United States Patent [19]

Reimbold, Jr. et al.

[11] **3,830,336**

[45] **Aug. 20, 1974**

[54] **PERSONNEL BUCKET BRAKE FOR HYDRAULIC CRANES**

[75] Inventors: **James J. Reimbold, Jr.**, Overland Park, Kans.; **Willard C. Kamberg**, Pleasant Hill, Mo.

[73] Assignee: **A. B. Chance Company**, Centralia, Mo.

[22] Filed: **Aug. 22, 1973**

[21] Appl. No.: **390,611**

[52] **U.S. Cl.** **182/2**, 188/170

[51] **Int. Cl.** **B66f 11/04**, F16d 59/02

[58] **Field of Search** ..... 182/2; 188/2 R, 110, 170; 214/763, 764, 769, 771

[56] **References Cited**

UNITED STATES PATENTS

2,372,311	3/1945	Brown	188/170 X
3,480,109	11/1969	Eitel et al.	182/2 X
3,625,373	12/1971	Hull	188/170 X
3,653,461	4/1972	Huxley et al.	182/2

FOREIGN PATENTS OR APPLICATIONS

746,283	3/1956	Great Britain	182/2

Primary Examiner—Duane A. Reger

Attorney, Agent, or Firm—Schmidt, Johnson, Hovey & Williams

[57] **ABSTRACT**

A fluid-pressure responsive brake and actuation system therefor is disclosed which is operable to selectively brake the movement of a pivotally mounted, gravity leveled personnel bucket positioned atop an extensible boom of a crane or aerial device. The brake comprises a closed housing mounted on the bucket with a reciprocable rod centrally disposed within the housing and extending through the bucket wall into registry with an arcuate slot provided in an adjacent, independent braking plate fixably secured to the bucket supporting, shiftable section of the boom. A piston is journaled on the rod within the housing and a brake pad is externally attached to the rod at a point proximal to the braking plate. A high-bias, low-deflection spring within the housing on one side of the piston serves to bias the pad connected thereto into a normal frictional locking position with the braking plate. The opposed face of the piston communicates with a fluid-pressure chamber which in turn is joined by duct means to a two-way pressure-responsive shuttle valve interposed within the overall hydraulic system for raising and lowering the boom. In this manner the biasing spring acts to preclude pivotal movement of the bucket when the boom is stationary and the hydraulic system is at relatively low pressure. However, when the boom pivoting controls are actuated to move the boom, increased pressure against the shuttle valve opens the latter to direct pressurized motive fluid to the brake chamber to thereby move the rod in opposition to the spring. This serves to release the pad from braking contact with the adjacent plate, thus allowing the bucket to pivot under the influence of gravity to maintain the latter in a level position during raising or lowering of the boom.

26 Claims, 5 Drawing Figures

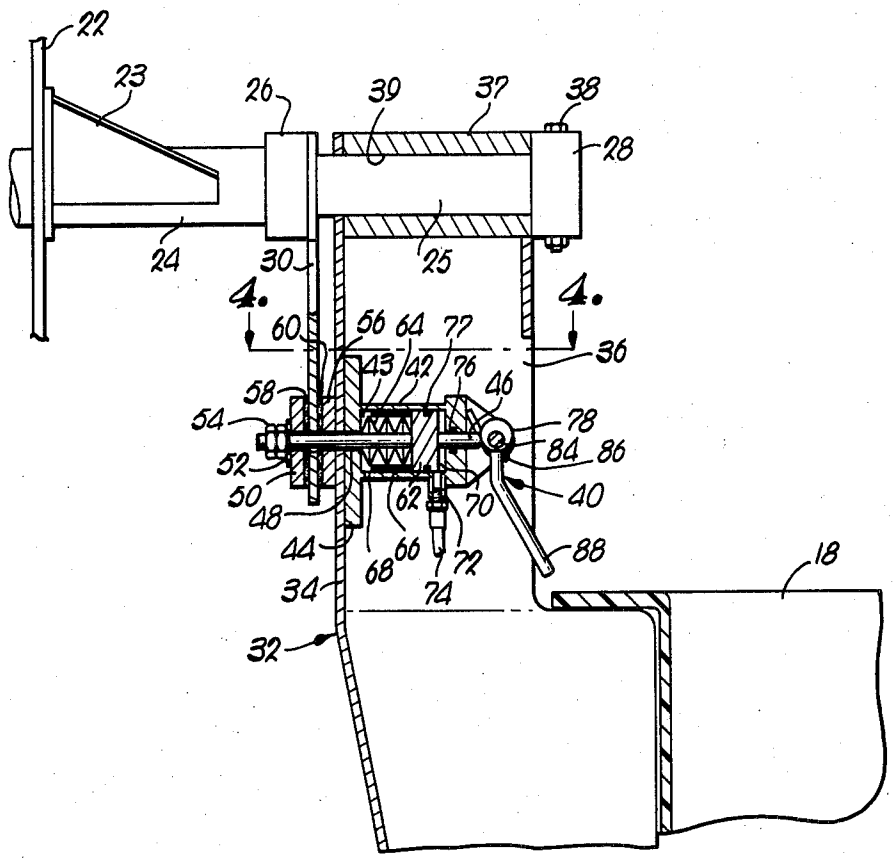


Fig. 1.

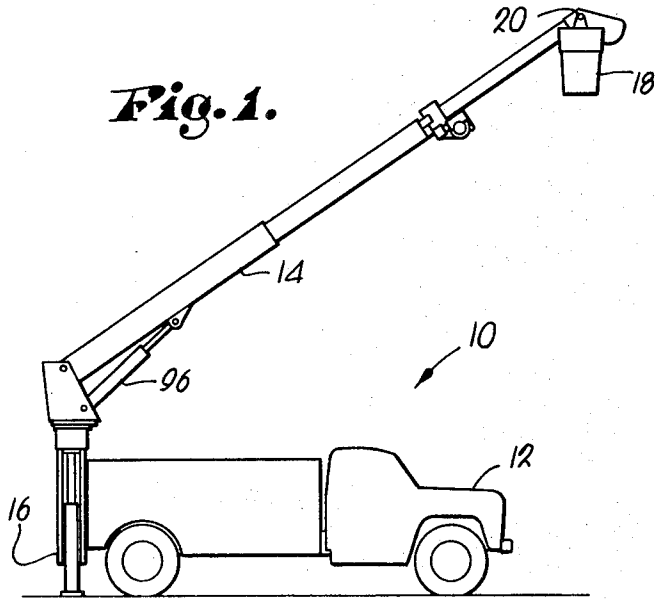


Fig. 4.

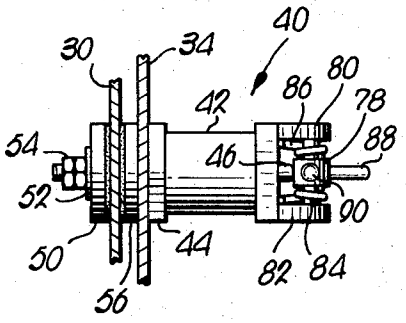


Fig. 3.

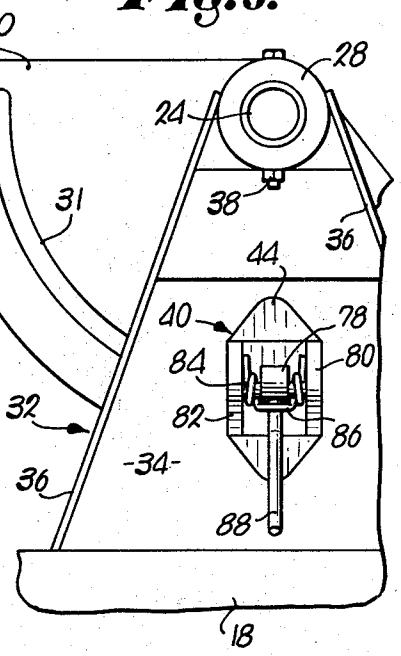
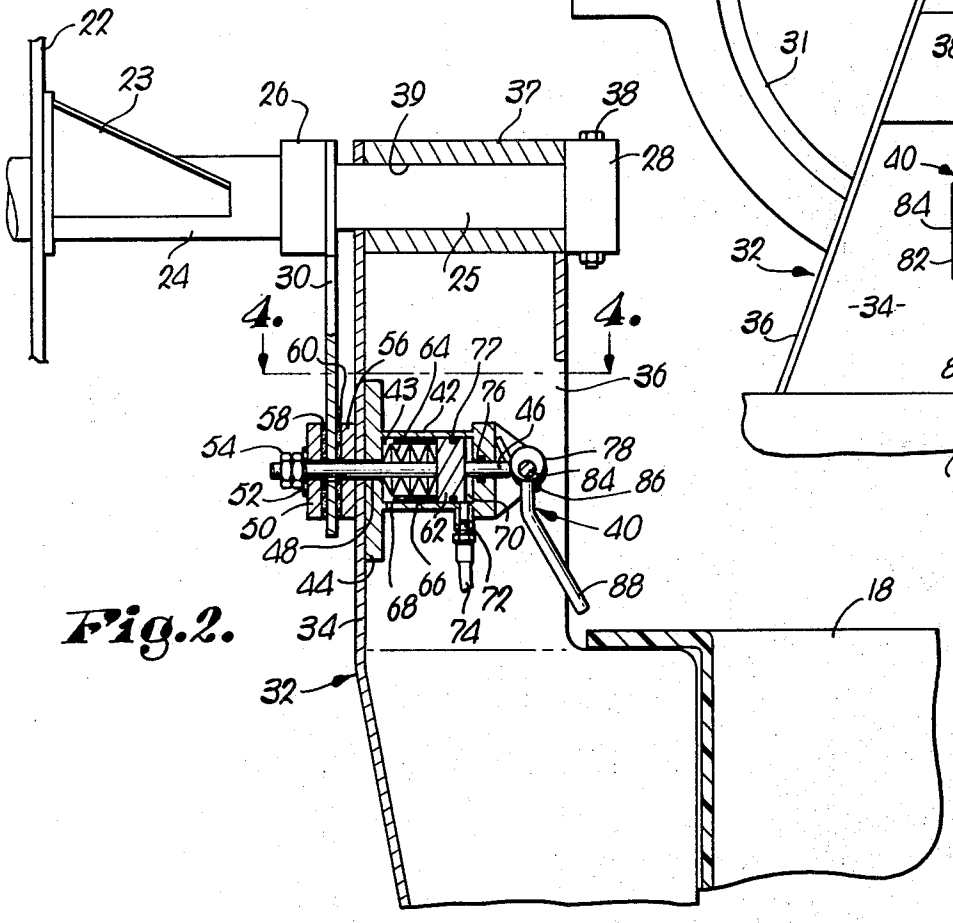


Fig. 2.



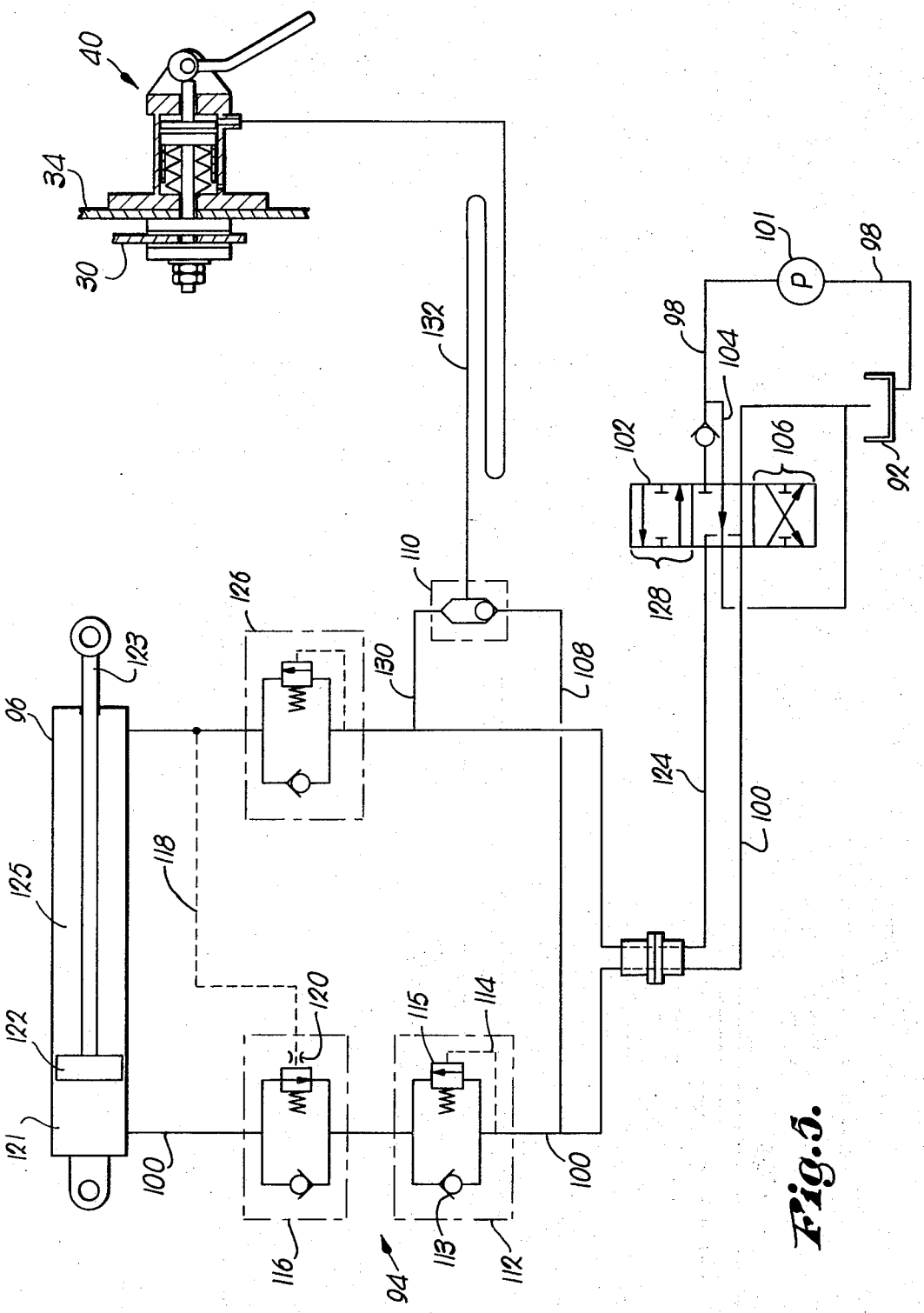

40
34
30
132
101
P
98
104
102
106
92
128
110
126
130
108
123
96
125
118
124
100
122
120
115
114
121
116
113
112
94

Fig. 5.

PERSONNEL BUCKET BRAKE FOR HYDRAULIC CRANES

BACKGROUND

This invention relates to a brake and actuation system therefor for use in selectively stopping movement of a gravity leveled personnel bucket pivotally mounted on a swingable, hydraulically operated, extensible aerial boom. More particularly, it is concerned with such a brake and system which serves to positively lock the bucket when the boom is stationary, and which automatically releases the bucket during pivotal movement of the boom to permit a safe, continual leveling of the bucket during such movement.

Electrical utilities, contractors and others have for a number of years employed mobile boom carrying units for construction and repair operations in the field. These units normally comprise a vehicle such as a truck with a hydraulically operated, extensible aerial boom swingably mounted thereon. The vehicular devices often have at least one gravity leveled lightweight personnel bucket fabricated from insulative synthetic resin material which is pivotally mounted at the outer end of the boom and is of a size to permit a workman to stand therein and perform needed construction or repair work on overhead areas, as for example electrical lines or the upper extremities of supporting structures such as poles. In practice, the worker enters the bucket at ground level with the boom near a horizontal position and the boom is then swung upwardly to a position convenient for the needed work. Upon completion thereof, the boom is lowered to the ground to facilitate egress from the bucket.

As can be appreciated, it is very important that the pivotally mounted bucket be securely locked against pivotal motion when the boom is in an upright, extended, stationary work position. If the bucket were allowed to swing freely at these times, any movement of the lineman therein would induce unrestrained pivotal motions which could cause serious mishaps. Furthermore, during raising or lowering of the boom it is equally as necessary to permit the bucket to pivot independently of the boom to achieve gravity induced leveling. If the bucket were locked with respect to the boom during such operations, raising or lowering of the latter could cause the bucket to become angularly disposed with respect to the vertical. In extreme situations, the bucket could become oriented in such a manner that it would be difficult for the worker to prevent himself from falling from the bucket.

In order to overcome the problems mentioned above, conventional personnel buckets have been provided with manually operable brakes. Thus, during swinging movement of the boom, the brake is in its open, unlocked position to allow the bucket to level itself under the influence of gravity. When the desired work position is reached and the boom becomes stationary, the worker standing in the bucket turns the brake to its operative position to achieve the necessary steadying of the bucket. In a similar fashion, when it was desired to lower the boom, the worker moved the brake to its normal unlocked position to again permit the bucket to continually level itself by swinging about the pivotal connection with the boom.

In practice however, such manually operable brakes have proven deficient in several respects. Most importantly, these brakes are generally unsafe because there is no quick and simple procedure for unlocking them from ground level. That is, if the worker within the bucket becomes injured or unconscious due to electrical shock or other trauma, there is no way to release the bucket brake to permit a safe, leveled lowering of the bucket. Hence, in emergency situations where speed is essential, the manually operated bucket brakes of the prior art have proven to be detrimental, because of the necessity of carefully lowering the boom in order that the worker does not fall from the bucket and further compound his injuries.

Therefore, there is a need in the art for a personnel bucket brake and actuation system therefor which is operable to normally lock the bucket when the supporting boom is in an extended, upright, stationary work position, but which is capable of automatically releasing the bucket to allow gravity-induced leveling movements thereof during raising or lowering of the boom.

SUMMARY

Accordingly, it has been found that the above outlined deficiencies can be overcome by providing a brake for personnel buckets which is normally mechanically biased to a locking position but which is keyed to the overall hydraulic system of the boom to achieve a selective unlocking of the brake during swinging movement of the boom to effect raising and lowering thereof.

In gerenal, the brake comprises a closed housing mounted on the interior face of a wall of the bucket, with a reciprocable actuating rod positioned within the housing and extending through the bucket wall and into registry with a slot within an adjacent braking plate. The latter is fixedly secured to the boom and is independent of the movement of the bucket. A brake pad is attached to the rod in proximal relationship to the braking plate such that the pad is capable of selectively engaging the plate in a frictional manner to yield the desired braking function.

A fluid pressure responsive piston is slidably mounted within the closed housing and is securely journaled upon the rod for reciprocation therewith, thus dividing the housing into two separate, closed chambers. A biasing spring is positioned in one such chamber and is adapted to communicate with the piston and urge the latter and the attached rod into a normal braking position, i.e., with the external pad connected to the rod being in frictional contact with the braking plate. The opposite face of the piston communicates with a sealed fluid pressure chamber and the latter has a hydraulic conduit operatively connected thereto. The conduit is, in turn, connected to a pressure responsive valving mechanism interposed within the hydraulic circuit for pivoting the boom to key the action of the brake thereto.

Therefore, when the boom is in an extended, stationary work position with relatively small fluid pressures present in the hydraulic system, the biasing spring acts to maintain a tensioned, frictional contact between the brake pad and plate, thus precluding pivotal movements of the bucket. However, during boom movement when hydraulic pressure within the actuating system is substantially increased, motive fluid is directed to the brake fluid chamber which causes the piston to be displaced in opposition to the biasing spring. In this man-

ner, the rod and connected pad are moved out of braking contact with the brake plate which permits unrestrained pivotal movements of the bucket under the influence of gravity.

The brake-actuating system in general comprises a supply of motive fluid with conduit means defining a boom-actuating circuit between the supply and a boom-actuating cylinder. Pump means are interposed within the circuit in order to build up the desired magnitudes of hydraulic pressure, and flow directing valve means is provided to direct hydraulic fluid from the pump to the desired portions of the circuit to effect selective movement of the boom.

In a preferred form, a two-way shiftable shuttle valve is interposed within the hydraulic circuit and is connected to both the boom raising and boom lowering segments of the hydraulic circuit. In this manner, a buildup of fluid pressure during either mode of operation of the boom topping cylinder serves to open the shuttle valve to thereby permit pressurization of the brake assembly. Thus, during raising and lowering of the boom, the brake remains in its open, unlocked position, while acting to prevent pivotal movements of the bucket when the latter is in a desired work or stored position.

In another preferred embodiment, an internally piloted, one-way sequence valve is interposed within each segment of the described hydraulic circuit which is operable to permit flow of hydraulic fluid therethrough only when the pressure thereof reaches a desired predetermined magnitude. This pressure limit is advantageously preset to a degree greater than that required to release the bucket brake. In this way, the brake is released an instant prior to actual movement of the boom, thus insuring a smooth, jerk-free, continuous leveling of the bucket.

DRAWINGS

FIG. **1** is a side elevational view of a truck-mounted, hydraulically operated crane provided with an extensible boom having a pivotally mounted personnel bucket mounted on the extreme end thereof;

FIG. **2** is a fragmentary, vertical sectional view of the personnel bucket brake of the present invention operatively attached to a pivotally mounted personnel bucket;

FIG. **3** is a fragmentary, front elevational view of the bucket brake shown in FIG. **2**;

FIG. **4** is a fragmentary, top plan view taken along line **4**—**4** of FIG. **2**; and

FIG. **5** is a schematic representation of that portion of the hydraulic circuit of the vehicle for raising and lowering the boom and including a secondary circuit interposed therein for the selective release of the mechanically biased personnel bucket brake.

DETAILED DESCRIPTION

The mobile crane shown in FIG. **1** and generally referred to by the numeral **10** is especially adapted for use by utility or construction crews to lift heavy objects as well as lift a workman to an elevated height. It includes a conventional truck **12** stabilized by means of rear outriggers **16** and provided with an extensible hydraulic boom **14** mounted thereon. A lightweight personnel bucket **18** fabricated from insulative synthetic resin material is pivotally mounted as at **20** on the outer, extensible end of boom **14.**

Referring specifically to FIGS. **2–4,** the details of the brake and associated mechanisms are shown in detail. At the upper left of FIG. **2** there is shown a boom tip plate **22** which forms an existing part of the shiftable outermost end of boom **14.** An elongated axle member **24** is secured to plate **22** with the help of mounting structure **23** in disposition extending generally perpendicularly from plate **22** with a pair of spaced, annular collars **26** and **28** journaled thereon at the opposed ends of the outer portion **25** thereof of reduced diameter. Depending from collar **26** is a generally semicircular braking plate **30** having an arcuate slot **31** therein which underlies member **24** and is coaxial therewith.

A metal hanger assembly **32** is pivotally suspended from portion **25** of axle member **24** between the spaced collars **26** and **28.** The hanger includes a generally planar, triangularly-shaped back wall **34** with a pair of forwardly extending, inclined sidewalls **36** attached thereto. the hanger **32** is provided with an axle-receiving assembly **37** at the apex thereof which includes a longitudinal bore **39** for the reception of the forward portion **25** of axle **24.** The forward locking collar **28** is secured to axle portion **25** by means of bolt **38,** and serves to rotatably lock depending hanger **32** onto axle member **24.** At its lower end, housing **32** may be positively connected to personnel bucket **18** by means of a series of conventional bolts (not shown). In this manner, hanger **32** presents an upstanding extension of bucket **18** and provides a housing or niche for the reception of the brake assembly generally referred to by the numeral **40.**

Brake assembly **40** includes a closed housing **42** mounted within the hanger **32** in any convenient fashion, for example by welding baseplate **44** onto back wall **34.** A reciprocable actuating rod **46** centrally disposed within housing **42** extends through mated apertures **48** provided in baseplate **44** and back wall **34** and into registry with the arcuate slot **31** in braking plate **30.** Rod **46** travels within the slot during all pivotal movements of the bucket, and therefore the slot is of complemental generally semicircular configuration to the path of travel of the rod as is shown in FIG. **3.**

A first braking pad **50** is attached to rod **46** at the end thereof remote from housing **42.** Pad **50** can be of any desired shape and is preferably fabricated from materials effective to give excellent frictional engagement with depending brake plate **30.** Pad **50** is mounted on rod **46** by means of annular bushing **52** and adjustable nut means **54,** the latter serving as a spring pressure adjustment for the biasing spring within housing **42.**

A second brake pad **56** is attached to back wall **34** and is positioned about rod **46** between back wall **34** and plate **30** in slightly spaced relationship from the latter. Both of the pads **50** and **56** are provided with slip-resistant brake lining elements presenting friction surfaces **58** and **60** which directly contact opposed faces of braking plate **30** sandwiched therebetween when the brake is in its normally locked orientation.

A pressure-responsive piston **62** is positioned within housing **42** and is positively connected to and journaled on rod **46** for reciprocation therewith. A high-bias, low-deflection spring assembly **64** is operatively positioned between the inner annular face of housing **42** and the left hand surface of piston **62** for biasing the piston in a rightward direction viewing FIG. **2** to cause frictional braking contact between pads **50** and **56** and braking plate **30.** In a preferred embodiment, the spring assem-

bly 64 comprises a plurality of discrete, generally cup-shaped, annular members fabricated from spring steel and slidably journaled on rod 46 with the open face of each member communicating with the open face of another such member. In this manner, a spring is provided which yields very high biasing forces when deflected only slightly. As can be appreciated, spring-biased pad 50 thus acts to slightly deflect plate 30 and bring the latter into contact with stationary pad 56 which is slightly spaced from the plate. Therefore, both pads cooperatively grip plate 30 in the stationary braking position, thus insuring that the bucket is securely locked against movement.

Preferably a rigid, tubular stop sleeve 66 is placed in circumscribing relationship to spring 64 which serves to limit the possible travel of piston 62. Additionally, the chamber of housing 42 receiving spring assembly 64 is vented as at 68 to preclude the possibility of pneumatic pressures building up therein during operation of the brake.

A fluid pressure chamber 70 is provided within housing 42 on the right side thereof defined in part by the face of piston 62 remote from spring 64. A hydraulic fitting 72 and associated conduit means 74 is attached to housing 42 at a point allowing fluid communication with chamber 70. Leakage of hydraulic fluid from the latter is prevented by means of annular seals 76 and 78 about rod 46 and piston 62 respectively.

It is apparent from FIG. 2 that when hydraulic fluid enters chamber 70 under sufficient pressure to overcome the bias of spring 64, piston 62 and rod 46 connected thereto are moved in a leftward direction as the assembly is depicted in FIG. 2. This serves to move pads 50 and 56 out of frictional braking contact with plate 30, which consequently permits pivotal movement of the entire personnel bucket about the axis of axle member 24. Hence, the operative position of brake assembly 40 is dependent upon the fluid pressure within chamber 70; and as will be more fully explained below, this pressure is keyed to the fluid pressure within the overall boom raising and lowering hydraulic circuit such that when the boom is stationary, the bucket is locked, and conversely when the boom is being raised or lowered, the bucket is free to pivotally move under the influence of gravity.

In the embodiment shown in FIGS. 2–4, rod 46 extends through the end of housing 42 removed from wall 34. A manually actuatable eccentric camming member 78 is positioned externally of housing 42 in proximal relation to the end of rod 46 extending out of the housing. Camming member 78 is mounted between a pair of spaced, generally triangularly-shaped braces 80 and 82 extending rearwardly from housing 42. The member 78 is mounted upon transverse gudgeon 84 extending between braces 80 and 82 and is spring-loaded by means of biasing spring 86, which serves to retain camming member 78 in the normal inoperative position depicted in FIG. 2.

The purpose of camming member 78 is to provide a means for manually releasing brake assembly 40 in the event of a malfunction in the hydraulic actuating system therefor. That is, should a malfunction arise in the hydraulic circuit serving brake 42, the worker can turn camming member 78 by means of handle 88 to mechanically shift rod 46 leftwardly to release the brake. To facilitate this operative effect, a detent 90 is provided on the camming member at the point of its greatest eccentricity. The detent is dimensioned to seat on the end of rod 46 in communication with the camming member to hold brake assembly 40 in its released position.

Referring now to FIG. 5, there is shown a schematic representation of that portion of the boom-actuating hydraulic circuit which serves to raise and lower the boom. A secondary circuit is also shown which is operable to direct motive fluid to the bucket brake assembly 40. In general, the system as illustrated includes a reservoir 92 of hydraulic fluid with conduit means defining a boom-actuating circuit 94 for permitting selective raising and lowering of the boom by the double acting boom-actuating piston and cylinder assembly 96. The secondary brake actuating circuit 95 is keyed to circuit 94 as explained below.

More specifically, a conduit 98 from reservoir 92 is connected to a fixed displacement, gear-type pump 101 which is in turn communicates with a four-way, three-position directional flow valve 102. As shown in FIG. 5, the valve is in its neutral position wherein pressurized hydraulic fluid is directed to bypass line 104 and back into reservoir 92.

However, when valve 102 is raised to operatively interconnect portion 106 thereof with line 98, hydraulic fluid is directed through conduit 110 in order to effect an extension of the piston of boom-actuating piston and cylinder assembly 96. In this operational mode, fluid flows through conduit 100 with a portion thereof being directed through secondary duct 108 which is connected to a two-way, shiftable shuttle valve 110. The remainder of the pressurized fluid in conduit 100 then flows to a conventional, internally piloted one-way sequence valve assembly 112.

The operation of valve assembly 112 is controlled by internal pilot line 114 which is connected to the flow-control mechanism 115 thereof. The latter is opened to permit fluid flow when the pressure within line 114 reaches a predetermined magnitude. Moreover, valve 112 is also operable to permit unrestricted fluid flow in the opposite direction, i.e., from cylinder 96 to reservoir 92 through one-way check valve 113 forming a part of the overall assembly.

An externally piloted holding valve 116 is interposed within the boom raising portion of circuit 94 between valve assembly 112 and cylinder 96. The operation of this valve does not interfere with boom raising and in controlled by means of external pilot line 118 interconnecting the flow control mechanism thereof and the boom lowering portion of circuit 94 for purposes which are made clear hereinafter.

When pressurized hydraulic fluid from reservoir 92 passes through line 100 and valves 112 and 116, it is then directed to the sealed extension chamber 121 of cylinder 96. This serves to move the hydraulic piston 122 and connecting rod 123 rightwardly as shown in FIG. 5, to thereby raise the boom as desired. Additionally, the buildup of pressure within the extension leg of circuit 94 serves to actuate shuttle valve 110 to permit flow of pressurized motive fluid to brake assembly 40. In one preferred embodiment, valve assembly 112 is initially set to open at a pressure of 500 psi, while a pressure of only 130 psi is required to open shuttle valve 110 and release brake 40. (It is to be understood however, that these initial settings may be modified somewhat during primary testing of the system in order to optimize the operation thereof.) Therefore, during

the buildup of pressure within line **100,** hydraulic fluid under pressure is directed to brake assembly **40** to release the personnel bucket before the boom begins to move. As can be appreciated, this allows the bucket to pivot in an unrestrained manner an instant before boom raising to thereby insure a smooth, jerk-free, gravity-induced leveling of the bucket.

In order to complete the hydraulic circuit **94,** fluid within sealed retraction chamber **125** of cylinder **96** flows therefrom through line **124** and valve assembly **126** and ultimately back to reservoir **92.** In this manner a smooth operation of the boom and associated bucket brake assembly is achieved during all modes of operation.

In a similar fashion, if valve **102** is moved such that portion **128** thereof is in operative communication with line **98,** the boom is caused to lower. Motive fluid is first directed through line **124** toward sequence valve **126,** with a portion thereof going through a second brake-actuating duct **130.** By virture of the fact that the boom lowering operation is identical in all respects to that of raising thereof, a complete discussion is superfluous and therefore has been omitted. In general, however, a sequence valve assembly **126** is employed which is identical to valve assembly **112** in order to insure uniformity in the response of brake assembly **40.** Additionally, during lowering of the boom hydraulic fluid flows from chamber **121** of cylinder **92** through line **100** to reservoir **92.** Thus, during either operational mode, the unused segment of the circuit serves as a hydraulic fluid return system.

The purpose of holding valve **116** is to prevent the boom from "creeping" when in a raised position and to permit the boom extension leg of circuit **94** to carry return fluid to reservoir **92.** Specifically, during lowering of the boom, fluid is directed through pilot **118** to actuate valve **116** as shown in FIG. **5;** this permits return flow of fluid from cylinder **96** back to reservoir **92** as described. Moreover, when the boom is in a static, raised position, valve **116** prevents return fluid flow therefrom to preclude the possibility of boom creepage, or slow intermittent lowering. This same safety function also obtains if pressure is lost within the system due to line breakage or the like since valve **116** operates to prevent undesirable sudden, as well as gradual, boom depressions.

Once shuttle valve **110** opens during either boom raising or lowering, hydraulic fluid enters looped line **132** and pressurizes the latter which is contained within the hollow, extensible portions of aerial boom **14.** Brake assembly **40** is in turn pressurized, and the buildup of fluid pressure therein causes the brake to release as fully described above. In the preferred construction it has been found that the fluid pressure for brake actuation should be below that required to actuate valve **110.** This causes smooth release of brake assembly **40** prior to boom movement to insure smooth, jerk-free gravity-induced pivotal movement of bucket **18.**

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. A selectively actuatable, fluid-pressure responsive brake assembly for use with a personnel bucket pivotally mounted on a shiftable boom, said brake assembly acting to free the bucket for gravitational leveling during raising and lowering of the boom and locking the bucket when said boom is stationary, the combination with said bucket and boom of:

support structure secured to the bucket for movement therewith;

a brake plate fixedly carried by the boom in proximal relationship to said support structure; and

a hydraulically operated unit carried by the support structure and provided with a shiftable brake pad located to move into frictional engagement with the plate for locking the structure and thereby said bucket to the boom, said unit including

means for normally forcing the pad into frictional locking engagement with said plate and

hydraulically actuated maans for shifting the pad out of said locking position engaging the plate in response to raising or lowering of the boom.

2. The combination of claim **1** wherein is provided hydraulically actuated piston and cylinder means connected to the boom for raising and lowering the latter, and hydraulic circuit means coupled to said piston and cylinder means for directing pressurized hydraulic fluid to either one end or the other of said piston and cylinder means to effect raising or lowering of the boom, said hydraulically operated unit being operatively connected to said circuit for actuation by pressurized fluid directed to either end of said piston and cylinder means to effect shifting of the brake pad out of frictional engagement with said plate during either raising or lowering of the boom.

3. The combination of claim **2** wherein said unit includes a housing, a shiftable rod projecting from the housing toward said plate and carrying said pad thereon, a piston secured to the rod within the housing, means within the housing engaging said piston on the side thereof forcing said pad into frictional locking engagement with the plate, and means for directing pressurized hydraulic fluid from said circuit to the housing for shifting the piston and thereby the rod through a displacement to move the pad out of locking engagement with the plate against the action of said biasing means during raising and lowering of the boom.

4. The combination of claim **3** wherein is provided means for effecting unlocking of the pad from said plate prior to raising or lowering of the boom by said piston and cylinder means.

5. A selectively actuatable, fluid-pressure responsive brake assembly for use with a personnel bucket pivotally mounted on a shiftable boom, said brake assembly acting to free the bcket for gravitational leveling during raising and lowering of the boom and locking the bucket when said boom is stationary, the combination with said bucket and boom of:

first and second plates positioned in adjacent, spaced relationship, said first plate being fixedly connected to said boom, and said second plate being connected to said bucket for movement therewith independent of said first plate;

a closed housing mounted on one of said plates;

a reciprocable actuating rod positioned within said housing and extending therefrom to pass through said adjacent plate, the latter being provided with a slot configured and arranged to allow said rod to travel therein during movement of said bucket;

a brake pad connected to said rod externally of said housing and positioned to selectively communicate with said adjacent plate in response to reciproca-

tion of said rod to effect a frictional, braking contact between the pad and adjacent plate;

a fluid pressure actuatable piston within said housing and journaled on said rod for reciprocation therewith;

biasing means within said housing on one side of said piston operable to bias the latter in a direction to cause braking contact between said pad and adjacent plate, the opposite side of said piston communicating with a fluid pressure chamber within said housing; and

means operatively connected to said chamber for increasing the fluid pressure therein during raising and lowering of said boom, whereby, when said fluid pressure is of sufficient magnitude to overcome the oppositely directed force of said biasing means, said piston and rod move in a direction to break the contact between said pad and adjacent plate, thereby freeing said bucket and allowing the latter to move.

6. The combination of claim **5,** wherein said second plate comprises the backwall of an upstanding hanger pivotally connected to said boom and attached to said bucket.

7. The combination of claim **6,** wherein said housing is mounted on the face of said second plate removed from said first plate, said reciprocable rod being centrally disposed therein and extending through the latter, said second plate being provided with an aperture therein to permit passage of said rod therethrough.

8. The combination of claim **3,** wherein a first brake pad is attached to said rod and positioned to engage the face of said first plate removed from said second plate, a second apertured brake pad being attached to the second plate and positioned in the space between the back wall and first plate with said rod extending therethrough, said first and second pads normally cooperatively engaging opposite faces of said first plate to prevent movement of the bucket when said boom is stationary.

9. The combination of claim **8,** wherein said housing is generally cylindrical in shape, said biasing means being positioned between said piston and second plate and operable to bias the piston in a direction away from the latter.

10. The combination of claim **9,** wherein said biasing means is a high-bias, low-deflection spring unit.

11. The combination of claim **10,** wherein said high-bias, low-deflection spring unit comprises a plurality of discrete, generally cup-shaped members fabricated of spring steel and slidably journaled on said rod with the open face of each member facing the open face of an adjacent member.

12. The combination of claim **11,** wherein said high-bias, low-deflection spring unit is constructed to be deflected to an extent to release said brake by an opposing pressure within said fluid pressure chamber of under 130 psi.

13. The combination of claim **9,** wherein said rod extends through the end of said housing removed from said plates, said housing being provided with manually actuatable means externally mounted on said end thereof operable to act on said rod to move the latter in a direction toward said plates to release said brake.

14. The combination of claim **13,** wherein said manually actuatable means is a pivotally mounted, spring-biased cam member operable to be turned about the pivot axis thereof and engageable with said rod to effect axial movement thereof against the action of said biasing means.

15. The combination of claim **14,** wherein said cam member is provided with a detent on the surface thereof operable to receive said rod and releasably hold the latter in a brake-releasing position.

16. The combination of claim **5,** wherein said housing is provided with an aperture in the portion thereof circumscribing said biasing means to effect venting of said portion.

17. The combination of claim **5,** wherein a stop sleeve is interposed in the portion of said housing receiving said biasing means and disposed in circumscribing relationship to the latter for limiting the extent of travel of said piston.

18. A braking system for use with a movable personnel bucket brake mounted on a fluid-pressure actuated boom to permit free movement of the bucket during raising and lowering of the boom and to lock the bucket when the boom is stationary, comprising:

a supply of motive fluid;

actuating means for raising and lowering the boom;

conduit means operatively interconnecting said supply and the boom actuating means, and defining a hydraulic circuit therebetween to effect selective raising and lowering of said boom;

means interposed within said circuit operable to force motive fluid therethrough under pressure;

directional means interposed within said circuit operable to selectively direct motive fluid through said circuit to a part of the boom actuating means to effect raising of said boom, and for selectively directing motive fluid through the circuit to another part of the boom actuating means to effect lowering of the boom;

pressure responsive means interposed within said circuit operable to permit flow therethrough when the fluid pressure within the circuit reaches a first predetermined magnitude;

selectively actuatable fluid pressure responsive brake means adapted to be operatively connected to said personnel bucket and operable to hold the latter against movement when said boom is stationary, said brake means being selectively actuatable to release said bucket and allow movement thereof when the fluid pressure therein reaches a second predetermined magnitude; and

conduit means interconnecting said pressure responsive means and brake means whereby, when the fluid pressure within the circuit reaches said first predetermined magnitude, motive fluid is directed to said brake means, said brake being actuated to release said bucket and allow movement thereof as soon as fluid under a pressure equal to or exceeding said second predetermined magnitude thereof is directed to said brake means from the circuit.

19. The system of claim **18,** said conduit means including a first boom raising portion interconnecting said directional means and boom to permit pressurized fluid-flow therethrough to raise the boom, and a second boom lowering portion interconnecting said directional means and boom to permit pressurized fluid-flow therethrough to lower the boom, said directional means

being selectively positionable to direct pressurized fluid through said first and second portions as desired.

20. The system of claim **19,** wherein each of said conduit portions is connected to said supply of motive fluid such that when pressurized fluid is being directed through one of said portions, the other portion serves as a return conduit for returning fluid from said boom actuating means to the supply.

21. The system of claim **20,** wherein an internally piloted, one-way sequence valve is interposed within said respective first and second portions between said boom actuating means and the directional means, said sequence valves being operable to perclude flow of motive fluid through said respective portions in a direction from the directional means to the boom actuating means until the fluid pressure therein reaches a third predetermined magnitude, and operable to allow unrestricted flow of motive fluid therethrough from the boom actuating means to the supply.

22. The system of claim **21** wherein said pressure responsive means comprises:

a first duct connected to said first conduit portion on the input side of the sequence valve interposed within the latter;

a second duct connected to said second conduit portion on the input side of the sequence valve interposed within the latter; and

a two-way, shiftable shuttle valve interconnecting said first and second ducts with conduit means interconnecting the shuttle valve and brake means, said shuttle valve being adapted to permit flow of motive fluid to said brake means when the fluid pressure within either of said ducts reaches said first predetermined magnitude.

23. The system of claim **22,** wherein said first predetermined magnitude is about 130 psi, said second predetermined magnitude is less than 130 psi, and said third predetermined magnitude is about 500 psi.

24. The system of claim **18,** wherein said means for forcing motive fluid through said conduit means under pressure is a fixed displacement pump.

25. The system of claim **24,** wherein said directional means is interposed in said circuit on the output side of said pump and comprises a four-way, three-position directional flow valve.

26. The system of claim **18,** wherein brake means comprises:

first and second plates positioned in an adjacent, spaced relationship, said first plate being adapted to be fixedly connected to said boom, and said second plate being adapted to be connected to said bucket for movement therewith independent of said first plate;

a closed housing mounted on one of said plates;

a reciprocable actuating rod positioned within said housing and extending therefrom to pass through an adjacent plate, the latter being provided with a slot configured and arranged to allow said rod to travel therein during movement of said bucket;

a brake pad connected to said rod externally of said housing and positioned to selectively engage said adjacent plate in response to reciprocation of said rod to effect a frictional, braking contact between the pad and adjacent plate;

a fluid pressure actuatable piston within said housing and journaled on said rod for reciprocation therewith; and

biasing means within said housing on one side of said piston operable to bias the latter in a direction to cause braking contact between said pad and adjacent plate, the opposite side of said piston communicating with a fluid pressure chamber within said housing.

* * * * *