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(21) Application No. 40615/77 (22) Filed 29 Sept. 1977
 (31) Convention Application No. 765 915 (32) Filed 1 Oct. 1976 in
 (33) South Africa (ZA)
 (44) Complete Specification published 8 April 1981
 (51) INT. CL.³ E02F 3/70 3/75
 (52) Index at acceptance
 B8H 301 340 403 432 556 DA



(54) LOADERS FOR USE IN TUNNELS

(71) We, GENERAL MINING AND FINANCE CORPORATION LIMITED, a company registered according to the laws of the Republic of South Africa, of 6 Hollard 5 Street, Marshalltown, Transvaal, Republic of South Africa, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

Background of the Invention:

This invention relates to loaders for use in tunnels and other working places with 15 limited head room.

The loading of rock in mine tunnels is a problem because of the limited head room and slewing space that are available. High capacity loaders as are used on the surface 20 cannot be employed in tunnels.

An object of the invention is to provide a loader which is suitable for loading rock in a mine tunnel and which will have a reasonably high capacity.

Summary of the Invention:

According to the invention a loader comprises:

a base;
 a yoke extending above the base and having 30 uprights spaced apart by a cross-member between the uprights;
 a shaft between the uprights;
 a dipper arm swinging from the shaft to move to either side of the yoke between 35 the uprights and below the shaft;
 means to cause the dipper arm to swing between a loading position at a first side of the yoke and an unloading position at the opposite second side of the yoke;
 40 a bucket pivoted to the free end of the dipper arm about a first axis parallel to the shaft; and
 means to rotate the bucket about its pivot axis from a digging attitude to a load retaining attitude.

Furthermore the yoke may be pivoted to the base about an axis parallel to the shaft and may include means to cause the yoke to move about the axis for the yoke 50 to lean towards its first side in order to

extend the reach of the dipper arm.

The yoke may also be slewable about an axis perpendicular to the base to increase the mucking width of the bucket, but in that case it is preferred that the yoke be 55 centralised before the dipper arm moves to its unloading position.

Further, according to the invention, a loader comprises:

a base mounted for rotation about a vertical axis; 60
 a hydraulic cylinder to slew the base about the vertical axis;
 a yoke extending above the base and having uprights spaced apart by a cross-member between the uprights, the uprights being pivoted on the base about a leaning axis;
 a shaft extending between the uprights parallel to the leaning axis; 70
 a hydraulic cylinder to cause the yoke to move between an erect and a forward leaning position about the leaning axis;
 a dipper arm swinging from the shaft to move to either side of the yoke; 75
 a hydraulic cylinder to cause the dipper arm to swing between a loading position forwardly of the yoke and an unloading position rearwardly of the yoke;
 a bucket pivoted to the free end of the dipper arm about a pivot axis parallel to the shaft; 80
 a winch means to cause the bucket to pivot about its pivot axis from a digging attitude to a load retaining attitude; 85
 and means to cause the bucket to turn upside down in the unloading position of the dipper arm.

In order that the invention may be more readily understood and so that further 90 features may be appreciated, the invention will now be described by way of example and with reference to the accompanying drawings in which:

Figure 1 is a front view of a loader 95 according to the invention,

Figure 2 is a side view of the loader in its starting position,

Figure 3 is a side view showing the dipper arm fully extended, 100

Figure 4 is a fragmentary plan view to a different scale of the base of the loader,

Figure 5 is a side view of the loader with the dipper arm in the unloading position, and

Figure 6 is a side view in the travelling position.

Description of a Preferred Embodiment:

The illustrated loader has a base generally indicated as 10 which in this case is carried by a frame which is part of the loading ramp 12 of a mucking train. The frame has not been illustrated in detail for the sake of clarity. In any case it can take a variety of forms depending on the mucking train in use. The essence is that the base 10 is anchored to what is effectively an immovable object.

A yoke having two uprights 13 pivoted at 9 to the base 10 also has a cross-member spacing the uprights 13 apart so that in effect a portal frame is formed. As can be seen from the various side views the uprights 13 can pivot quite extensively about the points 9.

Swinging from a shaft 14 between the uprights 13 is a forked dipper arm 17 (also a portal frame) which at its forked ends carries a loading bucket 18. Each of a pair of hydraulic cylinders 19 are fixed to an upright 13 by means of struts 20 and 21. Each strut 21 is collapsible as being formed as a single acting hydraulic cylinder. In use the strut 21 is always extended as shown in Figures 2, 3 and 6. For travelling purposes (Figure 6) the strut 21 is collapsed in order to reduce the headroom required to pass the loader.

The actuating rod 22 of each cylinder 19 is pivoted at 23 to a lever 24 pivoted at 25 on an upright 13 and at 26 to another lever 27. At its other end the lever 27 is pivoted to the dipper arm 17. The levers 24 and 27 thus form a toggle mechanism 45 for moving the dipper arm 17 and causing it to swing to and fro between the uprights 13.

A pair of hydraulic cylinders 28 tilt the uprights 13 about the pivot points 9. Thus the reach of the bucket 18 can be extended by lowering the upper parts of the uprights 13 as can be seen in Figure 3.

The bucket 18 is pivoted at 29 on the free ends of the forks of the dipper arm 17. Two cammed cheeks 34 are fitted to either side of the bucket 18. A flexible element such as a rope or chain 30 passes from each cheek 34 to winch wheel 31 which is driven by a hydraulic cylinder 35. The wheel 31 has a segmental slot passing around the shaft 14 to allow movement of the wheel 31.

The cylinder 35 acts to bring the bucket 18 towards its load retaining attitude which is attitude B in Figure 3. In order to ensure

return of the bucket 18 to its digging attitude, a rope 42 applies a bias to the bucket 18. The rope 42 passes from the cheek 34 over a pulley 38 to a drum driven by a reversible positive displacement motor 70 36. During loading the motor 36 merely applies a bias to the bucket 18. If the cylinder 35 is actuated, that bias is overcome and the rope 42 unwinds from the drum on the motor 36.

In an operating position such as illustrated in Figure 3 the cylinder 35 can cause the bucket 18 to operate between two attitudes indicated as attitudes A and B in Figure 3.

The axis of the wheel 31 and the axis 29 and the shape of the cammed cheeks 34 are so chosen that when the dipper arm moves to its unloading position (Figure 5) the flexible element 30 is shortened and causes the bucket 18 to turn to the attitude illustrated in Figure 5 and which has been marked as attitude D.

The starting position of the bucket 18 is position C marked in Figures 2 and 3.

The dipper arm is fitted with a pair of rail wheels 37 to facilitate transport of the loader.

The base 10 is secured to a turntable 50 (Figure 4) which can turn about a vertical axis 39. The base 10 is acted upon by two hydraulic cylinders. The first is the double acting cylinder 40 which allows one to slew the yoke about the axis 39 to increase the width over which the loader can work. The second is a centering cylinder 41 which is single acting. When fluid is admitted to the cylinder 41 it pulls the base 10 to the central position illustrated in Figure 4. The hydraulic circuit 105 is so arranged that when the dipper arm 17 moves towards the position illustrated in Figure 2 and to go to the Figure 5 position, the cylinder 40 is inactivated while fluid is admitted to the cylinder 41. The 110 effect is that the bucket 18 always unloads over the same position.

The loader is caused to operate by actuating a series of hydraulic devices:

- (a) the cylinders 19 cause the dipper arm 115 to swing to and fro;
- (b) the cylinders 28 cause the yoke to lean forward and to right itself;
- (c) the cylinder 35 causes the bucket to assume its load retaining attitude;
- (d) the cylinder 40 causes the yoke to slew; 120 and
- (e) the cylinder 41 causes automatic centering.
- (f) the motor 36 applies a bias and also 125 acts as described later on.

In use the cylinders 19 and 28 would normally operate together, but on the backswing the cylinder 35 is locked to retain the bucket 18 in its load retaining atti- 130

tude B. On the forward swing the cylinder 35 can be actuated for the bucket 18 to perform a dipping and lifting action on the material being mucked. The slewing 5 cylinder can also be actuated on the forward swing. As soon as a backswing to the Figure 5 position begins both ends of the cylinder 40 are connected to tank.

For mucking the loader is positioned 10 close to a pile of broken rock at the end of a mine tunnel. At that stage the loader assumes the shape shown in Figure 2 with the bucket 18 in position C and in a digging attitude. The forward swing is then 15 commenced and as the bucket 18 encounters broken rock, the cylinder 35 is actuated for the bucket to dig into and scoop up rock. When the bucket contains sufficient rock, the bucket 18 is caused to 20 assume attitude B and the backswing can commence. Centering takes place while the assembly moves to the Figure 2 position. Note that on the backswing the bucket 18 retains its attitude B to the floor of the 25 tunnel.

As the assembly moves from the Figure 2 position with the bucket in attitude B, to the Figure 5 position, the element 30 gets shortened and the bucket 18 rotates 30 counterclockwise about its pivot 29 to assume attitude D in Figure 5. The scooped up rock is thus discharged.

Upon return of the dipper arm to the Figure 2 position the feed to the motor 35 36 is increased to ensure a positive winching action by the rope 42 which in any case now has an increased mechanical advantage about the pivot 29. The assembly arrives at the Figure 2 position with the 40 bucket 18 in the load retaining attitude. As the cylinder 35 is unlocked, the bucket 18 moves to its digging attitude C or A.

The operation is repeated by leaning 45 more forwardly each time and by slewing 45 to right and left as required.

When a pile of muck is cleared, the loader is folded to the Figure 6 position and hauled away by the mucking train. In an actual machine with a bucket having 50 0,6 m³ capacity the headroom required in the Figure 2 position is 2,5 metres while the headroom required for travelling is 1,6 metres. The machine can muck up to 1,45 metres to either side of the centre line of 55 the mucking train.

WHAT WE CLAIM IS:—

1. A loader comprising:
a base;
a yoke extending above the base and having 60 uprights spaced apart by a cross-member between the uprights;
a shaft between the uprights;
a dipper arm swinging from the shaft to move to either side of the yoke between 65 the upright and below the shaft;

means to cause the dipper arm to swing between a loading position at a first side of the yoke and an unloading position at the opposite second side of the yoke;
a bucket pivoted to the free end of the 70 dipper arm about a first axis parallel to the shaft; and
means to rotate the bucket about its pivot axis from a digging attitude to a load retaining attitude. 75

2. The loader claimed in claim 1 in which the yoke is pivoted to the base about an axis parallel to the shaft and including means to cause the yoke to move about that axis for the yoke to lean towards its 80 first side.
3. The loader claimed in either of the above claims in which the yoke is slewable about an axis perpendicular to the base.
4. The loader claimed in claim 3 including means to centralise the yoke as the dipper arm moves to its unloading position. 85
5. The loader claimed in any of the above claims including a cam surface co-operating with the bucket so that with the 90 bucket initially in the load retaining attitude at the loading position of the dipper arm, the bucket turns upside down when the dipper arm reaches the unloading position. 95
6. The loader claimed in claim 5 in which the cam surface is carried by the bucket, a flexible element extends from the cam surface to a winch and the axes of the winch and the bucket are so positioned 100 that the bucket turns upside down in the unloading position.
7. A loader comprising:
a base mounted for rotation about a vertical axis;
a hydraulic cylinder to slew the base about the vertical axis; 105
a yoke extending above the base and having uprights spaced apart by a cross-member between the uprights, the uprights being pivoted on the base about a leaning axis;
a shaft extending between the uprights parallel to the leaning axis;
a hydraulic cylinder to cause the yoke to move between an erect and a forward 110 leaning position about the leaning axis;
a dipper arm swinging from the shaft to move to either side of the yoke;
a hydraulic cylinder to cause the dipper arm to swing between a loading position 115 forwardly of the yoke and an unloading position rearwardly of the yoke;
a bucket pivoted to the free end of the dipper arm about a pivot axis parallel to the shaft;
a winch means to cause the bucket to pivot about its pivot axis from a digging attitude to a load retaining attitude; 120
and means to cause the bucket to turn upside down in the unloading position of 130

the dipper arm.

8. The loader claimed in claim 8 including means to centralise the base and to immobilise the slewing cylinder.

5 9. The loader claimed in claim 7 or claim 8 in which the bucket is operated by means of a flexible element extending from a winch wheel mounted eccentrically to the cross-member and around a cammed 10 surface on the bucket, the eccentricity and the shape of the cammed surface being such that in the unloading position the bucket turns upside down.

10. A loader substantially as herein de-

scribed with reference to the accompanying 15 drawings.

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Printed for Her Majesty's Stationery Office by The Tweeddale Press Ltd., Berwick-upon-Tweed, 1981.
Published at the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies
may be obtained.

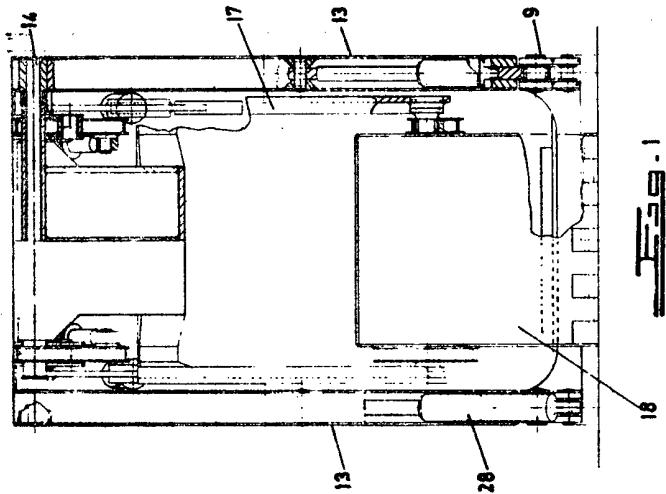
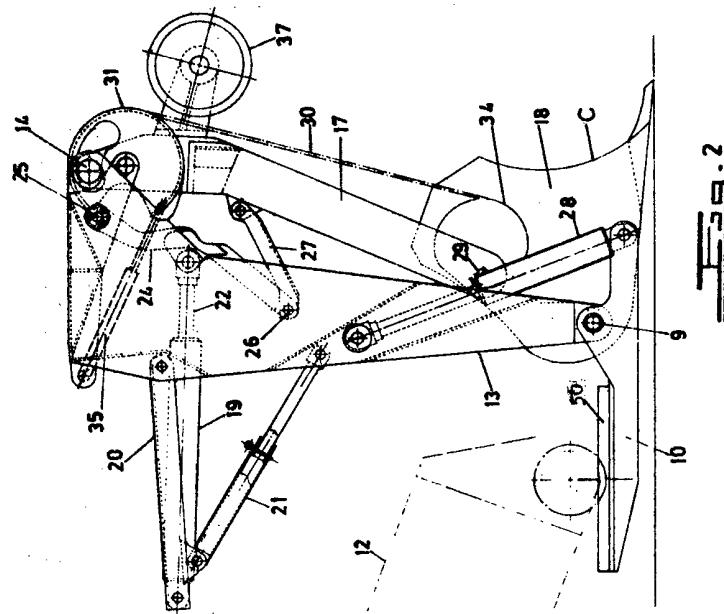
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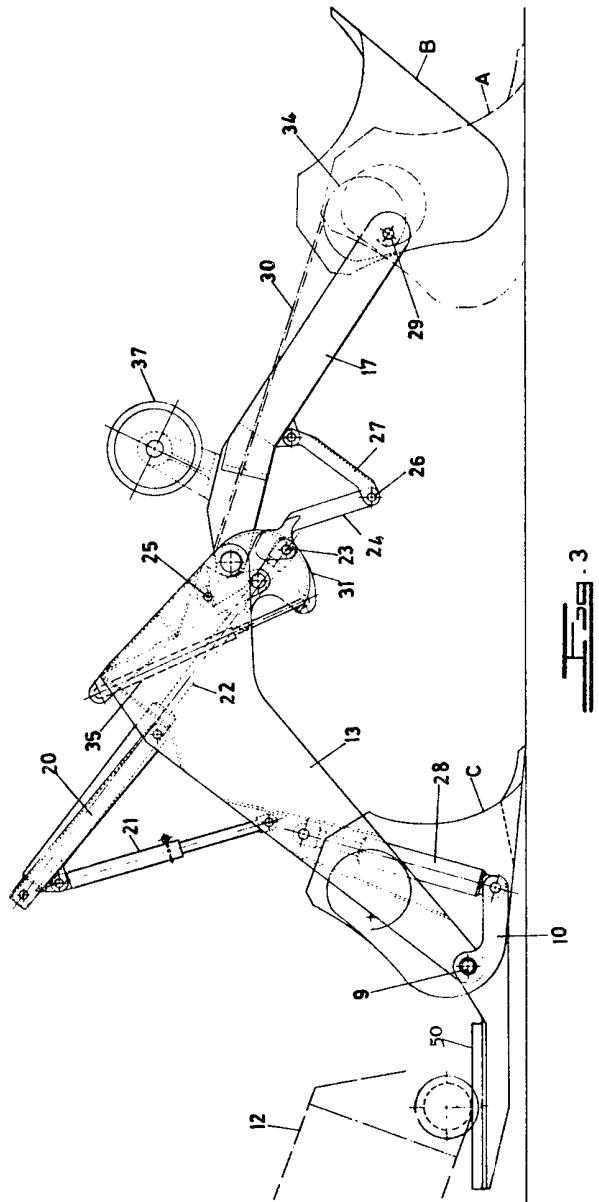
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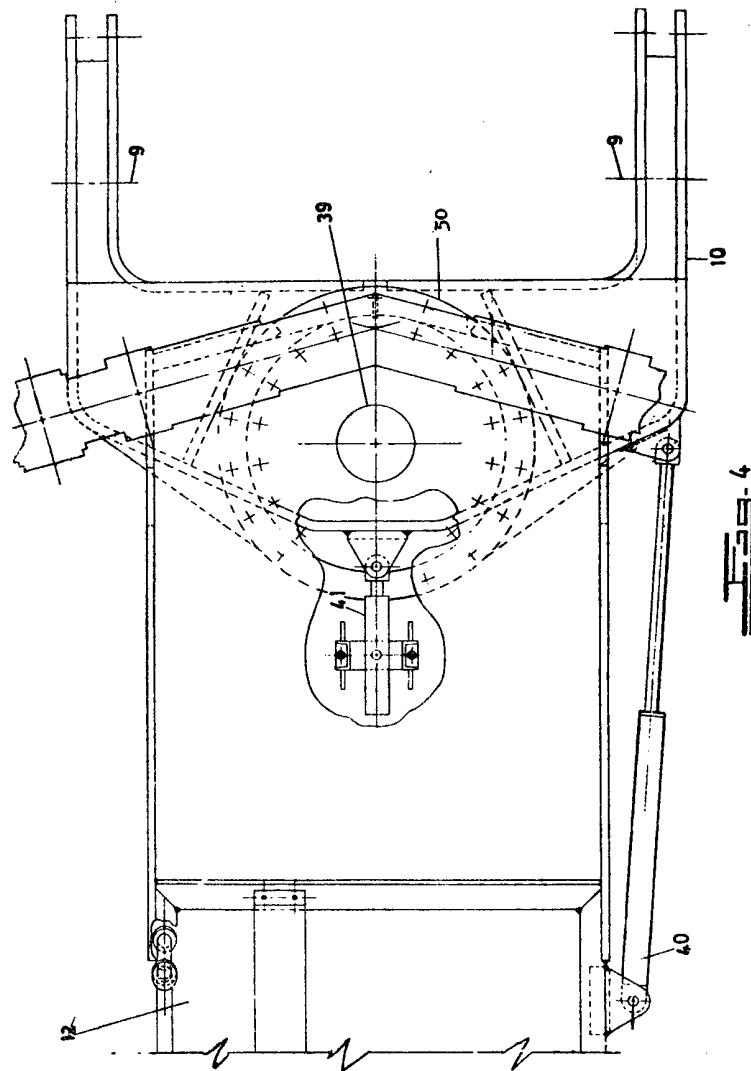
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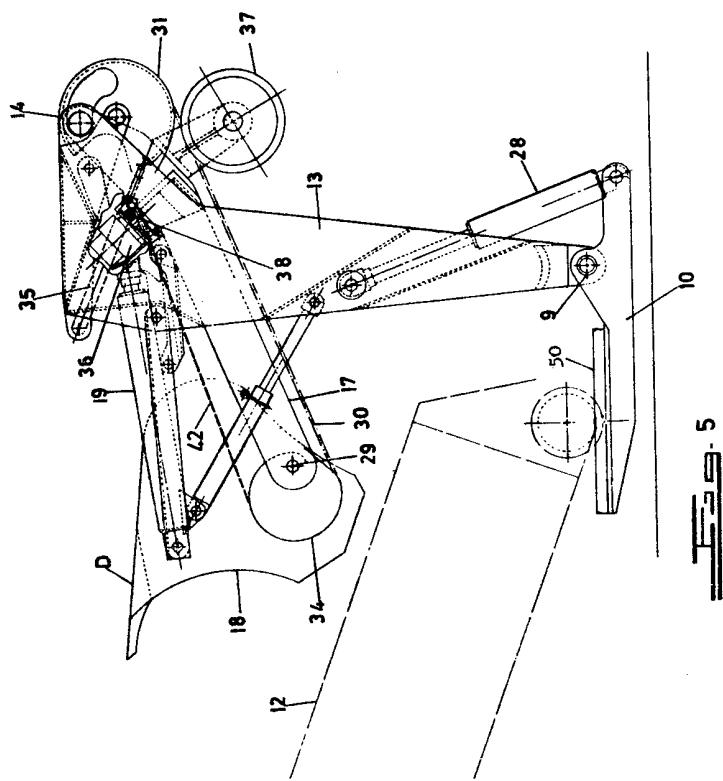


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