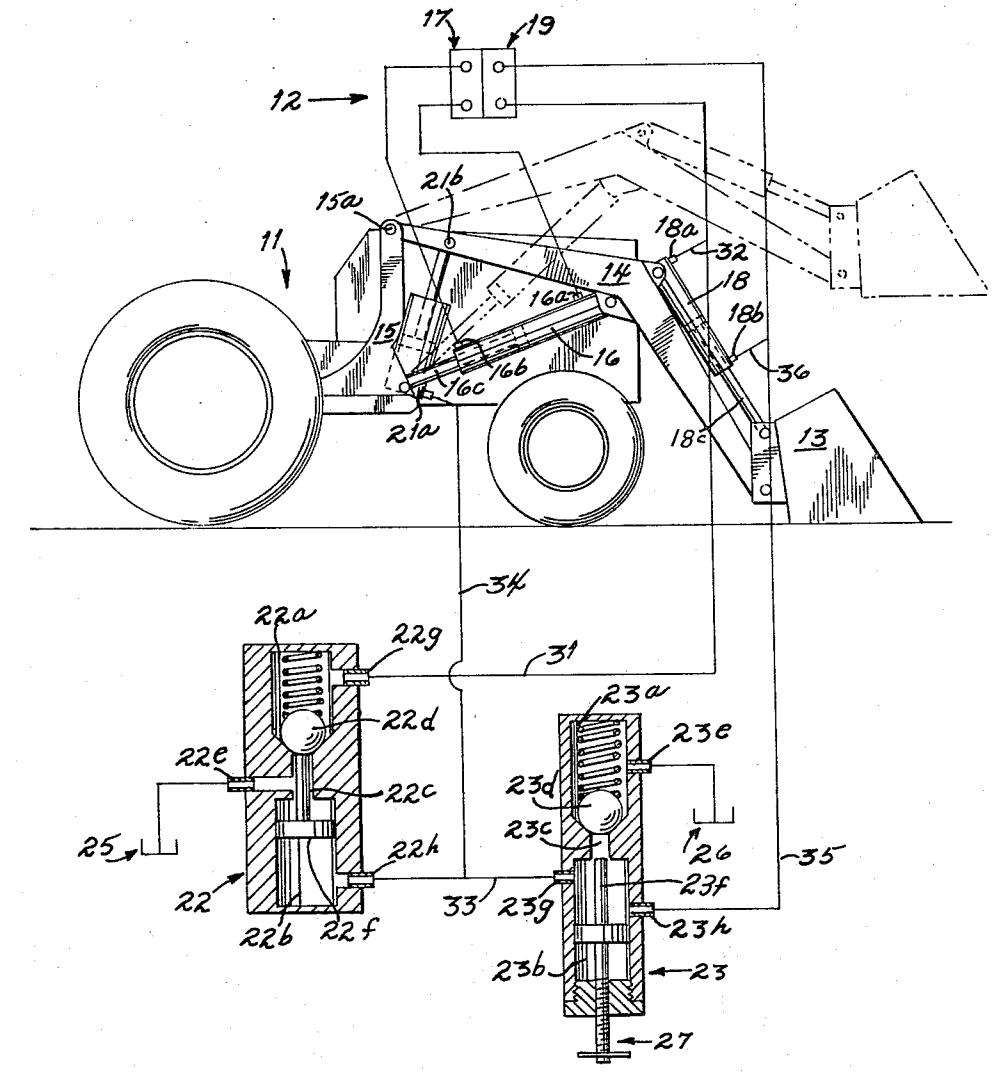
Jan. 10, 1967 R. A. KLAVITER ET AL 3,297,183

HYDRAULIC SELF-LEVELING DEVICE FOR A FRONT MOUNTED BUCKET TYPE MATERIAL LOADER

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FIG. 1



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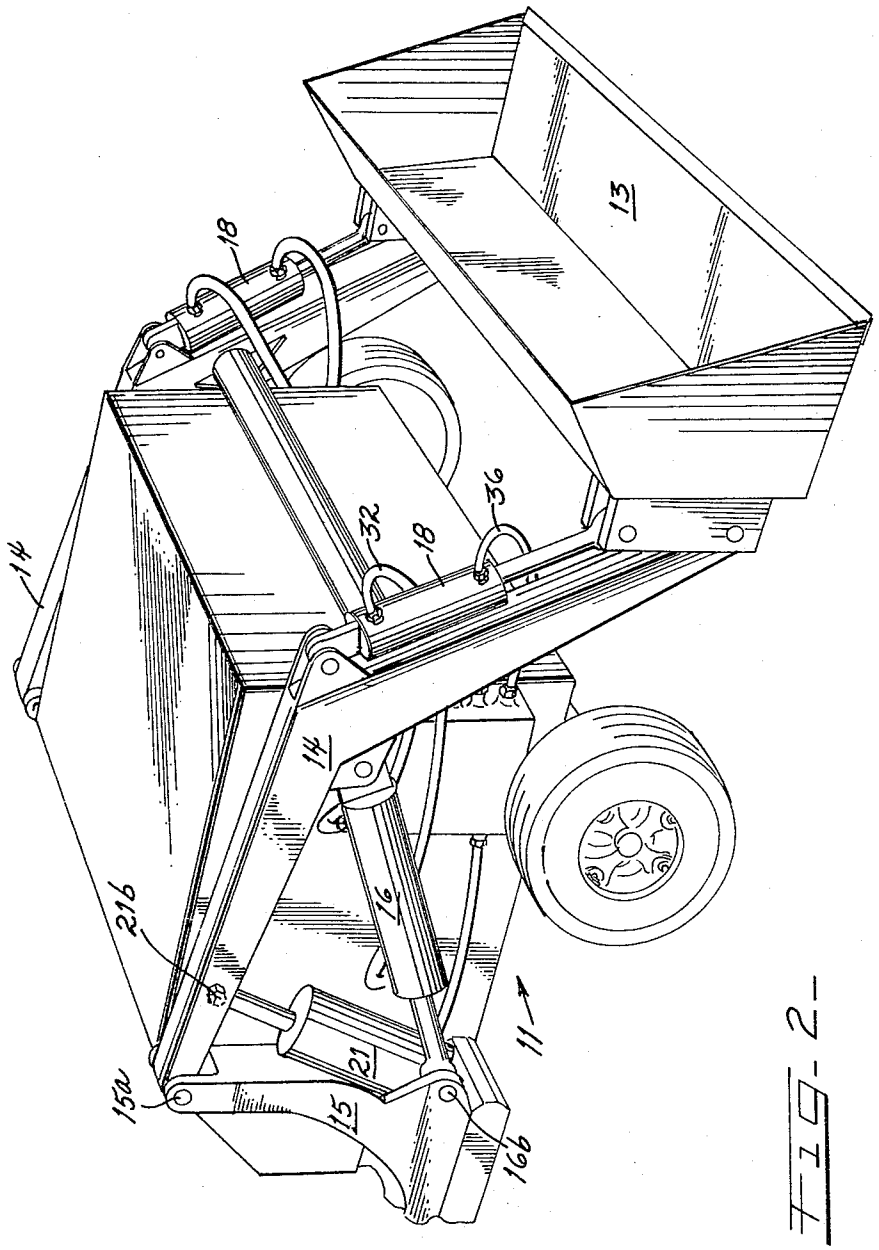


FIG. 2

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HYDRAULIC SELF-LEVELING DEVICE FOR A FRONT MOUNTED BUCKET TYPE MATERIAL LOADER

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7 Claims. (Cl. 214—771)

This invention relates to material loaders including a prime mover and a loader frame having a boom and a bucket, and more particularly to a device for maintaining a specific bucket position relative to the boom as the boom and bucket are raised and lowered from and to a ground level position.

An object of the invention is to provide an efficient economical device for better maintaining, at a desired level or position in relation to the horizontal at all stages of operation, the bucket of a material loader, which is raised and lowered by a hydraulically operated boom type structure.

Another object of the invention is to provide such a device utilizing the hydraulic system of the implement to operate an auxiliary hydraulic mechanism including a slave cylinder automatically to maintain the bucket in a desired posture as it is raised and lowered.

Other objects and advantages of the invention will appear as the description proceeds in relation to the drawings in which:

FIG. 1 is a schematic diagram of an embodiment of the invention including a side elevation of a material loader of the type mentioned with parts of the mechanism indicated in operated position;

FIG. 2 is a perspective view of a material loader equipped with the invention.

The loader **11** with which the invention is associated for present purposes, as illustrated in FIG. 2, comprises a dual hydraulic system **12** for manipulating and operating the bucket **13**, which is supported on a dual boom structure **14** pivotally mounted at **15***a* on sub-frame **15** of the loader. In view of this duality of mechanism, the description will proceed in the singular with the understanding that it is duplicated on the opposite side of the loader.

The hydraulic system **12** which is connected with a source of fluid (oil) under pressure on the loader (not shown) comprises a boom cylinder **16** operable under control of boom valve **17** to raise and lower the boom structure **14**, and a bucket cylinder **18** operable under control of bucket valve **19** to manipulate bucket **13** to positions of operation for filling and emptying it.

Boom cylinder **16** is pivotally connected at its head end **16***a* to boom structure **14** and at its rod end **16***b* to sub-frame **15** and operates, upon the introduction of fluid under pressure at its head end, to raise the boom and the bucket to a position as indicated in broken lines in FIG. 1, and upon release of that pressure to return the boom and bucket to a lower position.

The self-leveling device of the present invention comprises the interposition in such a system of a third cylinder **21**, called a slave cylinder, in association with a pair of relief valves respectively called a first relief or anti-cavitation valve **22** and a second relief, or diverter valve **23**.

Slave cylinder **21** is pivotally attached at its head end **21***a* to sub-frame **15** and at its rod end **21***b* to boom structure **14**. Cylinder **21** is also connected hydraulically at its head end with the rod end of cylinder **18** and arranged to operate in synchronism therewith. Because cylinder **21** has only a single hydraulic connection, it is known in the art as a single acting cylinder, since hydraulic pressure can act on only one side of the piston therein.

Valves **22** and **23** being relief valves are generally similar in type. Each has opposed upper and lower chambers **22***a*, **22***b*, **23***a*, **23***b* with a passage **22***c*, **23***c* therebetween, and normally closed by a spring pressed ball **22***d*, **23***d* in the upper chamber **22***a*, **23***a*.

Each relief valve has a port **22***e*, **23***e* in communication with a fluid reservoir **25**, **26**, with this difference as will be further noted, namely, that port **22***e* is in communication with passage **22***c* whereas port **23***e* is in communication with upper chamber **23***a*. Other ports and their function will be noted.

Only valve **22** has a piston **22***f* in its lower chamber with an upwardly extending rod receivable in the passage **22***c* between chambers **22***a*, **22***b* and arranged when the piston **22***f* is in upper position to push the ball upwardly out of closing relation with the passage and enable communication between the two chambers. Manually operable means **27** are provided for unseating valve **23** to render the self-leveling device inoperative.

Valves **22** and **23** are arranged in hydraulic communication with slave cylinder **21** and with valve **19** and cylinder **18** through their several ports.

Port **22***g* of valve **22** provides hydraulic communication between the upper chamber of valve **22** through line **31**, **32** with the head end **18***a* of bucket cylinder **18** and one side of valve **19**. Port **22***h* of valve **22** provides like communication through line **33**, **34** with the interior of the head end **21***a* of slave cylinder **21** and port **23***g* of valve **23** leading to chamber **23***b* thereof. Port **23***h* of the latter valve provides hydraulic communication between chamber **23***b* through lines **35**, **36** with the lower or rod end **18***b* of cylinder **18** and another side of valve **19**.

Opposing end portions **16***a*, **16***b* of cylinder **16** are in communication with corresponding sides of valve **17**.

The self-leveling device operates in the following manner:

Upon raising the boom structure **14** and bucket **13** through a conventional operation of valve **17**—which involves the introduction of oil under pressure to cylinder **16** at its head end **16***a*, thereby projecting the piston rod **16***c* outwardly—oil in the rod end of cylinder **18** is exhausted into cylinder **21** at its head end **21***a* correspondingly thereby supporting the piston thereof as it is drawn upwardly in the raising of the boom structure and steadying the latter.

As the bucket **13** is raised, and assuming that the bucket is loaded, the rod **18***c* of cylinder **18** is projected due to the downward pull of the loaded bucket (valve **19** being inoperative), thereby tending to create a vacuum in the head end of cylinder **18**. This vacuum is communicated to valve **22**, causing ball **22***d* to become unseated, thereby allowing oil to flow from reservoir **25** through port **22***e*, passage **22***c*, chamber **22***a* and port **22***g* and thence into the head end **18***a* of cylinder **18**, thus replacing the vacuum, correcting imbalance in the cylinder, steadying the operation of the cylinder, and preventing

unrestrained rocking or bouncing of the bucket **13**, especially during travel of the implement over rough terrain.

Upon lowering the boom structure **14** and bucket **13**, oil in cylinder **21** is exhausted correspondingly into the rod end of cylinder **18**, thus tending to equalize the pressure on opposite sides of the piston thereof, steadying the lowering operation, and averting disturbance of the posture of the bucket **13**.

As the piston and rod of cylinder **18** are retracted, pressure builds up in cylinder **18** and chamber **22***b* of valve **22**, causing upward movement of piston **22***f* and its associated rod, to lift ball **22***d* against the bias of its associated spring and open passage **22***c*, thereby allowing the escape of oil through port **22***e* to the reservoir **25**, the rod being of sufficiently less diameter than the passage to permit this, thus supplementing the stabilizing of the lowering operation.

During lowering of the boom structure **14** from top "raise" or "lift" position, when the rod of cylinder **18** is retracted to a point where the displacement of the piston is less than that of cylinder **21**, oil in the latter is not fully exhaustible into cylinder **18**. Hence pressure tends to build up to a value exceeding that of the setting of valve **23** thereby lifting ball **23***d* out of closing position and allowing oil to flow from head end of slave cylinder **21** into port **23***g* through chambers **23***a*, **23***b*, passage **23***c* and port **23***e* to the reservoir **26**, thus relieving the condition of imbalance and averting its consequence.

When the self-leveling device is not needed, the valve plunger **23***f* is actuated by operation of the manual means **27** to unseat ball **23***d* thereby allowing oil to pass from cylinder **21** through line **34**, port **23***g*, chamber **23***a* and port **23***e* to the reservoir **26**, port **23***h* being closed.

It will be apparent that the synchronous operation of the components of the device described in the manner stated in relation to the loader mechanism substantially stabilizes the raising and lowering of the boom structure and the bucket and substantially maintains the desired posture of the bucket automatically in the course thereof, thus providing an improved, simple, efficient and economical self-leveling device for the intended purpose.

We claim:

1. A device for automatically controlling the level of the work bucket of a material loader having

(a) a work bucket supported forwardly of the loader by a boom structure mounted on the frame thereof for pivotal movement about a generally horizontal axis extending transversely of said boom structure adjacent one end thereof, said boom structure being mounted adjacent its opposite end for pivotal movement about a generally horizontal axis on the frame of said loader, and

(b) hydraulic power operated mechanism operatively associated with a source of hydraulic power on said loader,

said mechanism comprising a first hydraulic cylinder for actuating said boom structure to raise and lower said bucket under control of a boom valve, and a second hydraulic cylinder for actuating said bucket under control of a bucket valve,

said first cylinder being mounted adjacent its piston rod end for pivotal movement about a generally horizontal axis on said loader frame and having its head end pivotally connected adjacent its outer extremity to said boom structure in predetermined spaced relation with said horizontal axes of said boom structure and said bucket,

said second cylinder being mounted adjacent its head end for pivotal movement about a generally horizontal axis on said boom structure and having its piston rod

pivotally connected adjacent its outer extremity to said bucket in predetermined spaced relation with said boom structure,

said device comprising auxiliary hydraulically operated mechanism operatively associated with said source including

(c) a single-acting third hydraulic cylinder

(d) a first relief, anti-cavitation valve, and

(e) a second relief, diverter valve said third cylinder being of the slave type,

said third cylinder and said relief valves being in operative hydraulic communication with one another and with said second cylinder and arranged to operate whereby upon operation of said first cylinder to raise said boom structure and said bucket, said third cylinder and said first relief valve are operated to apply fluid under pressure to said second cylinder opposing retraction of the piston rod thereof thereby to prevent pivoting of the bucket about the said horizontal axis thereof,

said third cylinder and said relief valves being further arranged to operate whereby upon operation of said first cylinder to lower said boom structure and said bucket, said third cylinder and said second relief valve are operated to apply fluid under pressure to said second cylinder enabling retraction of the piston rod thereof thereby to prevent pivoting of the bucket about the said horizontal axis thereof.

2. A device according to claim **1** in which the third cylinder is in hydraulic communication adjacent its head end with the rod end of the second cylinder, said cylinders being arranged to operate in synchronism with one another, whereby upon actuation of the first cylinder to raise the boom structure, said third cylinder is actuated correspondingly to follow the boom structure to raised position.

3. A device according to claim **1** in which the third cylinder is in hydraulic communication adjacent its head end with the rod end of the second cylinder, said cylinders being arranged to operate in synchronism with one another, whereby upon actuation of the first cylinder to raise the boom structure, said third cylinder is actuated correspondingly to follow the boom structure to raised position, and said first relief valve is actuated to enable the application of fluid under pressure into said second cylinders adjacent its head end correspondingly opposing retraction of the piston rod thereof whereby to maintain said bucket in a desired posture.

4. A device according to claim **3** in which, upon actuation of the first cylinder to lower the boom structure from raised position said second relief valve is actuated to relieve said third cylinder correspondingly whereby to enable steady lowering of the boom structure and to maintain said bucket in a desired posture.

5. A device according to claim **3** in which, upon actuation of the first cylinder to lower the boom structure from raised position said second relief valve is actuated to relieve said third cylinder correspondingly whereby to enable steady lowering of the boom structure and to maintain said bucket in a desired posture, said first relief valve being actuated to relieve said second cylinder correspondingly to enable steady lowering of the boom structure.

6. A device according to claim **3** including manually operable means associated with the second relief valve for rendering said valve and said device inoperative.

7. A device according to claim **1** in which said first and second relief valves are spring-biased in closed position and arranged to open upon counter-pressure of predetermined amount,

said first relief valve being actuated to open position

in the boom raising operation by vacuum in the system of predetermined value to counteract the same, and in the boom lowering operation by pressure imbalance in the system to counteract the same, and said second relief valve being actuated to open position in the boom lowering operation by the occurrence of pressure of predetermined value intermediately of the second and third cylinders to relieve the same.

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