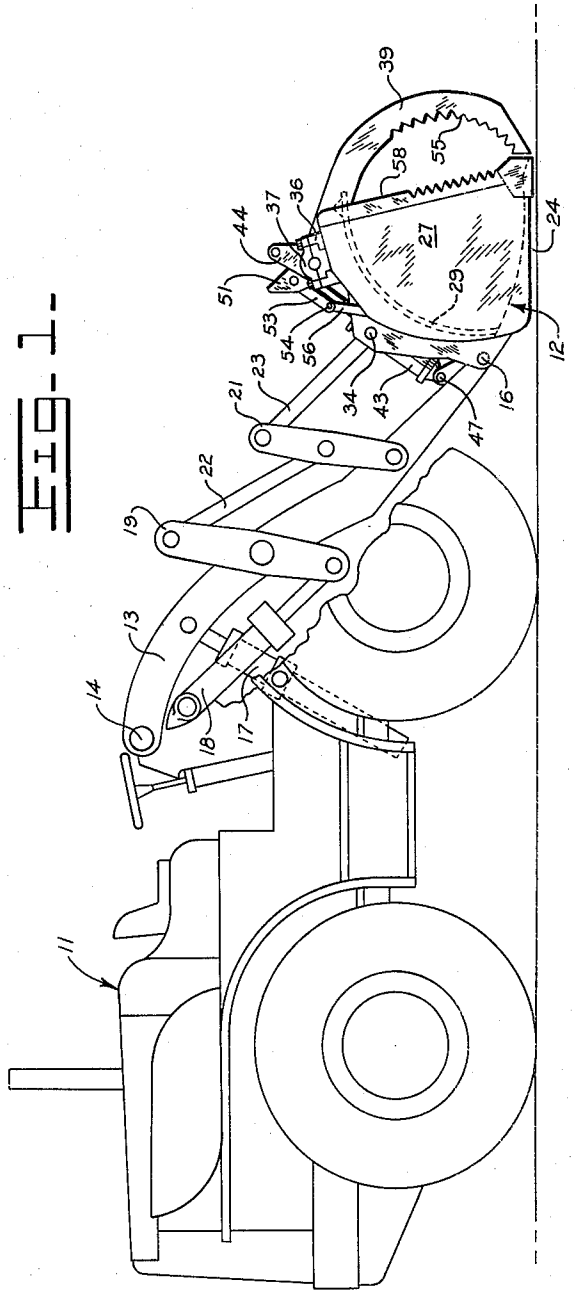
Oct. 12, 1965 R. H. HUNGER ETAL 3,211,065

HYDRAULIC SYSTEM FOR A UNIVERSAL BUCKET OF A TRACTOR MOUNTED LOADER

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FIG. 1.



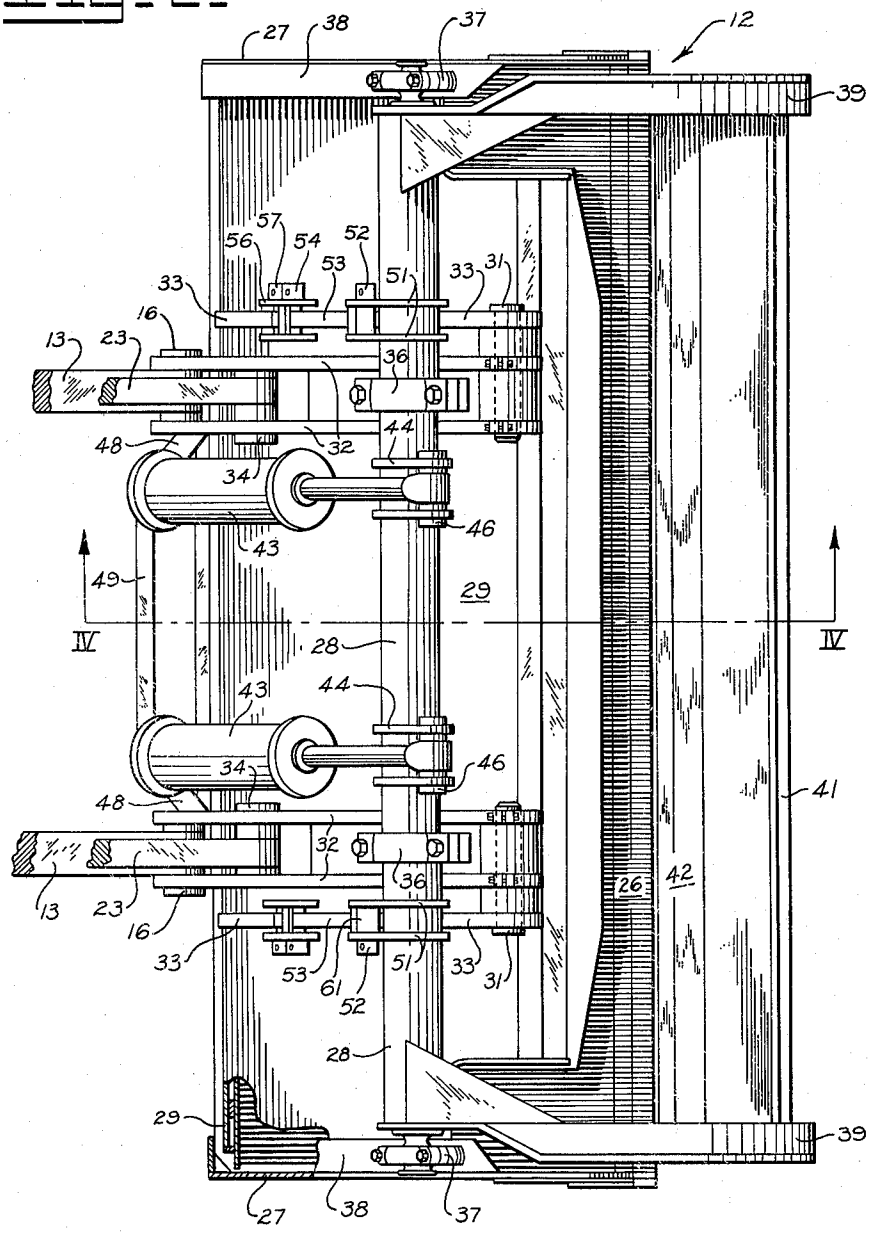
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Fig. 2



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Fig. 4.

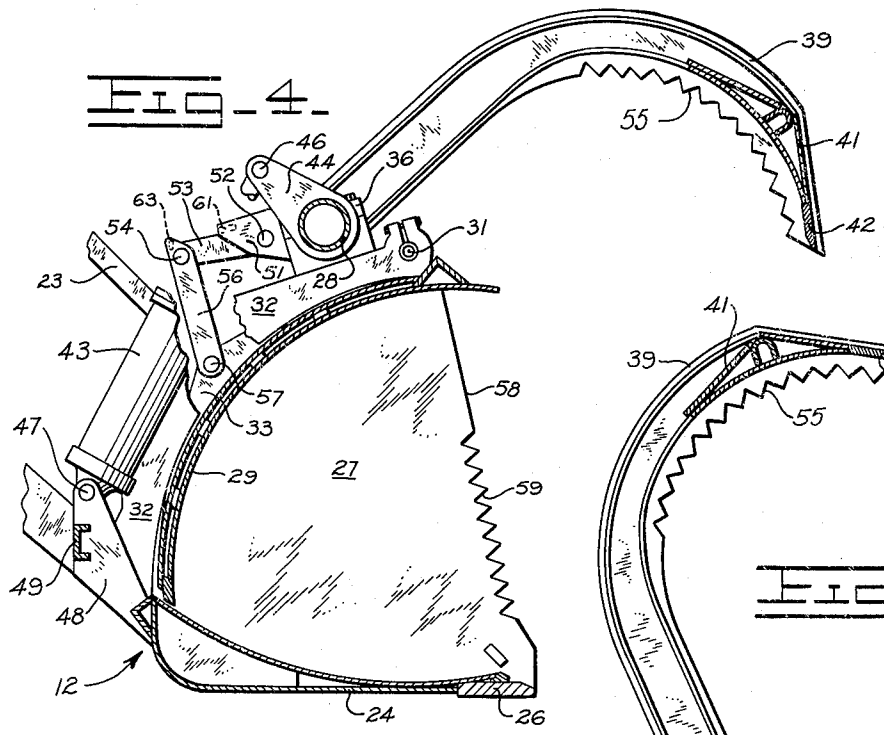


Fig. 5.

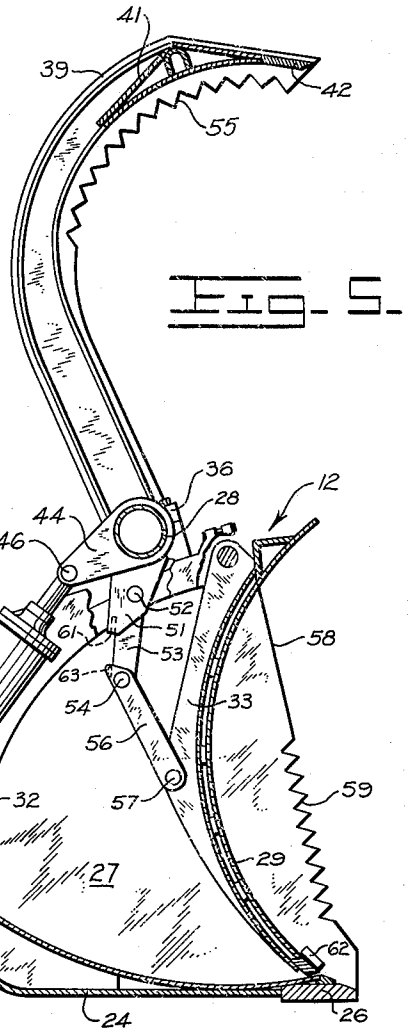
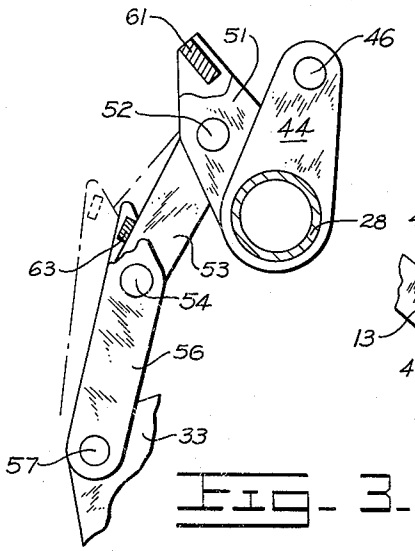


Fig. 3.



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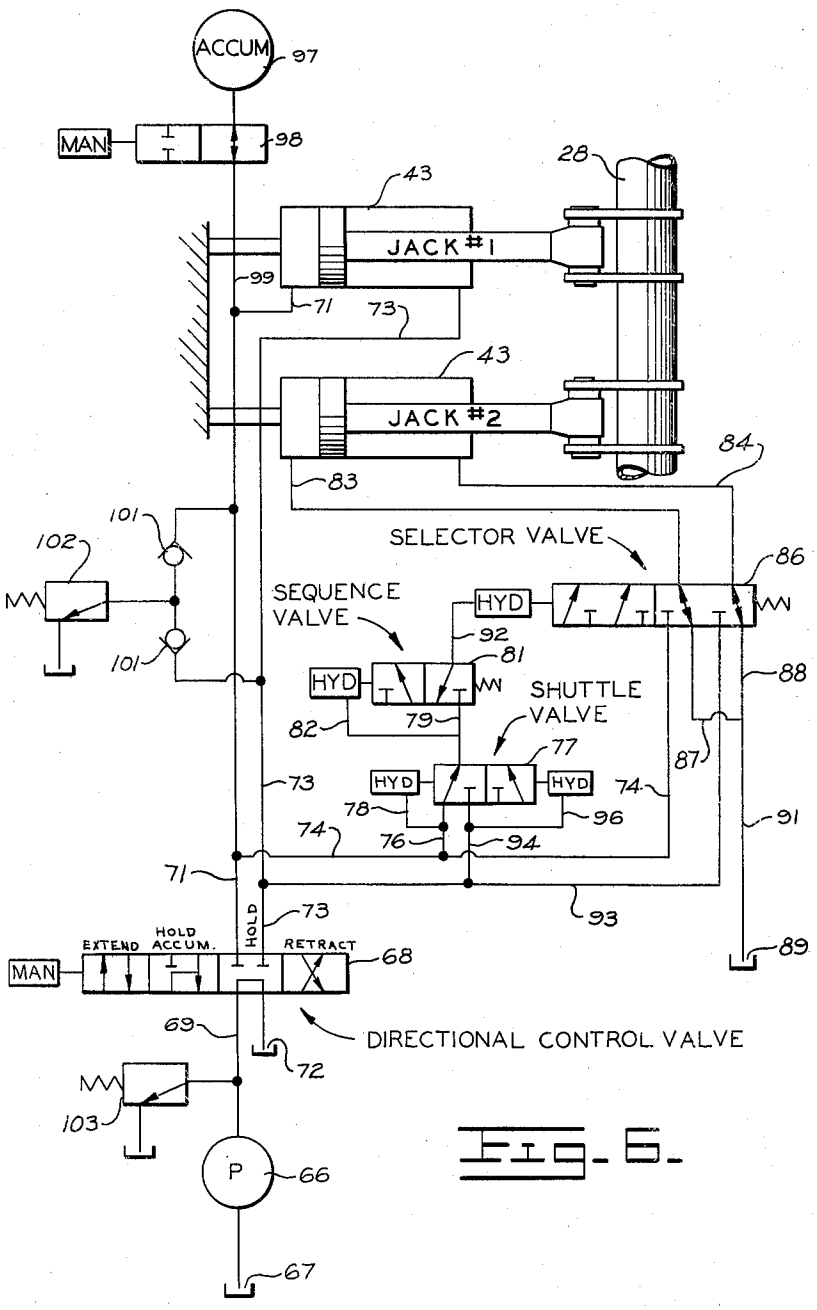


FIG. 6.

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HYDRAULIC SYSTEM FOR A UNIVERSAL BUCKET OF A TRACTOR MOUNTED LOADER

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5 Claims. (Cl. 91—412)

The present invention relates to material handling and earth digging machines, and more particularly to vehicle mounted loaders having material handling buckets capable of performing a variety of tasks.

Vehicle mounted loaders are generally equipped with a clamping or digging attachment designed primarily to perform a specific job. Attachments of this nature which are known in the art include log forks, pulpwood forks, bulldozers, buckets, ejector buckets, etc. All of the attachments have the common feature of being designed to move material from one place to another. On large scale construction projects it is not uncommon for various types of material to be moved from one place to another, and it is therefore often required that several vehicle mounted loaders, each with a different attachment, be in use.

Accordingly, it is an object of the present invention to provide a universal bucket for a vehicle mounted loader.

It is another object of the present invention to provide a universal bucket for a vehicle mounted loader which is hydraulically operated in such a manner as to perform in a quick, efficient and positive manner.

Further and more specific objects and advantages of the invention are made apparent in the following specification wherein a preferred form of the invention is described by reference to the accompanying drawings.

In the drawings:

FIG. 1 is a view in side elevation of a tractor mounted loader with a universal bucket emobdying the present invention;

FIG. 2 is an enlarged top plan view of the universal bucket of FIG. 1 with its clamp closed and shown in combination with operating mechanisms used in conjunction therewith;

FIG. 3 is an enlarged illustration of a portion of the linkage utilized in operating the universal bucket;

FIG. 4 is a section on the line IV—IV of FIG. 2, but with the clamp partially open;

FIG. 5 is a view like FIG. 4 but showing the clamp in a fully open position and with the ejector fully forward; and

FIG. 6 is a schematic diagram of the hydraulic system utilized to operate the components of the bucket.

A tractor as generally illustrated at 11 in FIG. 1 is shown as typical of any vehicle upon which a loader bucket may be mounted and the bucket of the present invention, generally indicated at 12, is shown as mounted at the forward end of a pair of lift arms, one of which is shown at 13, pivotally connected to the tractor at 14 and to the bucket at 16. Hydraulic jacks 17 are employed for raising and lowering the lift arms 13 and bucket 12. Tilt linkage of conventional construction is employed for tilting the bucket between load, carry and dump positions about the pivots 16. This linkage comprises jacks 18 for imparting swinging movement to levers 19 pivoted to the lift arms which in turn impart swinging movement to levers 21 through connecting links 22. Another pair of links 23 form a connection between the levers 21 and the bucket for imparting tilting movement thereto.

The bucket 12 comprises a bottom 24 with a cutting edge 26 (FIGS. 4 and 5) and side walls 27 extending upwardly in parallelism from its opposite ends. A cylindrical cross beam 28 (see FIG. 2) extends between the side walls adjacent their upper edges lending rigidity to the structure as well as performing other functions to be described in detail. A curved ejector plate 29 provides a back wall which extends the full distance between the side walls 27 and is pivoted as by pins 31 for forward swinging movement through the bucket to eject the contents thereof. The pivotal supports for the ejector as well as the pivotal connections of the lift arms and tilt mechanism is best shown in FIGS. 2, 4 and 5 wherein the bucket is shown as having a pair of spaced brackets 32 which extend from the bottom of the bucket at its rear edge to the cross beam 28 and continue upwardly and forwardly from the cross beam to provide supports for the ejector pivot pins 31. These pins support the ejector plate 29 by extending through ribs 33 welded or otherwise suitably secured to the back of the ejector plate, the further function of which will presently be described in detail. The spaced brackets 32 also serve as means for providing the necessary pivotal connections between the lift arms 13 and the bucket as shown at 16 in FIG. 2 and the tilt links 23 and the bucket, as shown at 34.

Cylindrical cross beam 28 is pivotally mounted by means of a pair of inner bearing blocks 36 associated with spaced brackets 32 and a pair of smaller bearing blocks 37 mounted on the widened upper edges 38 of side walls 27, as best illustrated in FIG. 2. Clamp 39 is rigidly secured to beam 28 at each end and is composed of a pair of curved lever arms interconnected by means of a cross brace 41 and cutting edge 42. Rotation of beam 28 is controlled by means of a pair of hydraulic cylinders or jacks 43 which are positioned equidistant the center line of bucket 12. The rods of jacks 43 are pivotally connected as by pins 46 to levers 44 which are rigidly secured to the beam 28. The jacks 43 are pivotally connected at 47 to rigid brackets 48 welded or similarly affixed to the bottom 24 of bucket 12. A cross member 49 connects brackets 48 to provide added rigidity thereto.

A second pair of levers 51 is also rigidly secured to beam 28 and is pivotally connected as by pins 52 to links 53. Links 53 are pivotally connected by pins 54 at their other ends to links 56 which are, in turn, pivotally connected at their other ends, by pins 57, to ribs 33.

As illustrated in FIGS. 1, 4 and 5, the curved lever arms of clamp 39 have teeth 55 on their interior edge to provide an effective gripping means in combination with edge 58 of sides 27 of bucket 12, which may also be equipped with teeth 59.

When it is desired to use bucket 12 for the movement of earth or similar material, clamp 39 is raised from a closed position approximately 60° to the position shown in FIG. 4 by counterclockwise rotation of beam 28 through retraction of jacks 43. The position of clamp 39 shown in FIG. 4 is the position generally established preparatory to grasping and picking up an object. For this movement range counterclockwise rotation of beam 28, clamp 39, and levers 51 causes a collapsing action of links 53 and 56 as may be noted by comparing FIG. 3 and FIG. 4 without exerting any force on pin 57. Thus, initial opening of clamp 39 is accomplished without any resulting motion of ejector 29. When, however, jacks 43 induce rotation of beam 28 beyond the predetermined position illustrated in FIG. 4, stops 61 secured on levers 51 engage links 53 and transmit forces through links 56 to pins 57 which swing ejector plate 29 about its pins 31 until the extreme forward position is reached as illustrated in FIG. 5. Stop blocks 62 mounted on the sides 27 of bucket 12 determine the extreme forward position of

ejector 29. The amount of counterclockwise rotation of beam 28 necessary to position ejector 29 at its extreme forward position simultaneously moves clamp 39 to its extreme open position.

With the bucket components positioned as shown in FIG. 5, the bucket is also capable of being used to perform bulldozer type functions. Probably the most advantageous use of ejector 29, however, is the function it performs by its sweeping motion when it travels from the position shown in FIG. 4 to that shown in FIG. 5. In moving the ejector in this manner essentially all of the contents of the bucket 12 are forced out, without the necessity of tilting the bucket to an extreme downward position as would be necessary in the absence of an ejector.

Upon initial clockwise rotation of levers 51 from the position shown by FIG. 5, links 53 and links 56 tend to position themselves in a straight line. But, if permitted, this action might allow links 53 and 56 to over-center and fold in a reverse manner to that intended. Blocks 63 integral with link 56 prevent any danger of over-centering links 53 and 56.

As beam 28 is rotated clockwise to its full extent ejector 29 assumes a rearward position corresponding to the solid line condition of links 53 and 56 as shown in FIG. 3. However, the ejector 29 can be urged rearwardly an additional incremental amount to engage spaced brackets 32 whereupon links 53 and 56 would assume the phantom line state. This clearance allowance insures that edge 42 of clamp 39 engages edge 26 of bottom 24 before ejector 29 contacts brackets 32.

Thus, bucket 12 as equipped with a clamp 39 and ejector 29 is capable of performing a wide variety of functions and of handling numerous types of material. Furthermore, operation in any of its capacities is conducted by the actuation of the single pair of hydraulic jacks 43 acting through lost motion linkage between the various components.

Because of the economic considerations involved in a construction project it is always desirable to furnish a machine which operates both quickly and efficiently. The various linkage and operating sequences described above are specifically designed to furnish efficient operation while providing a machine of wide versatility. The ability of the present invention to perform economically is further aided by the hydraulic system associated with jacks 43. The manner in which this hydraulic system works and the added efficiency which it gives to the invention will be described below with reference to FIG. 6.

Jacks 43 control the angular piston of beam 28 by being supplied with hydraulic fluid from a pump 66, which draws fluid from an appropriate source 67. Under most conditions of operation only low forces are required to rotate beam 28 and its associated mechanisms. It is, therefore, advantageous to direct all of the fluid flow from pump 66 to one of the jacks 43 exclusively, to induce a more rapid angular positioning of beam 28 than would be accomplished if pump 66 supplied fluid to both of jacks 43 at the same time. When the clamp engages an object to be grasped or the ejector is set into motion against a load of material in the bucket, the flow from pump 66 meets the resisting force on the jack receiving the full flow and the fluid pressure rises. When the pressure at pump 66 reaches a certain predetermined limit, the circuitry advantageously switches flow from acting only on a single jack 43 to acting on both of jacks 43. This provides equally distributed work forces and the lower speed operation necessary for proper performance under heavy load conditions.

Since clamping an object with clamp 39 requires extending jacks 43 and ejecting material from the bucket requires retracting jacks 43, the desired sequence of operation must be provided for either operation. Thus, the hydraulic system which operates the universal bucket of the present invention includes means by which one of

jacks 43 (designated as jack No. 1) is the only jack to receive fluid flow when the required pressure is below a determined value (for example, 1400 p.s.i.). When the fluid pressure supplied by pump 66 exceeds the predetermined value, fluid is delivered equally to both jacks 43 (the second jack being designated as jack No. 2) as long as the higher pressure is required. The entire hydraulic operation is normally conducted automatically except for a manually operated control valve 68 which determines whether the hydraulic system acts to retract, extend, or merely hold the jacks in a fixed position.

When it is desired to extend jacks 43, manually operated directional control valve 68 is positioned to the "extend" position to provide communication between line 69, from pump 66, and line 71, which leads to the head end of jack No. 1. As the piston of jack No. 1 moves to the right in response to fluid pressure from pump 66 fluid is forced out of the rod end of the jack and returned to a sump 72 by means of a return line 73 which communicates with sump 72 when valve 68 is in the "extend" position. The fluid pressure which exists in line 71 also exists in line 74 by virtue of the communication between the two lines. A line 76 forms communication between line 74 and a shuttle valve 77. The pressure in line 74 is thus communicated to line 76 where it induces, through a line 78, the hydraulic positioning mechanism of shuttle valve 77 to position the valve in such a manner as to form a communication between line 76 and a line 79.

Line 79 from shuttle valve 77 communicates with a sequence valve 81 as well as a line 82 to the hydraulic positioning mechanism therefor. While shuttle valve 77 positions to the right (as shown) when any pressure exists in line 71, sequence valve 81 is of such nature that its hydraulic positioning system responds only to pressures above a predetermined pressure, and until that pressure is realized, the pressure in line 71 is transmitted no further than line 79. Consequently, until the predetermined pressure is met, jack No. 1 receives the entire output of pump 66.

Even though jack No. 2 does not receive any fluid from pump 66, the mechanical connection between the two jacks through beam 28 causes the piston of jack No. 2 to follow that of jack No. 1 and draw fluid into its head end through line 83 and force fluid out of its rod end through line 84, when the jack is extending. Lines 83 and 84 communicate through a selector valve 86 with lines 87 and 88, respectively, when the pressure in line 71 is less than the predetermined pressure. Lines 87 and 88 both communicate with a sump 89, through a common line 91 therebetween.

When the predetermined pressure in line 71 is realized at sequence valve 81 (through lines 74, 76, and 79) pressure in line 82 moves valve 81 to the right so as to form communication between line 79 and a line 92 which leads to the hydraulic controls of selector valve 86. The pressure in line 92 activates the hydraulic controls of selector valve 86 so as to position it to the right forming communication between line 74 and line 83, and line 84 and a line 93. Line 93 communicates with line 73 forming a return path to sump 72. Thus with directional control valve 68 in the "extend" position and after the pressure in line 71 had become greater than the predetermined pressure, line 74 communicates with the head end of jack No. 2 thereby providing it with a fluid flow at the same pressure as provided to the head end of jack No. 1.

When selector valve 86 shifts so as to provide communication between pump 66 and jack No. 2, the pressure in line 71 drops by one-half. Sequence valve 81 is so designed, however, that the hydraulic controls therefor will maintain the valve in its communicating position as long as the pressure in line 82 does not drop much below one-half the value necessary to cause the sequence valve to initially shift into communicating position. (For example, the sequence valve will not back-shift until the pressure drops below 600 p.s.i. when the predetermined

initial shifting pressure is 1400 p.s.i.) By maintaining sequence valve **81** in its communicating position selector valve **86** is also maintained in the position which allows communication between pump **66** and jack No. **2**, which is the desired position until the pressure in line **71** drops below a specified value.

When it is desired to retract jacks **43**, such as when ejecting a load from the bucket, manual control valve **68** is positioned to the left, forming communication between line **71** and sump **72**, and lines **69** and **73**. The fluid flow from pump **66** is directed through line **73** to the rod end of jack No. **1**, forcing the piston to retract. This causes the fluid in the head end to flow through line **71** to sump **72**. During the mode of operation in which the pressure in line **73** is below the predetermined shift pressure, sequence valve **81** and selector valve **86** are positioned as shown by FIG. 6 so as to prevent communication between the rod end of jack No. **2** and pump **66**. Thus, while the pressure in line **73** exists also in line **93** it cannot be transmitted past selector valve **86**. The pressure in line **93** is communicated to shuttle valve **77** through line **94**, and from line **94** to the hydraulic controls of shuttle valve **77** through line **96**. The existence of pressure in line **96** causes the hydraulic controls for shuttle valve **77** to position it to the left so as to form communication between line **94** and line **79**. When the pressure in line **73** reaches the predetermined shifting pressure the pressure communicated from line **94** to lines **79** and **82** will induce sequence valve **81** to shift to the right, which in turn provides for the shifting of selector valve **86** to the right as described above. With selector valve **86** shifted into communicating position, fluid from line **73** is delivered equally to jacks **1** and **2** in the same manner as described in connection with operation in the "extend" position.

An accumulator **97**, with an established charging pressure greater than the predetermined shifting pressure required to shift sequence valve **81**, communicates through a manually operated valve **98** and a line **99** with line **71**. When clamp **39** is closed upon an object, when a pressure above the accumulator charging pressure is then felt at the head end of both jacks, and when directional control valve **68** has been shifted from the extend to the hold position, accumulator **97** provides a supplemental source of pressure to the head end of both jacks for use in the event that a slight drop in line pressure should occur. Action of the accumulator **97** thus maintains clamps **39** in tight engagement with the load. Although accumulator **97** will cause movement of both jacks to more securely engage a shifting load, the rate of fluid exit from the rod end of both jacks is determined by leakage in the circuitry. Therefore an optional "hold-accumulator" position may be added to directional control valve **68** so that fluid is allowed to pass from the rod ends of both jacks to drain **72**. This "hold-accumulator" position would allow the jacks to be extended more quickly in response to load shifting. In certain circumstances, however, accumulator **97** might cause an undesirable resilience in the system in which case manually operated valve **98** may be moved to the right to effectively remove the accumulator from the system.

Cylindrical cross beam **28** acts as a torsion bar or tube which stores energy like a spring when resistance is encountered during clamping. Consequently, when the load shifts slightly in the clamp, tension in the beam will compensate for any looseness which might occur. This torsion effect supplements action of the accumulator mentioned above, or may be used instead of the accumulator.

Check valves **101** in connection with relief valve **102** and relief valve **103** protect the jack line hoses and pump, from excessive pressures. Valves **101**, **102** and **103**, while not essential to the operation of the overall hydraulic system, should be provided where high pressures are contemplated, to prevent serious damage to the equipment.

One of the outstanding features of the hydraulic system described above is the manner in which it automatically adjusts itself to operate in the most efficient manner for the circumstances encountered. When beam **28** is being rotated to put the various components of the universal bucket in a desired position rather than to do work with the components, all of the available fluid flow from pump **66** is directed to a single jack so as to drive that cylinder quickly and efficiently to the desired position. When, however, heavy work is to be done the hydraulic system senses the need for equally distributed work type forces and conditions itself to provide those forces equally through the jacks. Thus, the present invention provides a bucket to be employed with tractor mounted loaders which is capable of performing a wide variety of tasks without sacrificing efficiency of operation to acquire the desired versatility.

We claim:

1. A hydraulically operated control system for actuating an oscillatable member, said system comprising in combination:

(a) a first hydraulically operated jack operatively connected to said member;

(b) a second hydraulically operated jack operatively connected to said member and connected to said first jack through said member whereby oscillating movement of said member in response to hydraulic actuation of one of said jacks causes movement of the other of said jacks;

(c) pressure fluid means disposed to supply fluid to said first jack under the full output pressure of said fluid means to effect oscillation of said member in one direction;

(d) sequence valve means communicating with said second jack and with said pressure fluid means, said sequence valve means being responsive to a predetermined pressure acting on said first jack and being operative to prevent fluid flow from said pressure fluid means to said second jack until said predetermined pressure acting on said first jack is exceeded; and

(e) means associated with said sequence valve means and with said second jack to effect fluid flow from said pressure fluid means to said second jack while simultaneously supplying fluid to said first jack when said predetermined pressure acting on said first jack is exceeded, whereby to cause both said jacks to effect oscillating movement of said member in said direction under the thereby divided force of said pressure fluid means.

2. The control system of claim **1** further comprising manually operable directional control valve means operatively disposed to enable fluid from said pressure fluid means to be selectively directed to the rod or head end of said jacks for retracting or extending said jacks, respectively.

3. The control system of claim **1** further comprising an accumulator in communication with said jacks through valve means, said valve means selectively operable to communicate said jacks with said accumulator.

4. The control system of claim **1** wherein said sequence valve means is operative to maintain communication between said pressure fluid means and said second jack, once established, until the pressure drops to some value below one-half the predetermined pressure at which the sequence valve initially establishes communication between said pressure fluid means and said second jack.

5. A hydraulically operated control system for actuating a movable clamping member of the bucket on a ve-

hicle mounted loader, said system comprising in combination:

(a) first and second fluid jacks operatively connected to the clamping member;

(b) pressure fluid means disposed to supply fluid to said first fluid jack under the full output pressure of said fluid means to move said clamping member to a position for engaging a work piece; and

(c) valve means disposed between said pressure fluid means and said second jack, said valve means being operative (i) to prevent fluid flow from said pressure fluid means to said second fluid jack until the work piece has been engaged by said clamping member under the force of said first jack and (ii) upon sensing said engagement by its response to a predetermined pressure from said pressure fluid means, to supply fluid to said second jack while simultaneously supplying fluid to said first jack, whereby to cause both said jacks to urge said clamping member against the work piece under the thereby divided force of said pressure fluid means.

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