Sept. 21, 1965 J. BIENAIME 3,207,340

EARTHMOVING AND HOISTING MACHINES

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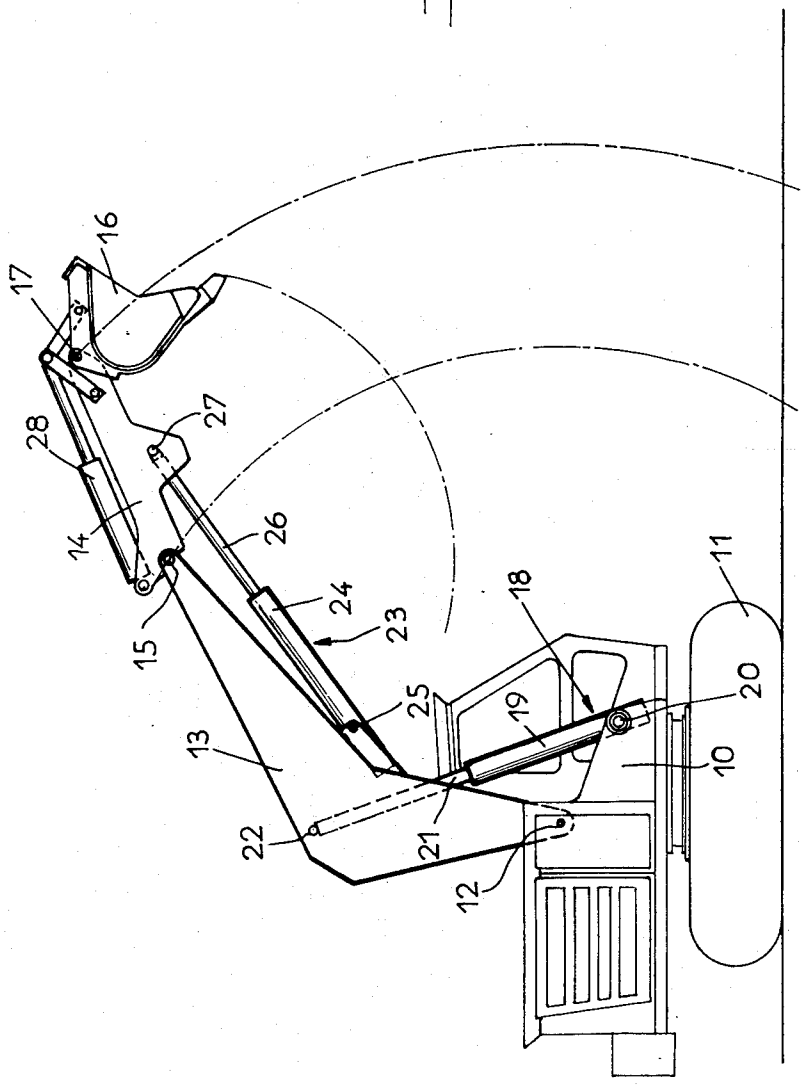
Fig. 1.



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EARTHMOVING AND HOISTING MACHINES

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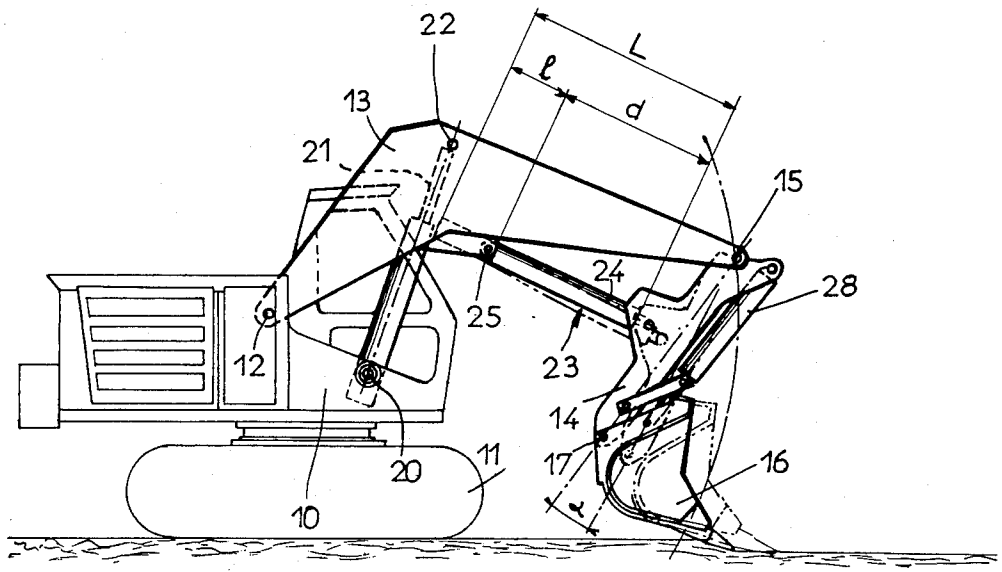
Fig. 2.



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EARTHMOVING AND HOISTING MACHINES

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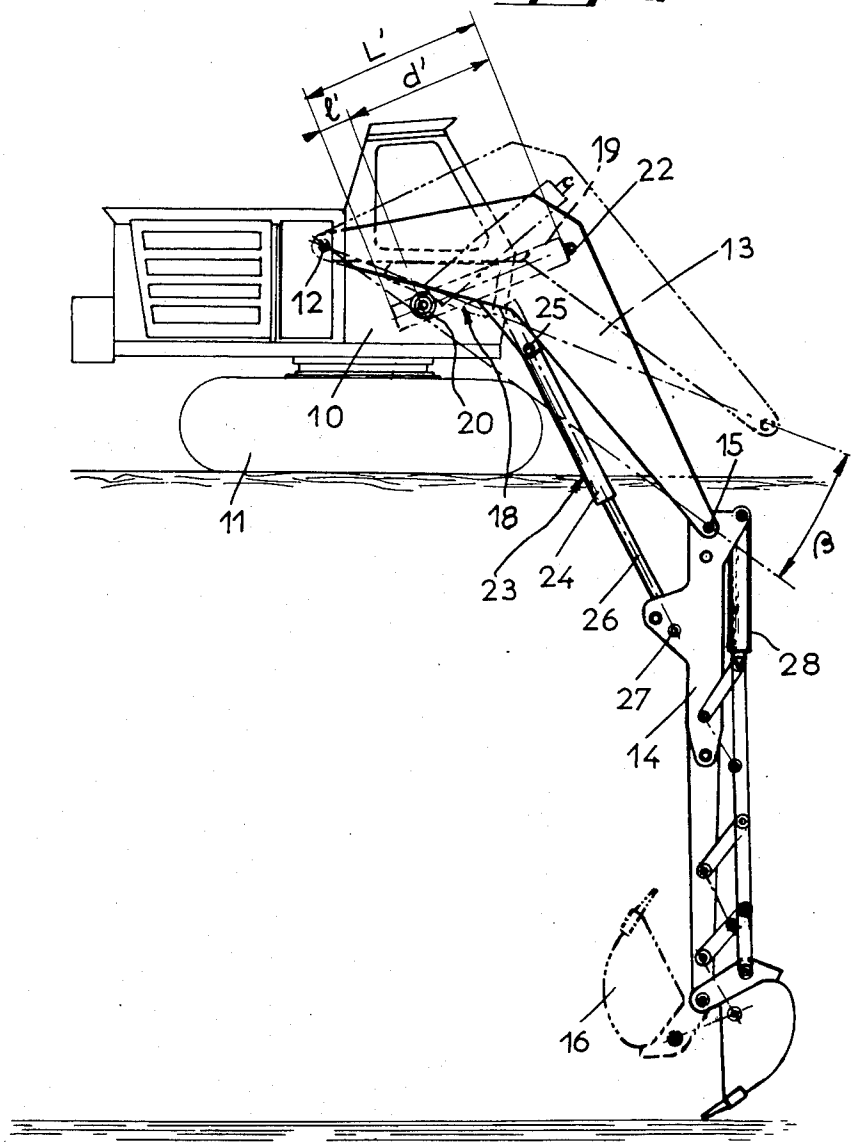
Fig: 3.



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EARTHMOVING AND HOISTING MACHINES

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Fig. 4.

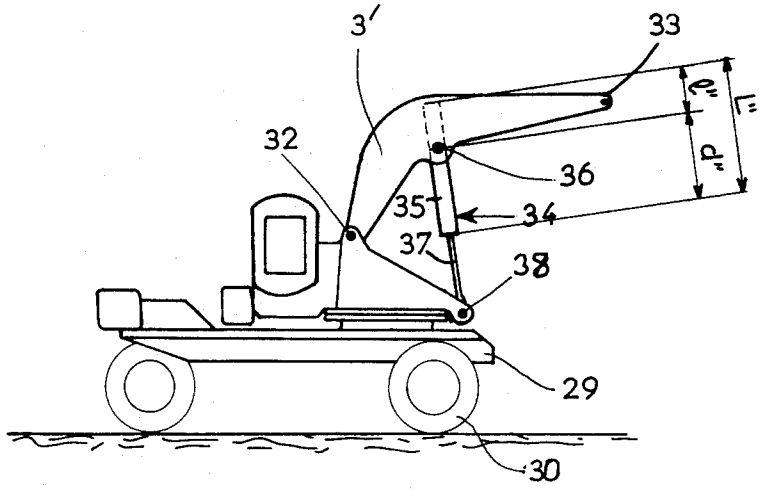

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Fig. 5.

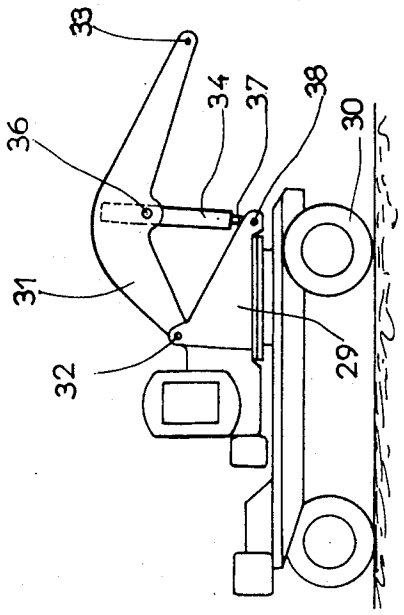

Fig. 6.

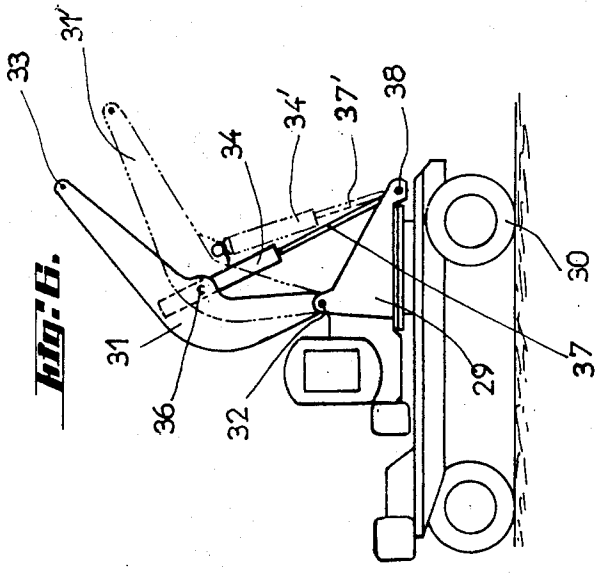

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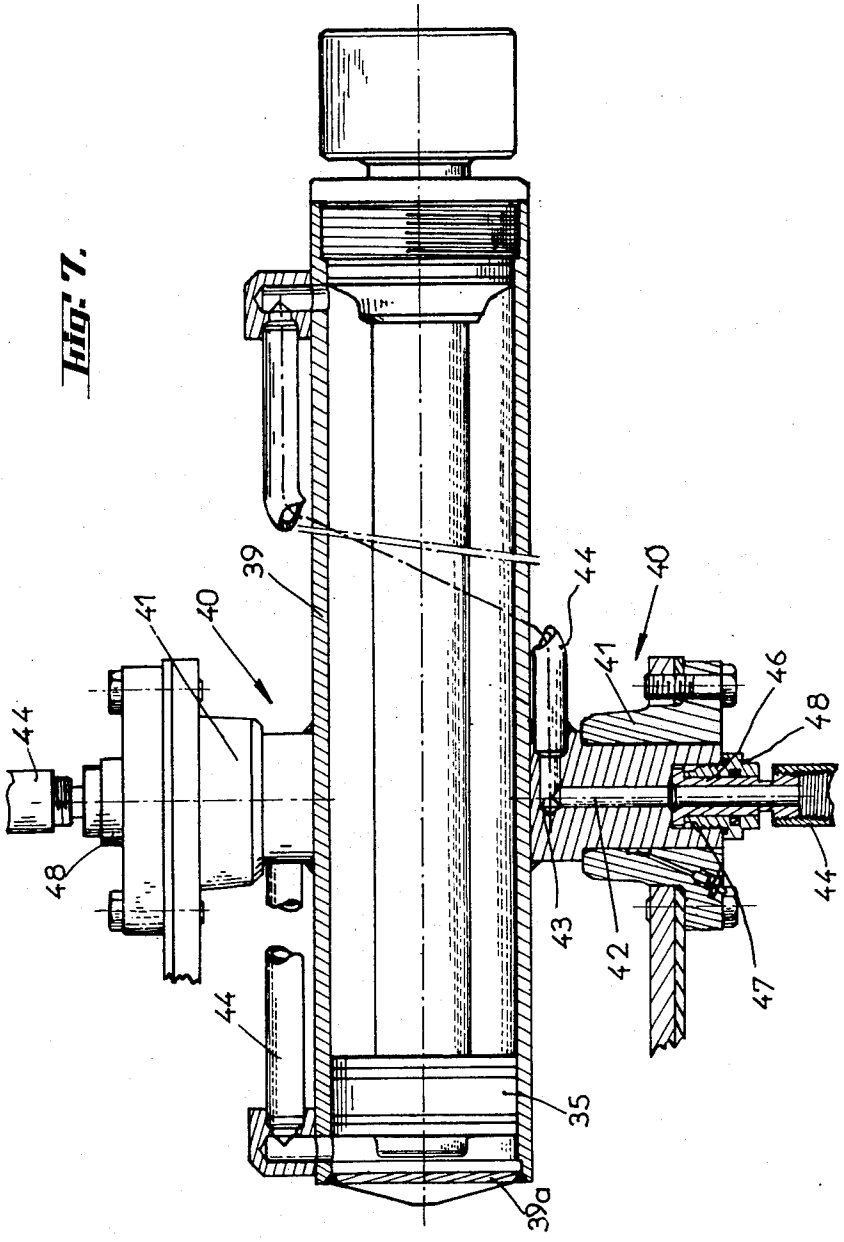
Fig. 7.



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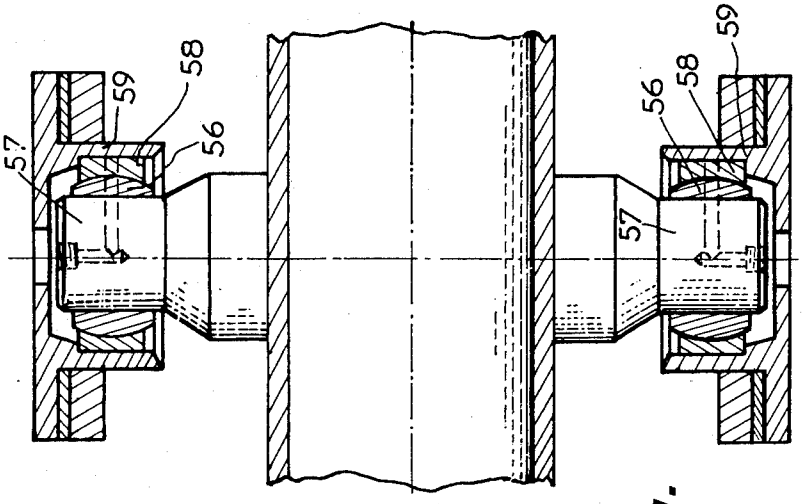

Fig. 9.

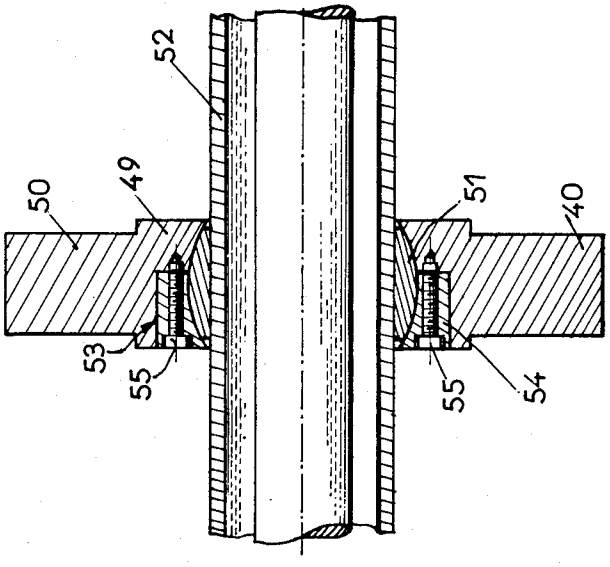

Fig. 8.

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United States Patent Office

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Patented Sept. 21, 1965

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3,207,340

EARTHMOVING AND HOISTING MACHINES

Jacques Bienaime, Paris, France, assignor to Yumbo, Genas (Isere), France, a body corporate of France

Filed July 26, 1963, Ser. No. 297,935
Claims priority, application France, Aug. 4, 1962, 906,118; July 3, 1963, 940,269
3 Claims. (Cl. 214—138)

The present invention relates essentially to public works or earthmoving and hoisting machinery, notably power shovels, cranes or the like, comprising on the one hand a boom pivoted on the main frame and actuated by a boom cylinder and on the other hand a bucket arm or the like pivoted on the end of said boom and actuated by an arm cylinder.

In hitherto known devices of this character various drawbacks limit their field of applications. Even the mere presence of the cylinders reduces considerably the minimum angle which the pivoted elements actuated thereby may form with each other. As the cylinders are pivoted on these elements on the one hand by the cylinder end and on the other hand by the outer end of the piston rod of the same cylinder, the permissible angular movement of the boom and of the arm is restricted by the length of this cylinder. Thus, in the case of a back-dragging power shovel for digging foundations, trenches or the like the boom cylinder actually limits the depth at which the bucket can be operated. Likewise, in the case of a skimmer bucket the presence of the arm cylinder limits the permissible backward stroke of the bucket.

On the other hand, these cylinders are mounted on pivot members which, on account of their specific configuration, cannot adapt themselves to misalignments existing or occurring inevitably in any mechanical construction subjected to important stresses.

The machine according to this invention is remarkable notably in that each cylinder aforesaid is provided with a pivot member secured at any desired location along its body and comprising two trunnions having a common axis extending at right angles and radially to the cylinder axis.

It will be seen that with this pivot member the point of attachment of the cylinder may be selected at any desired location along the cylinder body whereby the cylinder portion extending from this point of attachment to the cylinder bottom will not interfere with the downward movement of the boom or the backward movement of the bucket arm, as contracted with known arrangements.

According to a specific form of embodiment, the body of the boom cylinder is pivoted on the main frame but at a certain level above the platform thereof in order to permit its free movement, the piston rod of said cylinder being pivoted on the boom.

Still according to this invention the boom cylinder body is pivoted on the boom, and the cylinder portion extending beyond the point of fixation is housed inside the boom whilst the piston rod of said cylinder is pivoted on the bucket arm.

It will be seen that the boom cylinder and bucket-arm cylinder arrangement according to this invention affords a substantial increase in the range of working possibilities of the machine, irrespective of the manner in which it is operated.

According to a further feature characterizing this invention, the body of said cylinders is mounted on said pivot member through the medium of a swivel bearing, ball-and-socket joint or the like.

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This assembly enables the cylinder to accommodate the various misalignments likely to exist or occur between the main frame and the boom either by construction or as a consequence of distortions of these elements as will inevitably occur during the operation of the machine.

The aforesaid pivot member comprises a collar or like member of which the inner, part-spherical face, is adapted to co-act with a ball of a swivel joint rigid with said cylinder and with an annular member also formed with a part-spherical face and fitting in said collar in order to hold said ball in position.

Other features and advantages of this invention will appear as the following description proceeds with reference to the accompanying drawings illustrating diagrammatically by way of example typical forms of embodiment of the invention. In the drawings:

FIGURE 1 is an elevational view showing an earthmoving machine constructed according to the teachings of the invention, the boom and bucket arm being assumed to be in their outermost positions;

FIGURE 2 is a view similar to FIGURE 1, showing the machine during its operation as a skimmer;

FIGURE 3 is a view similar to FIGURES 1 and 2, showing the machine during its operation as a backhoe or trencher;

FIGURE 4 is an elevational view showing a machine constituting an alternate embodiment of the invention;

FIGURE 5 is a view similar to FIGURE 4 with the boom in its lowermost position;

FIGURE 6 is a view similar to FIGURES 4 and 5, showing the boom in its uppermost position;

FIGURE 7 is a section showing a cylinder according to a specific form of embodiment of the invention;

FIGURE 8 is a detail view showing in section the mounting of a cylinder body on the pivot member, and

FIGURE 9 is another detail view showing the mounting of the trunnions of the pivot member.

The machine illustrated in diagrammatic form in FIGURES 1 to 3 comprises a main frame **10**, for example of the type mounted for swivel motion on a crawlertrack undercarriage **11** and provided with a boom **13** having its lower end pivoted at **12** on said main frame. At its upper end the boom **13** carries a bucket or like arm **14** pivoted at **15** on the boom. This arm **14** carries a bucket or like tool **16** pivoted about a pivot **17** on the outer end of said arm **14**.

The boom is responsive to a boom cylinder **18** comprising a body **19** pivoted on the frame at **20** and a piston rod **21** pivoted on the boom at **22**. As shown, the cylinder body **19** is pivotally mounted at a point somewhat spaced from the bottom of this cyliner, the pivot point **20** on the frame **10** being disposed of course at a level sufficient to permit the free movements of the cylinder portion extending between said pivot point and the cylinder bottom.

The arm is actuated by means of an arm cylinder **23** comprising a cylinder body **24** pivoted on the boom at **25** and a piston rod **26** pivoted on the arm at **27**. This arm cylinder is pivoted like the boom cylinder at a point somewhat spaced from its bottom. Of course, the length of the arm cylinder which extends from the pivot point **25** and the cylinder bottom is slightly inferior to the

boom depth to permit the free movement of said cylinder.

Finally, the bucket or like tool **16** is actuated by means of another cylinder **28** constituting in this example part of a known assembly.

FIGURES 2 and 3 illustrate clearly the advantageous features characterizing this invention.

In FIGURE 2 the machine is being operated as a skimmer the boom **13** is in its intermediate position, the arm **14** being shown in its rearmost position (in thick lines). It will be seen that the arm can recede as if the cylinder **23** had only a length *d*, that is, the useful length L of the cylinder body minus the distance *l* between its pivot point **25** and its bottom, thus affording a greater angular movement than that obtained with a cylinder of same length but pivoted on the cylinder end (position shown in chain-dotted lines). The angle α corresponding to the increase in the permissible angular amplitude of arm **14** provides an increase of about 12% in the levelling stroke of the bucket. Thus, a machine capable, with conventional cylinders, of effecting 8-feet levelling strokes will accomplish 11-feet strokes with the cylinders of this invention.

In FIGURE 3 the machine is assumed to be operated as a backhoe for digging trenches or the like. The boom **13** is in its lowest position and the arm **14** is in an intermediate position. It will be seen that the boom may be lowered exactly as if the cylinder **18** had only a length *d'*, i.e. the useful cylinder length L' minus the distance *l'* between its pivot point **20** and its bottom, whereby it can be lowered to an extent considerably greater than the amplitude permitted by a cylinder of same length but pivoted at its bottom (as shown in chain-dotted lines). The angle β shows the increase in the permissible angular amplitude thus obtained. It may be pointed out by way of example that by equipping a machine of known type with a cylinder according to this invention the permissible angular amplitude of the boom increases from 80° to 95°.

The machine illustrated diagrammatically in FIGURES 4 to 6 of the drawings comprises a main frame or chassis **29** supported for example by wheels **30**. A boom **31** is pivoted at one end **32** on the frame **29** and may comprise at its opposite end **33** any desired hoisting, handling or working tool, such as hooks, buckets or the like. To operate the boom, a cylinder **34** is provided, the body **35** of this cylinder being pivoted at **36** on the boom and its piston rod **37** is pivoted at **38** on the main frame.

FIGURES 5 and 6 illustrate the advantageous properties of the machine illustrated in FIGURE 4. In FIGURE 5 the boom is in its lowermost position. It will be seen that the boom can be lowered exactly as if the cylinder had only a length *d''* between the attachment **38** and **36**, that is, the length L'' of the cylinder body minus the distance *l''*, whereby the boom can be lowered at a level considerably lower than that permitted by cylinders of greater length. FIGURE 6 shows the boom in its uppermost position, with the cylinder in its fully extended condition. The dotted lines show the position attained by the arm in its maximum raised position if the cylinder had only a total length *d''* corresponding to the actual dimension shown in FIGURE 5. This position corresponds to that of a boom **31'** actuated bya cylinder **34'** of total length *d''*, with a rod **37'** of corresponding length. It is clear that a substantial difference is obtained between the permissible angular strokes of booms **31** and **31'** when these two booms are in their uppermost respective positions, these two booms having on the other hand the same lowermost position corresponding to the position shown in FIGURE 5.

FIGURE 7 illustrates a typical embodiment of a cylinder according to this invention. The cylinder body **39** is provided with a pivot member consisting of a pair of trunnions or like elements **40** secured for example by welding at a certain distance from its bottom **39***a*. These trunnions are mounted in bearings **41** rigid with either

the main frame of the machine or the boom. Each trunnion **40** is formed with an axial bore **42** and a radial bore **43** connected to fluid supply line **44** adapted to deliver thereto a suitable fluid, for example oil under pressure, for actuating the piston **35**. The fluid supply pipes and each axial bore are interconnected through a member **46** mounted for free rotation in a recess **47** formed in said trunnions and secured thereto by means of a lock nut **48**. It will be seen that with this specific mounting the fluid supply pipes cannot be carried along during the angular movements of the cylinder.

The cylinder body **39** may be mounted on the pivot member by means of a swivel bearing as shown in FIGURE 8. In this case the pivot member comprises a collar **49** carrying the trunnions **50**. The ball member **51** of part-spherical and annular configuration is secured on the cylinder body **52** and contacts the inner part-spherical surface of collar **49**. This collar **49** has circular recess **53** formed on one side and adapted to receive an annular member **54** also formed with a part-spherical inner surface complementary to that of collar **49**, this member **54** being secured to the collar **49** by screws **55**, as shown.

The swivel mounting permits of accommodating the misalignment likely to exist or occur between the frame or cab, the boom and the boom cylinder proper, such as differences arising during the assembly or as a consequence of distortions of each component element of the structure during the operation of the machine.

The trunnions themselves may be mounted if desired on swivel bearing or ball-and-socket joints, as shown in FIGURE 9. In this case each part-spherical, ball-like element **56** is rigid with its companion trunnion **57** and mounted in a race or socket **58**, formed with a part-spherical inner surface. This race or socket **58** is carried in turn by a bearing member **59** rigid with the frame or boom of the machine. With this arrangement the trunnions are adapted to withstand considerable stress or distortion, as will occur inevitably in the frame and/or boom during the operation of the machine, without any abnormal or detrimental strain.

Although the present invention has been described in conjunction with preferred embodiments, it is to be understood that modifications and variations may be resorted to without departing from the scope of the invention, as those skilled in the art will readily understand. Such modifications and variations are considered to be within the purview and scope of the invention and appended claims.

What I claim is:

1. An earthmoving machine comprising a frame structure, a boom having one end pivoted on said frame structure, a boom cylinder for actuating said boom, said boom having a cylindrical body and a piston rod and being pivoted on said frame structure and also on said boom, an arm pivoted on the other end of said boom, an arm cylinder for actuating said arm, said arm cylinder having a cylindrical body and a piston rod and being pivoted on said boom and also on said arm, each one of said two cylindrical bodies having a pair of trunnions having a common axis extending at right angles and radially to the axis of said cylindrical bodies, fluid supply means in said trunnions, fluid supply lines for connecting said fluid supply means to said cylindrical body, bearing members respectively secured on said frame structure, said boom and said arms, said bearing members adapted to receive said trunnions and swivel joint means mounted between said cylindrical bodies and said bearing members whereby misalignments occurring between said frame structure, said boom and said arm are accommodated; said fluid supply means in each one of said trunnions comprising an axial recess and an axial bore formed in said trunnion, a connection member mounted for free rotation in said recess and connected to a duct fed with compressed fluid, a lock member secured in said recess for holding said connection member in position and a radial bore open-

ing in said axial bore and communicating with said supply line.

2. An earthmoving machine according to claim 1 wherein said swivel point means comprises a collar carrying said trunnions, said collar having a part-spherical inner face, said collar also being provided with a coaxial annular recess, a part-spherical male element secured on said cylinder and contacting the inner face of said collar and an annular element also formed with a part-spherical inner face, said annular element fitting in said recess and being secured on said collar.

3. An earthmoving machine according to claim 1 wherein said swivel joint means comprises a male element secured on each one of said trunnions, said male element having a part-spherical outer face, and a female element carried by said bearing member, said female element

having a part-spherical inner face contacting the outer face of said male element.

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HUGO O. SCHULZ, *Primary Examiner.*

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,207,340 September 21, 1965

Jacques Bienaime

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 52, after "boom", third occurrence, insert -- cylinder --.

Signed and sealed this 22nd day of March 1966.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents