

May 3, 1966

K. J. KLEIN ETAL

3,249,168

EXCAVATING MACHINE

Filed Dec. 23, 1963

7 Sheets-Sheet 1

Fig. 1

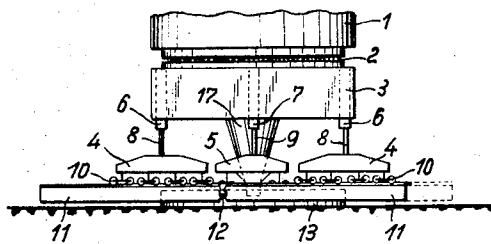


Fig. 2

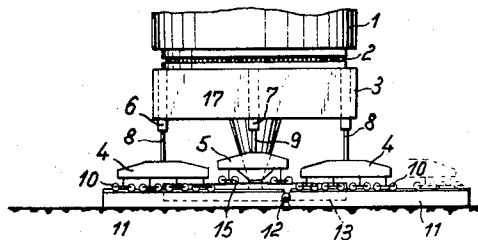
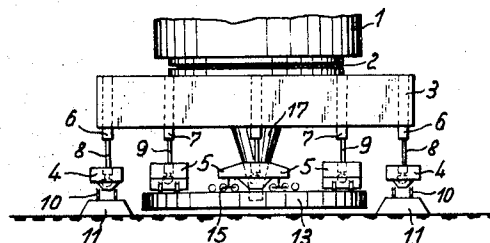


Fig. 3



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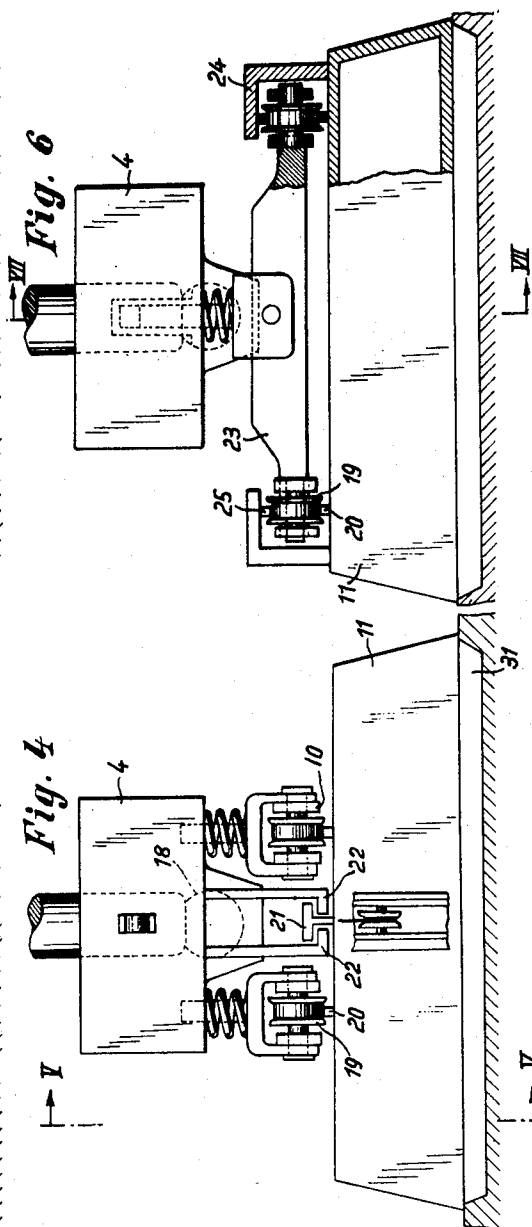
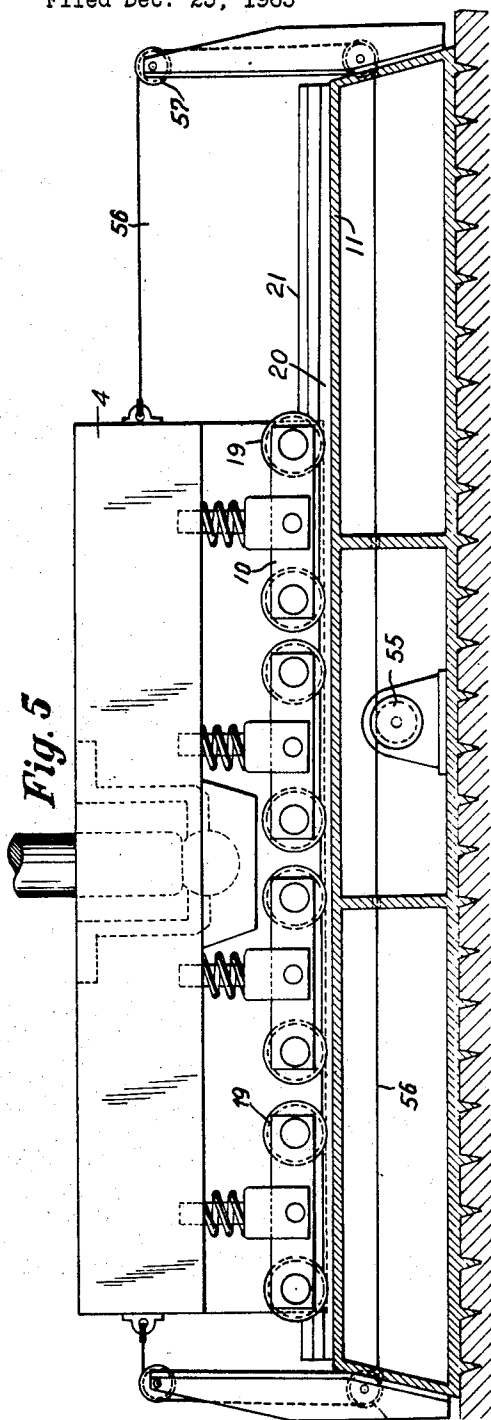
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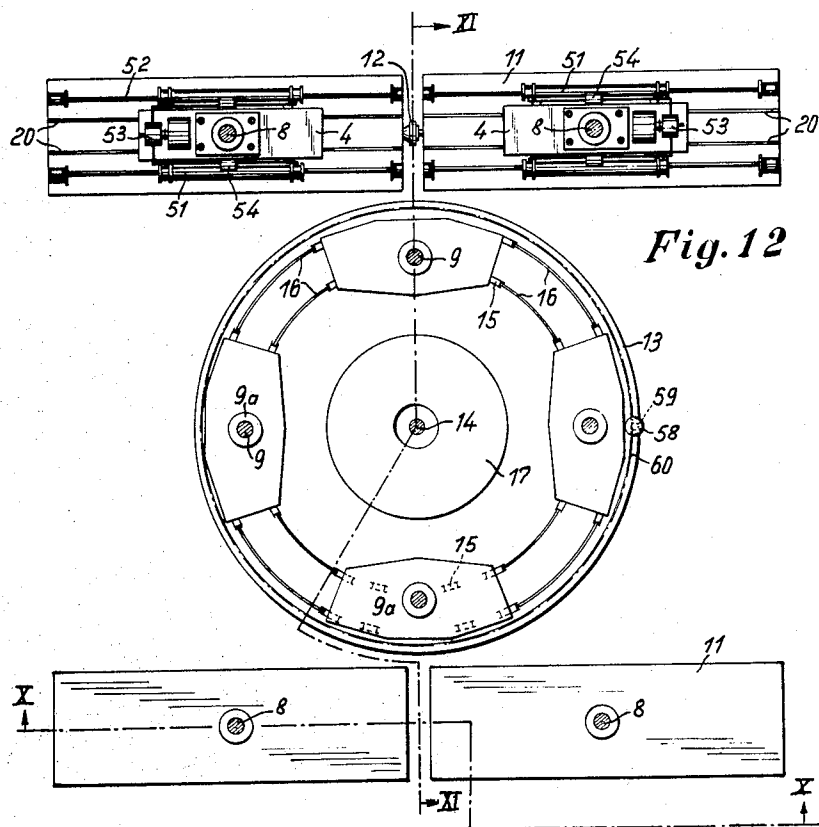
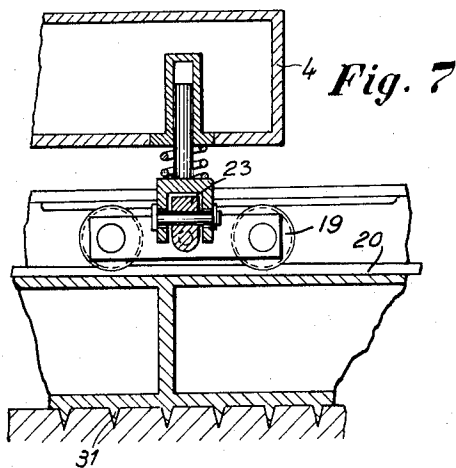
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EXCAVATING MACHINE

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Fig. 8

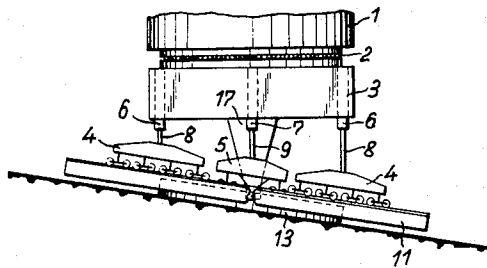
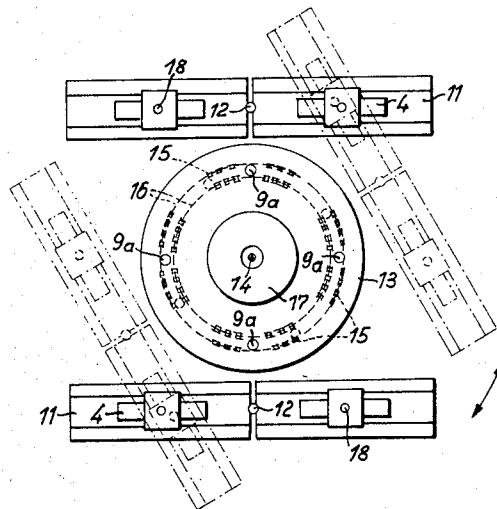


Fig. 9



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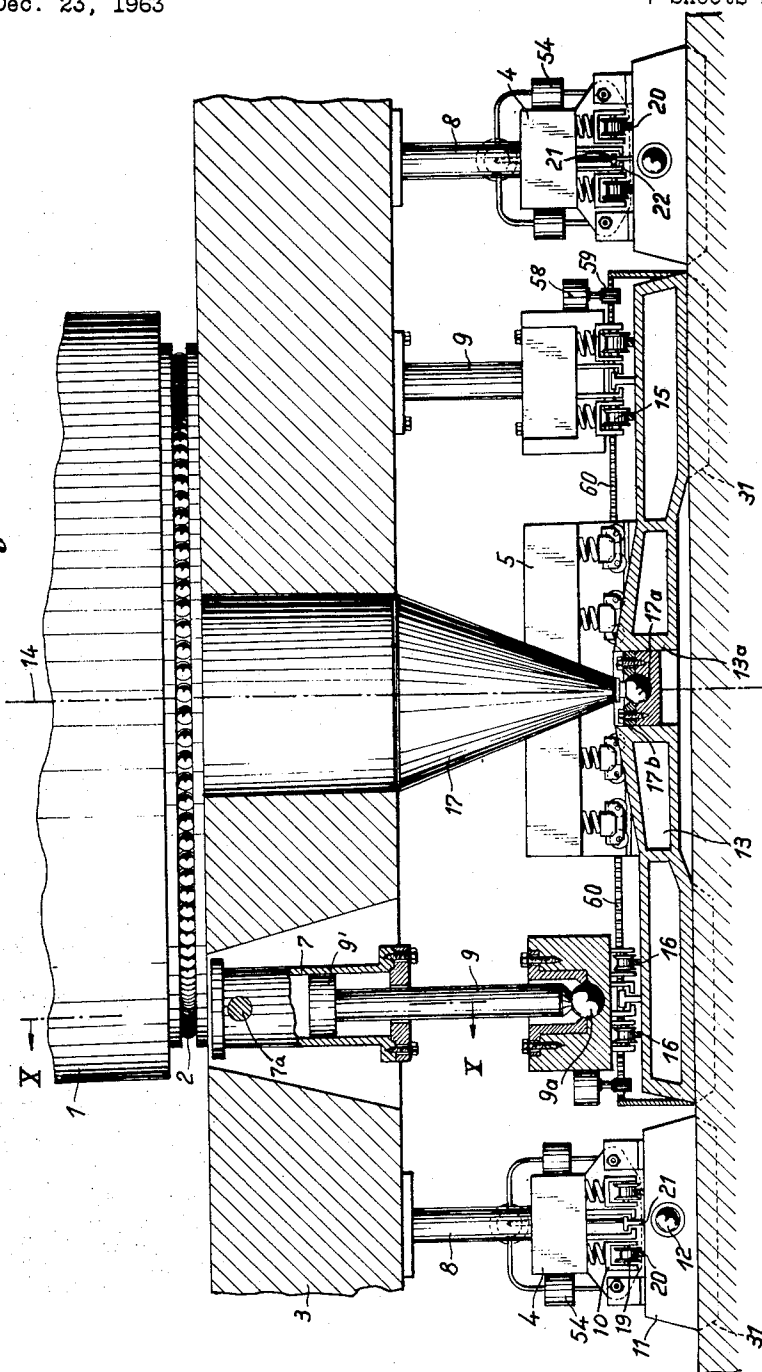
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Fig. 11



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Fig. 14

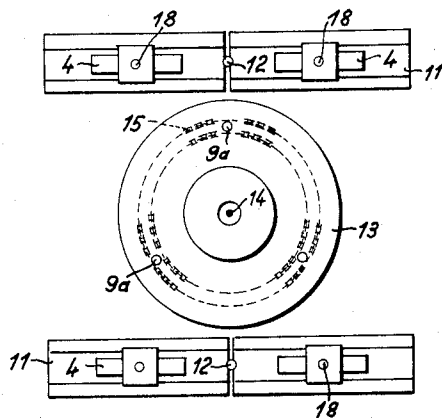


Fig. 15

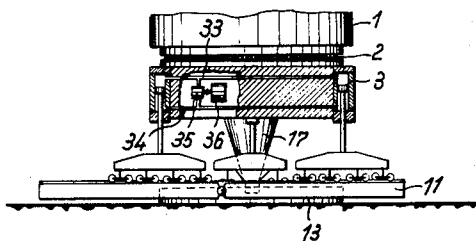


Fig. 13

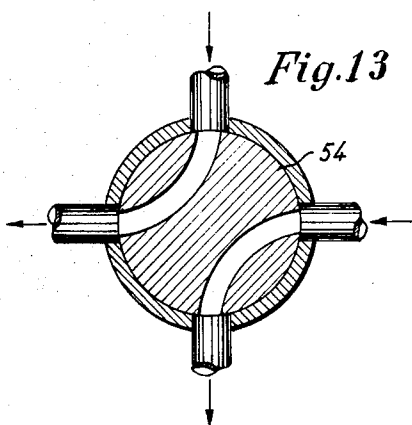
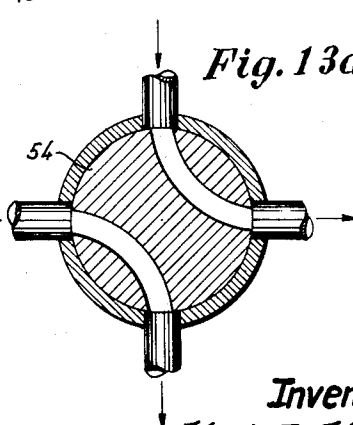


Fig. 13a



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EXCAVATING MACHINE

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Claims priority, application Germany, Dec. 29, 1962, B 70,172/62

7 Claims. (Cl. 180—8)

The present invention relates to an excavating machine with a so-called walking mechanism. It is known to equip surface or open pit mining machines with a so-called walking mechanism instead of full tracks or caterpillars. These walking mechanisms are actuated mechanically or hydraulically and operate in the following manner. With each step, the front portion of the machine frame is lifted by means of feet contacting the ground and is simultaneously moved forward, whereas the rear portion of the machine frame is usually dragged over the ground. The advance of the machine or device is thus brought about by a continuous lifting, tilting and lowering of the machine frame. Such walking mechanisms are not applicable in all instances, especially not for bucket wheel excavators with which the walking operation is intended to be employed for adjusting the excavating or scraping depth. In this instance it is required that the machine advance by means of the walking mechanism practically without changing its location as to height so that the scraping operation will not be interfered with. This requirement has been met by other heretofore known walking mechanisms for excavators. These walking mechanisms comprise two pairs of skid-like tracks on which the excavator understructure is supported alternately by means of circular sector-shaped rollers. While the understructure of the excavator moves on the tracks of one pair of tracks by means of the downwardly directed arched or curved race surface of the rollers, the track skids of the other pair which are lifted off the ground are moved forwardly. Inasmuch as the two track skids arranged on both sides of the machine are spaced from each other by relatively small distances only, with this design of excavators, the two pairs of track skids which approximately are of the same length can be turned relative to each other by a very small angle only. Consequently, the excavator when advancing can move along rather flat curves only.

According to another embodiment of excavators of the general type involved, the track skids of one pair of skids are so short that they can be turned by 360° between the track skids of the other pair. However, as far as the support of the machine on the track skids is concerned, only a correspondingly small supporting base is available. Moreover, with this arrangement the track skids do not easily adapt themselves to rather irregular ground contours and are not suitable for moving over steep inclines.

It is, therefore, an object of the present invention to provide a walking mechanism for excavators and the like which will be able to advance practically without changing its location as to height.

It is another object of this invention to provide an excavator as set forth in the preceding paragraph, which will excel by its steadiness.

Still another object of this invention consists in the provision of an excavator which will be able to move over irregular ground contours with considerable inclines.

These and other objects and advantages of the present invention will appear more clearly from the following specification in connection with the accompanying drawings, in which:

FIGS. 1 and 2 diagrammatically illustrate the walking mechanism of a bucket wheel excavator and, more specifically, show the lower portion of a bucket wheel ex-

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cavator as seen in a direction transverse to its advancing direction with the walking mechanism occupying two different positions in FIGS. 1 and 2 respectively.

FIG. 3 shows the lower portion of the excavator of FIG. 2 but seen in a direction transverse thereto.

FIG. 4 illustrates on a large scale than that of FIG. 3 a part of the structure of FIG. 3 in a face view.

FIG. 5 is the section along the line V—V of FIG. 4.

FIG. 6 is a face view of and a partial section through a different embodiment of a part of the structure of FIG. 3 on a larger scale.

FIG. 7 is the section along the line VII—VII of FIG. 6.

FIG. 8 represents a view corresponding to that of FIG. 1 but with the lower excavator portion moving over a considerable incline.

FIG. 9 is a top view of the two track skids showing in solid lines one position thereof and in dot-dash lines a second position thereof.

FIG. 10 is a partial section through the lower portion of an excavator according to the invention, said section being taken along the line X—X of FIG. 12 and partially according to the line X—X of FIG. 11.

FIG. 11 represents a section taken along the line XI—XI of FIG. 12.

FIG. 12 illustrates a section taken along the line XII—XII of FIG. 10.

FIG. 13 shows a four-way cock in a cross section on a larger scale than in FIG. 10.

FIG. 13a shows the cock of FIG. 13 in another position.

FIG. 14 represents a section corresponding to the section of FIG. 9 but with an excavator having two supporting points on each of the two skid tracks and having three supporting points on a central supporting member.

FIG. 15 illustrates a section through the lower portion of an excavator according to the invention and, more specifically, through the axes of two actuating cylinder piston systems thereof.

The present invention is based on an excavator structure or the like with a walking mechanism comprising two different types of supporting plates which during the advancing movement of the machine alternately rest on and are lifted off the ground. The arrangement is such that for purposes of moving through curves, turning movements can be carried out between the frame of the machine and the supporting plate.

The present invention is characterized primarily in that the machine frame is by means of legs supported by supporting plates which three-dimensionally movably rest on carriages and can be adjusted as to height to adapt themselves to the contour of the ground. This adjusting and lifting operation is preferably effected by means of fluid operable cylinder piston systems.

The invention is furthermore characterized in that it comprises a supporting plate which is arranged substantially below the center of gravity of the machine frame and is equipped with a circular track for the respective carriages in order to permit a turning movement of the machine. Expediently, the supporting plate equipped with the circular track is by means of a centering column, adapted to convey horizontal forces, so connected with the machine frame that the said supporting plate can relative to said centering column carry out movements upwardly and downwardly and also tumbling movements. The legs by means of which the machine frame rests on the supporting plate equipped with said circular track are adapted to carry out pendulum movements radially with regard to the turning center while being able to convey forces in tangential direction. On each side of the machine there may be provided two supporting plates arranged one behind the other and provided with straight tracks. The said supporting plates may be inter-

connected by joints adapted merely to convey transverse and normal forces.

Referring now to the drawings in detail, the upper structure 1 of the excavator rests by means of a ball-supported turntable 2 on the understructure 3 which latter by means of two groups of supporting legs rests on carriages movable on rails of supporting plates. Each of these supporting legs comprises a cylinder 6, 7 connected to the understructure 3, and piston rods 8, 9 which by means of ball joints rest on compensating rockers 4 and 5 of the carriages and by means of pistons 8', 9' are reciprocable in cylinders 6, 7.

The first group of supporting legs has four cylinders 6 (FIG. 10) connected to the understructure 3. The carriages 10 pertaining thereto are movable on straight rails 20 of box-shaped supporting plates 11. On each side of the excavator there are provided two of said supporting plates in series arrangement. These supporting plates are interconnected by a joint 12 which transmits therebetween merely transverse and normal forces.

The other group 7, 9 of four legs rests on a circular supporting plate 13 which is arranged between the two series of supporting plates 11 below the center of gravity of the excavator. The piston rods 9 of this group rest on ball joints 9a forming the corners of a square, said ball joints 9a being mounted on the carriages 15. The said carriages 15 are movable on circular rails 16 which are coaxial with regard to the axis 14 of plate 13. The cylinders 7 pertaining thereto are linked to the understructure 3 of the excavator in such a way that they are able to swing radially toward the axis 14 while being able to convey forces in tangential direction between the carriages 15 and the understructure 3 of the excavator.

From the understructure 3 there extends downwardly a centering column 17 having its axis in alignment with the axis 14. The lower end of said column 17 (see FIG. 11) is by means of a ball 17a connected to a plate 17b which in its turn slidably engages a bore 13a of the supporting plate 13. The arrangement is such that column 17 is able to convey horizontal forces between the understructure 3 of the excavator and plate 13 while permitting movements of plate 13 upwardly and downwardly and also tumbler movements thereof.

In order to assure that when drawing in piston rods 8 and 9, the respective supporting plates 11, 13 will be lifted off the ground, between said plates and the carriages 10, 15 there is provided a connection, for instance of the types shown in FIGS. 4 to 7.

According to FIGS. 4 and 5, the bottom side of the compensating rocker 4 on which the respective piston rod of an understructure rests in a ball joint 18 is provided on the bottom, with the additional smaller rockers 10 carrying wheels 19 arranged along two rows adjacent to each other. These wheels or rollers roll on two rails 20 on supporting plate 11. Interposed between the two rails 20 on plate 11 there is a support 21 of a T-shaped profile. Angle irons 22 extend below the flanges of said T-profile 21, said angle irons 22 being connected to the bottom side of rocker 4.

According to the embodiment diagrammatically illustrated in FIGS. 6 and 7, there are provided two rows of wheels 19 movable on rails 20 and interconnected by means of a transverse rocker 23 pivotally supporting the carriage rocker 4. As will be evident from the drawing, further rails 25 are connected to angle irons 24 extending upwardly from the side edges of the supporting plate 11 in such a way that they extend with slight play above the wheels 19. The straight movement of the excavator is effected in the following manner.

When the excavator occupies the position shown in FIG. 1, the excavator frame 1, 3 rests by means of legs 7, 9 on the circular supporting plate 13, while legs 6, 8 are in retracted position so that the carriages 10 are in lifted position. In view of the above mentioned connection between the carriages and the supporting plates 11,

for instance in conformity with FIGS. 4 to 7, plates 11 are lifted off the ground.

Plates 11 will then be displaced toward the right in any convenient manner so that the flanges of the T-beam or girder 21 will in conformity with FIGS. 4 and 5 slide on the horizontal legs of the angle iron 22, or the rails 25 will in conformity with FIGS. 6 and 7 move on rollers 19. The displacement of the plates 11 is achieved for instance by means of hydraulic cylinders 51 fixed to the rockers 4 the piston rods 52 being attached at the ends of the plates 11. A pump 53 on each rocker 4 delivers oil under pressure selectively to one end or the other of the cylinder 51 according to the positions of a four-way cock 54. Alternatively, the displacement of the plates 11 can be achieved by means of winch 55 installed within the plate 11 (FIG. 5) and a rope 56 fixed to the ends of the rocker 4 and wound around pulleys 57 on the plates 11.

When the supporting plates 11 have been displaced toward the right as far as possible (see dash line position shown in FIG. 1), the said supporting plates 11 are by lowering the piston rods 8 rested on the ground, and the excavator frame will in view of the fluid acting in cylinders 6 from the top upon the respective pistons 8' rest on the carriages 10 and thereby on plates 11. Thereupon, piston rods 9 are pulled in, and through the intervention of the carriages 15 the circular supporting plate 13 is lifted off the ground as shown in FIG. 2. The excavator frame 1, 3 is then by means of carriages 10 moved on supporting plates 11 into the position shown in dash lines in FIG. 2. This cycle may then be repeated as often as desired.

For purposes of turning the excavator about axis 14 thereof, frame 1, 3 rests by means of legs 7, 9 on plate 13 resting on the ground, while the supporting plates 11 are lifted off the ground. For purposes of turning the excavator, the carriages 15 are moved on the circular rails 16 for instance into the position shown in FIG. 9 in dot-dash lines.

In this way it will be possible to turn the excavator on the spot in both directions by 360°. This is achieved by means of motors 58 each fixed to a rocker 5 and driving a gear wheel 59 which meshes with a toothed rim 60 fixed to the plate 13.

As will be evident from FIG. 8, the walking mechanism according to the invention also permits the operation and movement of the excavator on ground with unusually steep inclination, as for instance with the inclination 1:6. In these conditions, the supporting plates 11, 13 adapt themselves to the contour of the ground and, accordingly due to the ball joint connection 18, 9a of the piston rods, 8, 9 with the carriages, the carriages 10, 15 and the rockers 4, 5 will occupy a corresponding position without difficulties. In view of the interconnection of each two straight supporting plates 11 by means of joints 12 which permit relative turning movements of the two plates within certain limits, the peak values of the ground pressure will be reduced when the carriages occupy a rather eccentric position. Since, as mentioned above, cylinders 7 are adapted to carry out a pendulum movement in radial direction with regard to the understructure 3 of the excavator, the adjustment of plate 13 in conformity with the inclination of the ground is likewise effected without any difficulties. To permit cylinder 7 to carry out the referred to pendulum movement, trunnion or pivot pin 10 and means 7a (FIG. 11) may be provided to connect the cylinders near the upper ends thereof with understructure 3. One of the trunnions, as will be seen in FIG. 10, can be availed of for leading hydraulic lines into cylinder 7. Each cylinder 6 and 7 is provided with a control device, comprising a motor 61, a pump 62 and a four-way cock 63 (similar to the four-way cock 54 of FIG. 13). By means of these control devices the piston rods 8, 9 individually may move, and so in each instance it is possible that the piston rods of the various supporting legs will be uniformly loaded, even when the ground has great

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inclination, as indicated for instance in FIG. 8. The understructure of the excavator may in each instance be so supported that also at great inclination of the ground, the turning axis of the excavator will remain vertical.

Expediently, the supporting plates 11 and 13 have their bottom side provided with spikes 31 which under the load acting on plates 11 and 13 are pressed into the ground thereby preventing the plates from slipping on the incline. These spikes are easily pulled out of the ground when the plates 11 and 13 are lifted. In contrast hereto, when employing carriages with caterpillar tracks, corresponding spikes on the bottom plates would greatly impede the advancing movement of the excavator, especially in curves, inasmuch as considerable shearing resistances would have to be overcome which in turn requires considerable energy.

It will thus be appreciated that the arrangement according to the present invention brings about the great advantage over heretofore employed caterpillar equipped carriages for excavators of the type involved that the excavator can operate on considerably steeper inclines while a considerable saving in weight will be obtained. Moreover, a machine according to the present invention excels over heretofore known caterpillar carriages in maneuverability.

With the embodiment illustrated in the drawing, a four-point support is selected with regard to the outer supporting plates 11 as well as the inner plate 13. It is, of course, also possible to select a three-point support for both groups of supporting legs or to select a four-point support for one group of supporting legs and to select a three-point support for the other group of supporting legs. FIG. 14 shows a three-point support 9a on the inner plate 13 and a four-point support 18 on the outer plates 11. The last mentioned support may be converted into a three-point support for instance by interconnecting the cylinders 6 of two legs by compensating conduits 33, 34 to which is connected a control device 35 with a pump 36 (FIG. 15). For purposes of moving the carriages 10 on the supporting plates 11 and for moving the carriages 15 on plate 13, any desired driving means, as for instance winches, chain drives, drive shafts, pinion-rack mechanisms or hydraulic driving means, may be employed.

It is, of course, to be understood that the present invention is, by no means, limited to the particular constructions shown in the drawings but also comprises any modifications within the scope of the appended claims.

What we claim is:

1. An earth working machine, especially excavator, which comprises: a frame structure, first supporting means on opposite sides of the longitudinal axis of said machine for supporting said frame structure, first connecting means connecting said frame structure to said first supporting means and operable selectively to lower said first supporting means to the ground on which said machine is standing and to lift said first supporting means off said ground, said first connecting means including means for permitting movement of said first supporting means and said frame structure relative to each other in the direction of the longitudinal axis of said machine, means operatively connected to said first supporting means and said frame structure for effecting relative movement thereof in the direction of the longitudinal axis of said machine, second supporting means arranged between said first supporting means and below the center of gravity of said frame structure, said second supporting means including circular track means and being movable upwardly and downwardly independently of said first supporting means, carriage means movable on said track means and operatively connected to said track means for upward and downward movement with said second supporting means, and second connecting means connected on one hand to said frame structure and on the other hand to said carriage means for selectively and independently of said first connecting means lifting said second supporting means off the ground

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on which said machine is standing or to lower said second supporting means thereonto.

2. An earth working machine according to claim 1, in which said first and second connecting means include fluid operable cylinder piston means having one member thereof connected to said frame structure and having another member connected by universal joint means to the respective supporting means pertaining thereto.

3. An earth working machine according to claim 2, in which said cylinder piston means pertaining to said second connecting means is pivotally connected to said frame structure.

4. An earth working machine according to claim 1, which includes a plurality of first connecting means arranged one behind the other in longitudinal direction of the machine and operable independently of each other, and which also includes adjusting means for respectively arresting said first connecting means in different positions to thereby permit said first supporting means to adapt themselves to an incline while maintaining said frame structure in a substantially horizontal position.

5. An earth working machine, especially excavator, which comprises: a frame structure, first supporting means on opposite sides of the longitudinal axis of said machine for supporting said frame structure, first connecting means connecting said frame structure to said supporting means and operable selectively to lower said first supporting means to the ground on which said machine is standing and to lift said first supporting means off said ground, said first connecting means including means for permitting movement of said first supporting means and said frame structure relative to each other in the direction of the longitudinal axis of said machine, means operatively connected to said first supporting means and said frame structure for effecting relative movement thereof in the direction of the longitudinal axis of said machine, second supporting means arranged between said first supporting means and below the center of gravity of said frame structure, said second supporting means including circular track means and being movable upwardly and downwardly independently of said first supporting means, carriage means movable on said track means and operatively connected to said track means for upward and downward movement with said second supporting means, second connecting means connected on one hand to said frame structure and on the other hand to said carriage means for selectively and independently of said first connecting means lifting said second supporting means off the ground on which said machine is standing or to lower said second supporting means thereonto, a centering column having one end connected to said frame structure, and universal joint means connecting the other end of said centering column with said second supporting means for conveying horizontal forces from said frame structure to said second supporting means while permitting the latter to move in any direction relative to said centering column.

6. An earth working machine according to claim 1 in which said second supporting means is connected to said frame structure by a plurality of second connecting means arranged along a circle, and in which said second connecting means are pivotally connected to said frame structure and are connected to said second supporting means by universal joint means for permitting a pendulum movement of said second connecting means in radial direction with regard to said circle, said second connecting means being operable to convey forces to said second supporting means in tangential direction with regard to said circle.

7. An earth working machine, especially excavator, which includes: a frame structure, two first supporting means respectively arranged on opposite sides of the longitudinal axis of said machine, each of said first supporting means comprising two longitudinal supporting members arranged one behind the other and extending in the direction of the longitudinal axis of said machine, each of said first supporting means also including joint means

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interconnecting said longitudinal supporting members pertaining thereto for conveying only forces acting transversely and normally upon said supporting members, first connecting means connecting said frame structure to said first supporting means and operable selectively to lower said first supporting means to the ground on which said machine is standing and to lift said first supporting means off said ground, said first connecting means including means for permitting movement of said first supporting means and said frame structure relative to each other in the direction of the longitudinal axis of said machine, means operatively connected to said first supporting means and said frame structure for effecting relative movement thereof in the direction of the longitudinal axis of said machine, second supporting means arranged between said first supporting means and below the center of gravity of said frame structure and including circular track means and being movable upwardly and downwardly independently of said first supporting means, carriage means mov-

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able on said track means and operatively connected to said track means for upward and downward movement with said second supporting means, and second connecting means connected on one hand to said frame structure and on the other hand to said carriage means for selectively and independently of said first connecting means lifting said second supporting means off the ground on which said machine is standing or to lower said second supporting means thereonto.

References Cited by the Examiner

UNITED STATES PATENTS

1,615,055	1/1927	Turner	180—8
2,132,184	10/1938	Poche	180—8
2,660,253	11/1953	Davidson	180—8
2,785,761	3/1957	Becker	180—8

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