with the latter means.

Or, in the reverse case, when the total volume of hydraulic liquid in the two measuring cylinders is increased, the previously expelled excess volume of liquid can be returned to the first working cylinder due to the force of the return spring in the second working cylinder displacing the pistons in both working cylinders.



The work spaces in the measuring cylinders and in the working cylinders must be sealed fluid-tight from the pistons; this is preferably achieved by means of sealing membranes.

U.S. Pat. No. 3,453,424 (German Offenlegungsschrift 1,555,063), discloses hydraulic systems of the above-described type. However, these systems are manufactured and sold as closed units, and when a repair is to be carried out, these systems must be opened and/or emptied, an operation which is very cumbersome and expensive. Special filling and venting means have to be built subsequently into systems of this type and the entire system must be readjusted in a complicated manner.

## OBJECT AND SUMMARY OF THE INVENTION

It is therefore, an object of the invention to provide an improved system of this type wherein simple means for easily and rapidly filling and re-adjusting the system have been provided.

This object is attained by providing one of the two component systems described with a single fill-up valve and the other component system with a single venting valve, and by linking both component systems by way of hydraulic connecting conduit means which are equipped with shut-off means for interrupting the flow of hydraulic liquid therethrough.

This has the important advantage that both component parts of the improved system according to the invention, although being in operation closed each upon itself, can be filled together by means of a single fill-up valve and vented by means of a single further valve. During the filling operation, the shut-off means in the connecting conduit means between the two systems must be opened. When adjustment and setting of the headlights to a prescribed position is effected during the filling operation, the whole hydraulic system will be set to continuously adjust the positions of the headlights to this prescribed position.

In one embodiment of the hydraulic system according to the invention, the connecting conduit means are located outside the first working cylinder and preferably connect the two work spaces in the latter cylinder with one another, spring-biassed check valve means being interposed in the said connecting conduit means, which check valve means open in the direction of liquid flow from the fill-up valve in one of the two component systems to the vent valve in the other component system. This has the advantage of the system being adjustable simultaneously with the filling operation, while fixing the positions of the pistons in the working cylinders, without any outside intervention.

In a further embodiment according to the invention, the closing force of the return spring biassing the check valve is greater than the frictional forces occurring at the mechanical motion-transmitting linkage means associated with the headlights. It is an advantage of this feature that the check valve in the component system-connecting conduit means can only be opened by the filling pressure of the hydraulic liquid, and that there can be no passage of hydraulic liquid from one component system to the other during operation.

In order to provide a safe sealing off of both component systems from one another which is independent of the frictional forces occurring at the linkage means associated with the headlights, which forces may rise very considerably especially in winter due to ice-formation on them, or due to corrosion, the check valve in the connecting conduit means can be replaced by an externally actuable gate valve or the like.

In a further embodiment according to the invention, the connecting conduit means consist in a stepped axial bore through the piston of the first working cylinder, wherein a wider diameter portion of the axial bore houses a spring-biassed check valve which opens in the direction of flow of the hydraulic liquid during filling from the fill-up valve in the one component system to the vent valve in the other component system. This check valve preferably has its seat at a shoulder between the wider bore portion and an adjoining narrower bore portion, and may be provided with adjustable abutment means for the spring of the check valve in the said axial bore, whereby the bias of the spring can be varied. This embodiment has the advantage of making separate connecting conduit means between the two component systems outside the first working cylinder superfluous, thus eliminating the need for further connecting points requiring sealing means and the risk of leakage of hydraulic fuel caused thereby.

## BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood and further objects and advantages will become apparent from the ensuing detailed specification of preferred but merely exemplary embodiments taken in conjunction with the drawings.

FIG. 1 shows in a highly schematical view a hydraulic system, according to the invention, for automatically adjusting the position of the headlights of an automobile, which system comprises a first embodiment of the first working cylinder thereof;

FIG. 2 shows in a schematical partially sectional view another embodiment of the first working cylinder of the system; and

FIG. 3 shows in a similar view a third embodiment of the first work cylinder of the same system.

## DETAILED DESCRIPTION OF THE EMBODIMENTS

The relative movement of the front and rear axles of an automobile in relation to the automobile body is transmitted from the front axle suspension 1 and rear axle suspension 2 via mechanical linkage means 3 and 4, respectively, to a measuring cylinder 5 associated with the front axle and to a measuring cylinder 6 associated with the rear axle. The two measuring cylinders are of identical construction. Each of measuring cylinders 5 and 6 houses a piston 8, 8′ which contacts a flexible membrane 9, 9′ which latter encloses together with the one end portion of the measuring cylinder 5,6 a work space 10,10′. A displacement of the piston 8,8′ in the cylinder 5,6 is effected by means of the linkage means 3,4 actuating a lever 11,11′ which acts by means of a spring-supporting disc 12, 12′ and a spring 13,13′ on the piston 8,8′, thereby guaranteeing a shock-free transmission of forces.

The chambers 10,10′ are connected with one another via a hydraulic conduit 14. A further hydraulic conduit 15 leads from the measuring cylinder 5 via a throttle means 16 to a double-work space cylinder 18. In this double-work space cylinder 18 there is housed a piston 19 which divides the interior of this cylinder into a rear work space 20 and a front work space 21. These work spaces 20 and 21 are sealed against the piston 19 by means of flexible membranes 22 and 23, respectively, which are clamped in between flanges 24 and 25, respectively, of the double-work space cylinder 18. Piston 19 is connected by means of position-adjusting linkage means 28 to a car headlight 29 which is mounted for swivelling about a pivot 30.

The work spaces 20 and 21 are connected with one another by a bypass conduit 32 in which there is located a check valve 33 which is held on its valve seat by means of return spring 34. A hydraulic connecting line 35 leads from the work space 21 of the double work-space cylinder 18 to the sole work space 42 of another work cylinder 36 which houses a piston 37 which adjusts the position of a second headlight 39 mounted on a pivot 30′ by means of adjusting linkage means 38. The piston 37 is separated from the work space 42 by means of a membrane 41 which is clamped in between flange means 40 of the cylinder 36. The frontal face of the piston 37 turned away from the work space 42 in work cylinder 36 is acted upon by a spring 43 housed in the work cylinder 36. The work space 42 can be ventilated by means of a vent valve 44. The work space 10′ of measuring cylinder 6 can be filled with hydraulic liquid by means of fill-up valve 45.

Operation of the Hydraulic System Shown in FIG. 1.

In the case of an even turning-in of the front axle and the rear axle of the vehicle, the volumes of work spaces 10 and 10′ in measuring cylinders 5 and 6 will be altered in an opposite sense, e.g. when moving the left-hand axle ends of the front axle and the rear axle toward one another in a left turn of the automobile, piston 8 will be moved into cylinder 5 while piston 8′ will be moved in a direction out of cylinder 6. A pressure balance in work spaces 10 and 10′ is achieved via conduit 14. If, however, the degrees of turn-in of the front axle and of the rear axle are different, then a change in the total volume made up of the sums of the volumes of work spaces 10 and 10′ will be the result. If the total volume is decreased the resulting excess of hydraulic control liquid will be forced out of measuring cylinders 5 and 6 via the hydraulic conduit 15 into the double work-space working cylinder 18, with the throttle means 16 exercising the function of damping this oscillation. The liquid which is being introduced into work space 20 of work cylinder 18 displaces piston 19 in cylinder 18, whereby the latter is induced to cause an adjustment on the position of the headlight 29 by swiveling the latter about its pivot 30 by means of the adjusting linkage means 28, while liquid from the work space 21 of cylinder 18 is forced via connecting line 35 into the work space 42 of second work cylinder 36. This addition of liquid in work space 42 then displaces piston 37 in cylinder 36 in outward direction against the force of spring 43, whereby the piston causes the adjustment of the position of the second headlight 39 about its pivot 30′ by means of adjusting linkage means 38. However, this operation will only be possible if bypass conduit 32 connecting the two work spaces is interrupted in a fluid-tight manner by the check valve 33. The closing force of the check valve spring 34 must therefore be larger than the forces of friction opposing the adjusting movements in the system.

Hydraulic liquid is filled into the system by way of the fill-up valve 45 provided at measuring cylinder 6. Prior to filling in the liquid, the vent valve 44 provided at the second work cylinder 36 must be opened, and both headlights **29** and **39** adjusted to and set in their prescribed positions. The filling pressure of the liquid to be filled in must be sufficiently high to overcome the force of spring **34** acting on the check valve **33.** During the filling operation, liquid will flow through valve **45** into the measuring cylinder **6,** from there via hydraulic conduit **14** to measuring cylinder **5** and on to work space **20** of first work cylinder **18** via hydraulic conduit **15,** from where it will flow via bypass conduit **32,** and by opening check valve **33** into work space **21** and through connecting line **35** into the cylinder **36** from where it will leave the system via vent valve **44.** Filling is terminated when no more gas is found to leave vent valve **44,** whereupon both valves **44** and **45** will be closed.

## Description of Further Embodiments

FIG. **2** shows a second embodiment of the first, double work-space, working cylinder **18,** wherein the check valve **33** in bypass conduit **32,** shown in FIG. **1,** has been replaced by an externally actuable gate valve **48.** This valve permits to separate the two partial hydraulic systems present on opposite frontal faces of work piston **19** in an unobjectionable manner. The operation of the system having this second embodiment of the double-space working cylinder **18** is the same; however, when filling the system, it is necessary to first open the gate valve **48** and to close the same after the filling is terminated. By means of this valve **48,** it is also possible to effect a later adjustment of the basic positions of the headlights **29** and **39** by opening the valve **48,** shifting the headlights to their desired corrected position and then closing valve **48** again. Such subsequent adjustment of the basic position of the headlights is only possible in the system as shown in FIG. **1** by a forced shifting of pistons **19** and **37,** whereby check valve **33** is forced to open.

FIG. **3** shows yet another embodiment of the first, double work-space, working cylinder **18** housing a piston **19'** which has a stepped axial bore consisting of a narrower bore portion **50** opening out of membrane **22** into work space **20** of cylinder **18,** and a wider diameter bore portion **51** opening out of membrane **23** into work space **21** of the cylinder **18.** This axial bore **50, 51** replaces the bypass conduit **32** connecting work spaces **20** and **21** in the embodiment of the working cylinder **18** shown in FIG. **1.** In the wider diameter bore portion **51** there is inserted a check valve **33'** biassed by a spring **34'** against the annular shoulder **52** between the wider and narrower bore section acting as a valve seat. The closing force of spring **34'** is adjustable by means of a spring supporting abutment member **53** having an axial bore therethrough, which is set or screwed into the bore section **51** and the position of which in the axial bore portion **51** can be varied.

The filling and adjustment of the system as well as the operation of the same, when equipped with the embodiment of the first working cylinder as shown in FIG. **3** is the same as in the case of the system shown in FIG. **1.**

The above-described hydraulic system for automatically adjusting the positions and in particular the angle of inclination of the headlights of an automobile permits a re-filling with hydraulic fuel and a re-setting of the headlights to the prescribed position, e.g. at low beam, in a very simple manner, not only in general, but especially after the automobile has undergone repair work that may have caused a shift in the position of the headlights.



What is claimed is:

**1.** In a hydraulic system for automatically adjusting the positions of the headlights of an automobile,

which system comprises a first and a second component system each of which is closed upon itself, and a first working cylinder and a first working piston displaceably and sealingly housed in said cylinder and separating from one another in said cylinder a first work space being included in said first component system and a second work space being included in said second component system; and

I. wherein said first component system comprises
  - a. first mechanical linkage means adapted for being associated with a spring-suspended front part of the automobile,
  - b. second mechanical linkage means adapted for being associated with a spring-suspended rear part of the automobile,
    both said first and second mechanical linkage means being responsive to a movement of said suspended front and rear parts relative to one another in an opposite sense;
  - c. a first measuring cylinder and a piston therein which is connected to said first linkage means,
  - d. a second measuring cylinder and a piston therein which is connected to said second linkage means, and
  - e. hydraulic conduit means connecting said first measuring cylinder and said second measuring cylinder with one another and with said first work space in said first working cylinder; and

II. wherein said second component system comprises
  - f. a second working cylinder, a second working piston displaceably and sealingly housed therein and defining a work space in said second working cylinder, and spring means for biassing said second working piston,
  - g. hydraulic conduit means connecting said second work space in said first working cylinder with said work space in said second working cylinder, and
  - h. a pair of headlight-position adjusting means adapted to be connected to a pair of pivotably mounted headlights of the automobile and one of said pair of adjusting means being connected to said first working piston and the other to said second working piston, the improvement comprising
    - i. a fill-up valve for hydraulic liquid in one of said component systems,
    - ii. a vent valve in the other component system,
    - iii. hydraulic interconnecting conduit means between said first and second component systems, and
    - iv. shut-off means located in said hydraulic interconnecting conduit means for closing said interconnecting conduit means during a headlight adjustment operation and opening said interconnecting conduit means during a filling operation for said system.

2. The improvement described in claim 1, wherein said hydraulic interconnecting conduit means connect said first work space and said second work space of said first working cylinder with one another.

3. The improvement described in claim 2, wherein said hydraulic interconnecting conduit means are located outside said first working cylinder.

4. The improvement described in claim 1, wherein said shut-off means is a spring-biassed check-valve adapted for opening in the direction of liquid flow from said fill-up valve to said vent valve.

5. The improvement described in claim 4, wherein said check valve comprises a return spring the closing force of which is greater than the sum of the frictional forces acting on said first and said second working piston during a displacement of liquid in said hydraulic system.

6. The improvement described in claim 1, wherein said shut-off means is a gate valve.

7. The improvement as described in claim 1, wherein said hydraulic interconnecting conduit means comprise a stepped axial bore through said first working piston and wherein said shut-off means is a spring-biassed check valve located in said axial bore, and adapted for opening in the direction of liquid flow from said fill-up valve to said vent valve.

8. The improvement described in claim 7, wherein said check valve comprises return spring means biassing said check valve and spring-bias adjusting means displaceably associated with said return spring means in said axial bore.

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