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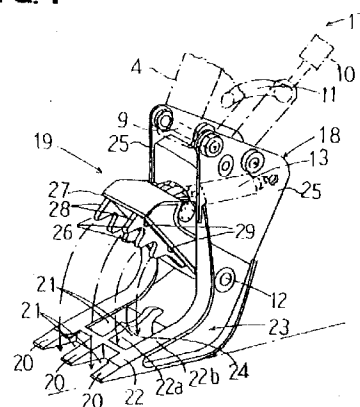
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(54) Machine for removing and breaking pavement

(57) A machine 17 for removing and breaking pavement with subdividing function is provided. The machine includes an upper jaw 19 and a lower jaw 18 attached to the forward end of an arm 4. The upper jaw and lower jaw are connected together by means of a pin for open-close movement relative to one another. The lower jaw 18 is moved in the vertical direction by means of a cylinder 10 attached to the arm 4. The upper jaw 19 is moved by a cylinder 13 connected between the lower jaw 18 and the upper jaw 19 for open-close movement. The lower jaw 18 includes plurality of removing blades 20 at the forward end thereof, and a plurality of breaking bores 21 adjacent to the forward end thereof. The upper jaw 19 includes a plurality of breaking blades 26 disposed opposite to the respective breaking bores 21. The breaking blades 26 are engaged into the respective breaking bores 21 so as to break a pavement material.

FIG. 1



- | | |
|-------------------------------------|---|
| 4 arm | 17 machine for removing and breaking pavement |
| 9 pin | 18 lower jaw |
| 10 cylinder for actuating lower jaw | 19 upper jaw |
| 12 pin | 20 removing blade |
| 13 cylinder for actuating upper jaw | 21 breaking bore |
| | 26 breaking bore |

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention:

This invention relates to a machine for removing and breaking pavement such as a layer of concrete or asphalt. More particularly, the invention relates to a machine for removing pavement of a road from the ground and breaking the same into small pieces.

2. Prior Art:

It is a conventional practice, in order to break up a roadbed paved, for example, with concrete for repairing a road, that an operator uses a rock drill to give vibrations to the pavement (for example, concrete layer). By this, the pavement is broken into small pieces. Such small pieces are then loaded into a large truck by means of a loader, for example. It is noted, however, that the use of such a rock drill causes vibration pollution and/or noise pollution to residents around the construction site. Furthermore, the conventional operation for removing a pavement is time consuming and inefficient.

In order to eliminate the above problems, a machine for removing and breaking pavement has been developed recently and is used for road repairing. The machine is capable of removing a pavement from the roadbed and breaking it into small pieces.

Fig. 7 shows one example of such machines for removing and breaking pavement as disclosed, for example, in Japanese Patent Public Disclosure No. 05-339908 (KOKAI No. HEISEI 5-339908). The machine includes a pivotable arm 4 pivotably connected to the forward end of a boom 3 of a working machine 2 extending therefrom for pivotable movement in the vertical direction. The machine for removing and breaking pavement also includes an upper jaw 6 and a lower jaw 5 attached to the forward end of the pivotable arm 4 for open-close movement relative to one another. The boom 3 may be pivoted in the vertical direction by means of a hydraulic cylinder 7. The pivotable arm 4 may be pivoted in the front and rear direction by means of a hydraulic cylinder 8 attached to the boom 3.

The lower jaw 5 is pivotably connected at its rearward end, to the forward end of the pivotable arm 4 by means of a pin 9. The rearward end of the lower jaw 5 is connected, through a linkage 11, to the forward end of a piston rod 10a of a hydraulic cylinder 10 attached to the pivotable arm 4. The lower jaw 5 is moved by the hydraulic cylinder 10 about the pin 9 in the vertical direction.

The upper jaw 6 is connected, at its rearward end, to the substantially mid-point of the lower jaw 5 by means of a pin 12. The upper jaw 6 is disposed opposite to the forward end portion of the lower jaw 5 for pivotable movement (open-close movement) about the pin 12. The open-close movement of the upper jaw 6 relative to the

lower jaw 5 is caused by a hydraulic cylinder 13 disposed between the upper jaw 6 and the lower jaw 5.

The lower jaw 5 includes a removing pawl 14, having sharp tip, at the forward end thereof, and a receiving bore 15 adjacent to the forward end thereof, as shown in Fig. 8. The upper jaw 6 includes a breaking blade 16 in the lower surface thereof. The breaking blade 16 is disposed opposite to the receiving bore 15 of the lower jaw 5 so as to be fitted into the receiving bore 15.

The machine for removing and breaking pavement is adapted to cause the removing pawl 14, having a sharp tip, at the forward end of the lower jaw 5 to be urged against the surface of a pavement, or to cause the upper jaw 6 and the lower jaw 5 to clamp a torn-up end of the pavement therebetween, so as to break the pavement into pieces. This is accomplished by appropriately driving the hydraulic cylinder 10 for actuating the upper jaw 6 and the lower jaw 5 at the forward end of the pivotable arm 4 in the vertical direction, or by appropriately driving the hydraulic cylinder 13 for actuating the upper jaw 6 to be openably closed.

Specifically, and during road repairing operation the removing pawl 14, having a sharp tip, at the forward end of the lower jaw 5 is forcibly inserted between the pavement a and the roadbed b for performing pavement tearing-up operation, as shown in Fig. 9 (a) to (c). The torn-up end c of the pavement a may be clamped between the upper jaw 6 and the lower jaw 5, as shown in Fig. 9 (d). Then, the torn-up end c of the pavement a as clamped between the upper jaw 6 and the lower jaw 5 may be broken into pieces (breaking operation), as shown in Fig. 7.

As explained in the above, the machine for removing and breaking pavement 1 includes the single removing pawl 14, having a sharp tip, at the forward end of the lower jaw 5. The forward end of the removing pawl has a width of about 400 mm. Such machine is suitable to be used in an operation for removing a portion of the pavement, for example, when replacing electric poles. It is noted, however, that such machine is not suitable for road repairing operation in which the entire pavement is repaired for the reason below.

When a portion c of the pavement is clamped between the upper jaw 6 and the lower jaw 5 and broken thereby, the portion c of the pavement is broken solely by the lower surface of the breaking blade 16 disposed above the receiving bore 15. Thus, the portion of the pavement is only reduced, in its width, to at most one-half to one-third. Accordingly, when the pavement, for example of concrete, having been torn up from the roadbed and broken into pieces is loaded into a dump truck, the pieces of pavement present a relatively large space or void (i. e., low bulk density). This prevents a dump truck to be loaded to a full load capacity. It is therefore necessary for the pieces of pavement c to be crushed by the machine in plural stages or crushed by a separate apparatus for breaking concrete material.

The lower jaw 5 has a bottom surface of a curved

configuration. This causes the forward end of the removing pawl 14 to be lifted from the surface of the roadbed by the amount of m (Fig. 8) and is not fixed at a certain height. Thus, it is difficult for the removing pawl 14 to be inserted between the pavement and the roadbed in a horizontal direction.

The removing pawl 14, having a sharp tip, of the lower jaw 5 and the breaking blade 16 of the upper jaw 6 tend to be worn out during use. They must be severed or cut by means of a welding machine for replacement with new ones. This requires cumbersome procedures.

SUMMARY OF THE INVENTION

It is therefore one object of the invention to provide a removing and breaking pavement of a open-close jaw type which is capable of efficiently subdividing pavement pieces, and uniformly removing the pavement from a roadbed, so as to improve subdividing operation for pavement pieces, prevent formation of irregularity in the surface of the roadbed, and eliminate difficulties during replacement of removing pawl and the breaking blade experienced with prior art machine for removing and breaking pavement of a open-close jaw type.

It is another object of the invention to provide a machine for removing and breaking pavement which permits easy replacement of the removing pawl and the breaking blade.

In order to achieve the above object, the invention provides a machine for removing and breaking pavement comprising a lower jaw connected to the forward end of the arm of a working machine by means of a pin for vertically swingable movement, an upper jaw connected to the lower jaw by means of a pin for open-close movement relative to the lower jaw, a hydraulic cylinder for moving the upper jaw, together with the lower jaw, in the vertical direction, and a hydraulic cylinder for moving the upper jaw relative to the lower jaw. The lower jaw includes a plurality of removing pawls at the forward end thereof, and a plurality of breaking bores disposed adjacent to the forward end of the lower jaw. The upper jaw includes a plurality of breaking blades arranged in opposed relationship with the respective breaking bores. The plurality of breaking blades are engaged in the respective breaking bores, so as to break a pavement material clamped between the upper jaw and the lower jaw.

The forward end portion of the lower jaw has a substantially flattened lower surface.

The removing pawls are removably connected to the forward end portion of the lower jaw.

The plurality of breaking blades are adapted to be connected, at their base portions, to the upper jaw by means of bolts.

OPERATION

A pavement material removed from a roadbed is flexed and broken into pieces of a predetermined size by

means of the cooperating plural breaking bores and plural breaking blades. The forward end portions of the removing pawls are prevented from moving upwardly from the roadbed when they are urged against the surface of the roadbed in order to remove the pavement from the roadbed, since the lower surface of the forward end portion of the lower jaw is flattened. This permits uniform removal of the pavement. The removing pawls of the lower jaw and the breaking blades of the upper jaw upon wearing thereof may be easily replaced with new ones, without relying upon a welding machine.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view showing the main construction of a machine for removing and breaking pavement according to the invention;

Fig. 2 is a side elevational view illustrating one operational example of the machine for removing and breaking pavement of Fig. 1;

Fig. 3 is a side elevational view illustrating another operational example of the machine for removing and breaking pavement of Fig. 1;

Fig. 4 is a perspective view of an alternative embodiment of the upper blades mounted a plate member;

Fig. 5 is a side elevational view of another embodiment of the upper blade;

Fig. 6 is a side elevational view an alternative embodiment of the removing blade to be attached to the lower jaw;

Fig. 7 is a side elevational view illustrating the construction of one example of a machine for removing and breaking pavement in prior art;

Fig. 8 is a perspective view illustrating a main construction of Fig. 7; and

Fig. 9 illustrates, in side elevational view, operational examples of the prior art machine for removing and breaking pavement

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Several embodiments of the invention will be explained below with reference to Figs. 1 through 6.

A machine for removing and breaking pavement 17 includes an upper jaw 19 and a lower jaw 18 connected to the forward end of the pivotable arm 4 of the working machine 2 shown in Fig. 17. The upper jaw 19 and the lower jaw 18 are connected, by means of a pin, so as to be pivoted relative to one another (open-close move-

ment). A mechanism for driving the upper jaw 19 and the lower jaw 18 in the vertical direction is similar to that of the machine for removing and breaking pavement 1 shown in Fig. 7. Thus, the components the same as those of the machine of Fig. 7 are designated by the same reference numerals.

The lower jaw 18 is pivotably connected to the forward end of the pivotable arm 4 by means of a pin 9. The lower jaw 18 is pivoted, in a vertical plane, by means of a hydraulic cylinder 10 attached, one end thereof, to the pivotable arm 4, and a linkage 11. The upper jaw 19 is connected, at its rearward end, to the lower jaw 18 at the mid-point thereof by means of a pin 12, so as to be pivoted in a vertical plane. The vertically pivotable movement (open-close movement) of the upper jaw 19 is performed by a hydraulic cylinder 13 connected between the upper jaw 19 and the lower jaw 18.

The machine for removing and breaking pavement 17 according to the invention is basically different from the prior art machine for removing and breaking pavement 1 by the construction of the upper jaw 19 and the lower jaw 18 attached to forward end of the pivotable arm 4.

The lower jaw 18 includes a plurality of removing blades (three removing blades in the illustrated embodiment) 20, having a sharp tip, at the forward end thereof. The removing blades 20 are arranged in parallel and spaced a predetermined distance from one another. The lower jaw 18 also includes plural rows of breaking bores (two rows of breaking bores in the illustrated embodiment) 21 of a predetermined size. The forward end of each of the rows of breaking bores 21 are opened. The removing blades 20 are integrally attached to the forward end of a grating body 23 consisting of partition walls 22 arranged in a latticed fashion. Two rows of breaking bores 21 of a rectangular configuration are formed between the three rows of removing blades 20 and the partition walls 22 and extend therethrough in the vertical direction. The central partition wall 22a extending in the forward and rearward direction has a rearward end portion having a thickness slightly larger than that of the opposite partition walls 22b. The rearward end portion of the central partition wall 22a has, in the upper surface thereof, a protrusion 24 having an upper surface raised upwardly relative to the upper surface of the opposite partition walls 22b. The grating body 23 has a flat lower surface. The grating body 23 is disposed between a pair of left-hand and right hand side plates 25 partly constituting the lower jaw 18 and integrally attached to them at the forward end portions thereof. The lower surface of the forward end portion of the lower jaw 18 is flat and flushed with the lower surface of the grating body 23. The lower surface of the rearward end portion of the lower jaw 18 is curved upwardly in L-shaped configuration.

The upper jaw 19 includes, in the lower surface thereof, breaking blades 26 disposed oppositely to the respective breaking bores 21. The breaking blades 26 are formed by a pair of blade plates 28 welded to a plate

member 27 and arranged in parallel relationship with each other. Specifically, the breaking blades 26 are formed by three peaks of each of the blade plates 28. The plate member 28 is secured to the lower surface of the upper jaw 19 by means of screw means.

The machine for separating and breaking pavement 17 is adapted to remove a pavement material from a roadbed and to break the pavement material into pieces when the upper jaw 19 and the lower jaw 18 are appropriately raised or lowered and/or opened or closed by the actuation of the hydraulic cylinder 10 for moving the lower jaw in the vertical direction and the hydraulic cylinder 13 for moving the upper jaw in the vertical direction in a manner similar to that shown in Fig. 9.

For example, when the hydraulic cylinder 10 is actuated to cause the lower jaw 18 to be pivoted about the pin 9, the lower jaw 18 is rotated about the rearward end thereof as a supporting point O in the direction indicated by the solid line, as shown in Fig. 2. This causes the removing pawls 20 at the forward end of the lower jaw 18 to be raised by an angle of theta degrees. By this, a portion c of the pavement material is separated from the remaining portion of the pavement in a manner similar to that shown in Fig. 9 (c). Then, the hydraulic cylinder 10 is actuated in the opposite direction so as to cause the lower jaw 18 to be pivoted about the rearward end thereof as a supporting point O, as shown by the dotted line in Fig. 2, to the original horizontal position. The sharp tip of each of the removing blades 20 will not be raised upwardly from the upper surface of the roadbed, since the lower surface of the lower jaw 18 is flat. When the machine is moved horizontally to the left when viewed in Fig. 2, the pavement material will be removed from the roadbed in a flat state.

When it is intended to break the pavement material c having been removed from the roadbed, the hydraulic cylinder 18 is actuated so as to cause the upper jaw 19 to be pivoted about the pin 12, as shown in Fig 3. Thus, the pavement material c (not shown) is clamped between the upper jaw 19 and the lower jaw 18. The hydraulic cylinder 13 is further actuated so as to move the upper jaw 19 toward the lower jaw 18. By this, the plural rows of breaking blades 26 of the upper jaw 19 are fitted into the respective one of the plural rows of breaking bores 21. As a result, the pavement material c is broken at plural points into small pieces of pavement material d.

In this regard, it should be noted that the pavement material c is first broken by the protrusion 24, to which breaking force is centralized, formed in the central partition wall 22a of the lower jaw 18. Then, the pavement material c is broken into small pieces by means of the breaking blades 26.

Fig. 4 shows an alternative embodiment of the breaking blades 26 to be attached to the lower surface of the upper jaw 19. The breaking blades 30 of this embodiment are arranged on a plate member 27 in plural rows so as to correspond to the respective rows of breaking bores 21 of the lower jaw 18. The plate member 28

is adapted to be removably connected to the upper jaw 19 by means of screws.

Each of the breaking blades 30 includes, as shown in Fig. 5, a conical member 31 having round tapered end, and bolt 32 by which the breaking blade 30 is threadingly connected to the plate member 27. The breaking blades 30, when worn out during road repairing operation, may be replaced with new ones by releasing or unscrewing the respective bolts 32 and removing them from the plate member 27.

Fig. 6 shows another embodiment of the removing blades 20 to be disposed at the forward end of the lower jaw 18. The removing blades 33 of this embodiment is of a triangular hollow configuration. This configuration permits the removing blades 33 to be replaceably attached to the forward ends of the grating body 23.

Specifically, the removing blade 33 includes a pawl body 34, having a sharp tip, and a mount portion 35 attached to the rearward end of the pawl body 34. A bolt hole 36 is formed in the mount portion 35. Although not specifically illustrated in the drawing, the mount portion 35 of the removing blade 33 is adapted to be tightly fitted over the forward end of the grating body 23 and to it by means of a bolt to threaded into the bolt hole 36. Thus, the removing blade 33, upon worn out, may be easily replaced with new one.

In the above embodiment, the upper jaw 19 and the lower jaw 18 are connected to pivotable arm 4 of the working machine 2. It is noted, however, that, when the machine according to the invention is only used to remove a pavement from the roadbed and resulting pieces of pavement material are treated by a shovel car, it is unnecessary for the arm to be pivoted. In such a case, the upper jaw 19 and the lower jaw 18 may be directly connected to the boom 3 of the working machine 2.

ADVANTAGE OF THE INVENTION

As explained in the above, and in accordance with the invention, a pavement material may be clamped between the plural rows of breaking blades of the upper jaw and the plural rows of breaking bores of the lower jaw and broken into pieces. Thus, the pavement material may be broken into small pieces by a single open-close operation of the jaws. Such small pieces have a relatively high bulk density, so that they may be loaded into a truck to its full loading capacity. The machine of the invention also permits easy replacement of the removing blades and breaking blades. The machine of the invention also permits a pavement to be uniformly removed from a roadbed.

Claims

1. A machine for removing and breaking pavement comprising:
 - a lower jaw connected, by means of a pin, to

the forward end of an arm extending from a working machine for movable in a vertical plane,

the lower jaw including plural rows of removing pawls at the forward end thereof, and plural rows of breaking bores adjacent to the forward end thereof;

an upper jaw connected, by means of a pin, to the lower jaw so as to be moved toward and away from the lower jaw;

the upper jaw including plural rows of breaking blades arranged in opposed relationship with the respective rows of breaking bores;

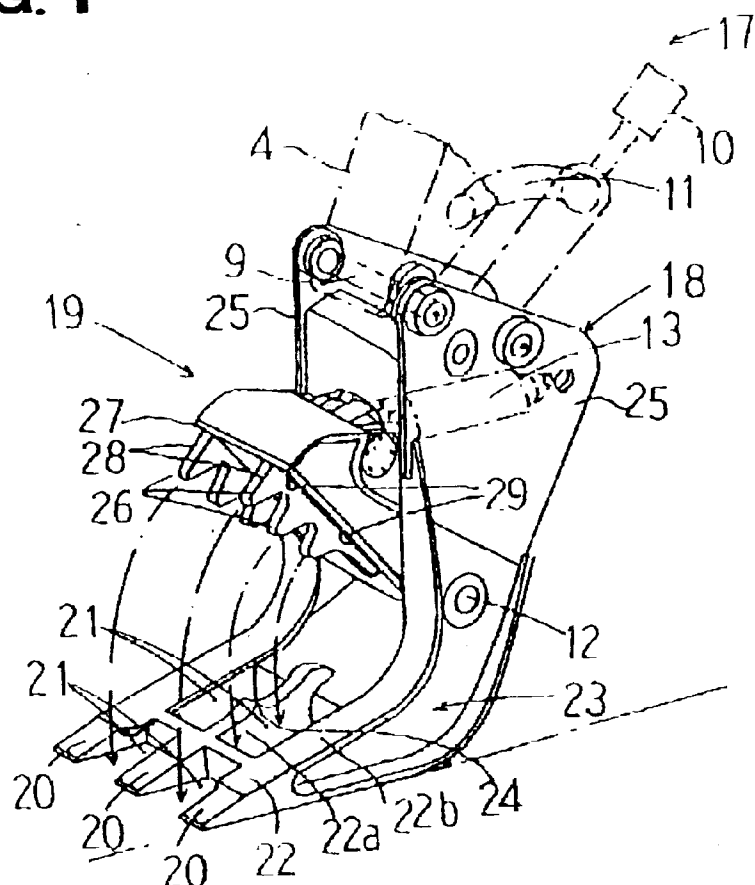
a first cylinder connected the lower jaw and the arm so as to cause the upper jaw, together with the lower jaw, to be pivoted in a vertical plane; and

a second cylinder for causing the upper jaw to be pivoted relative to the lower jaw;

whereby a pavement material may be clamped between the upper jaw and the lower jaw and broken into pieces.

2. A machine for removing and breaking pavement according to Claim 1, wherein the lower jaw includes a forward end of which lower surface is flat.
3. A machine for removing and breaking pavement according to Claim 1, wherein the removing pawls are replaceably connected to the forward end of the lower jaw.
4. A machine for removing and breaking pavement according to Claim 1, wherein each of the plural rows of breaking blades includes, at its base portion, a bolt having a thread, so that it may be threadingly connected to the upper jaw.

FIG. 1



- | | |
|-------------------------------------|---|
| 4 arm | 17 machine for removing and breaking pavement |
| 9 pin | 18 lower jaw |
| 10 cylinder for actuating lower jaw | 19 upper jaw |
| 12 pin | 20 removing blade |
| 13 cylinder for actuating upper jaw | 21 breaking bore |
| | 26 breaking bore |

FIG. 2

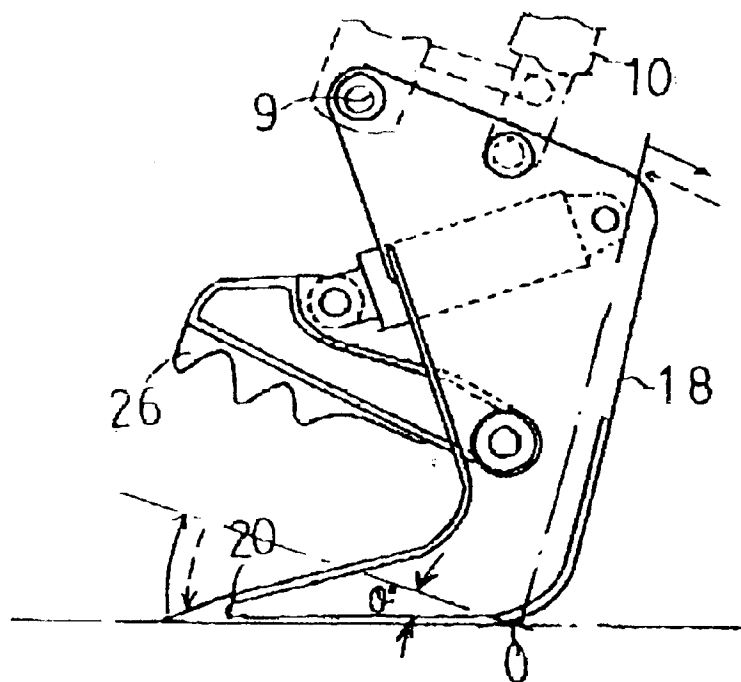


FIG. 3

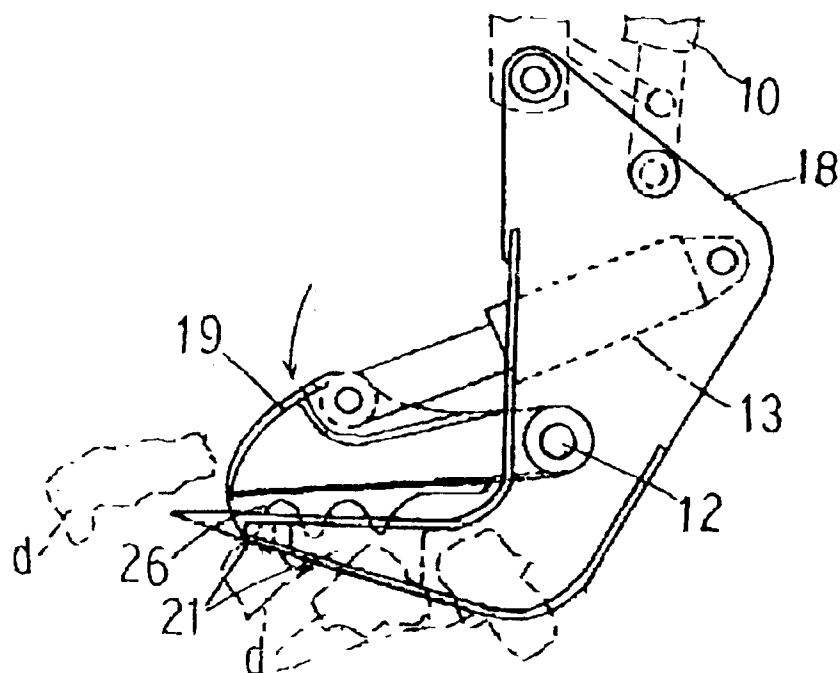


FIG. 4

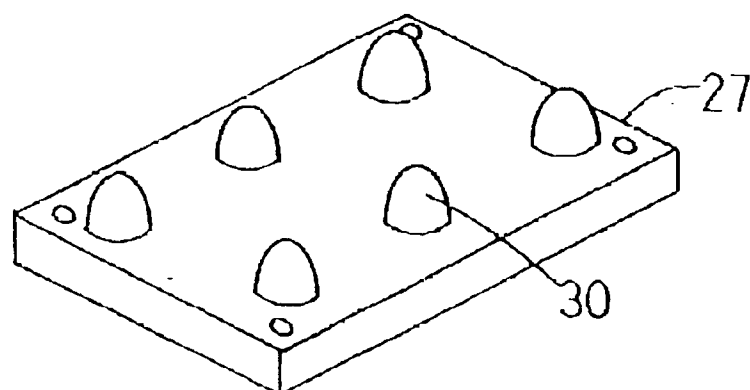


FIG. 5

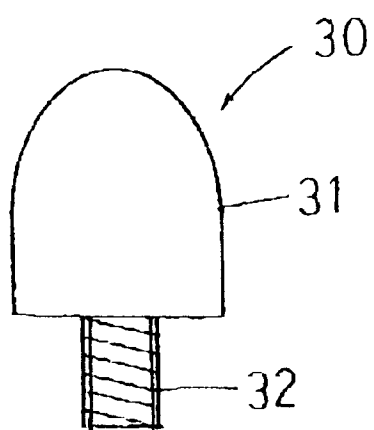


FIG. 6

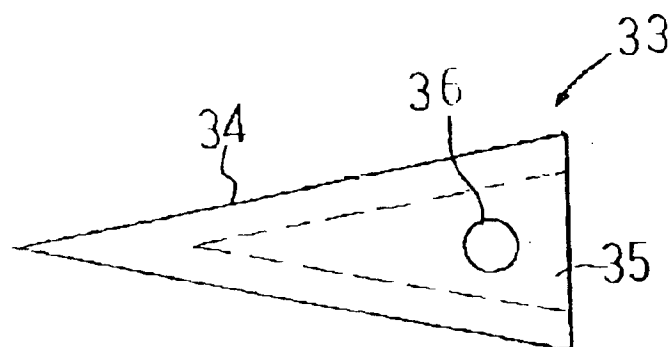


FIG. 7

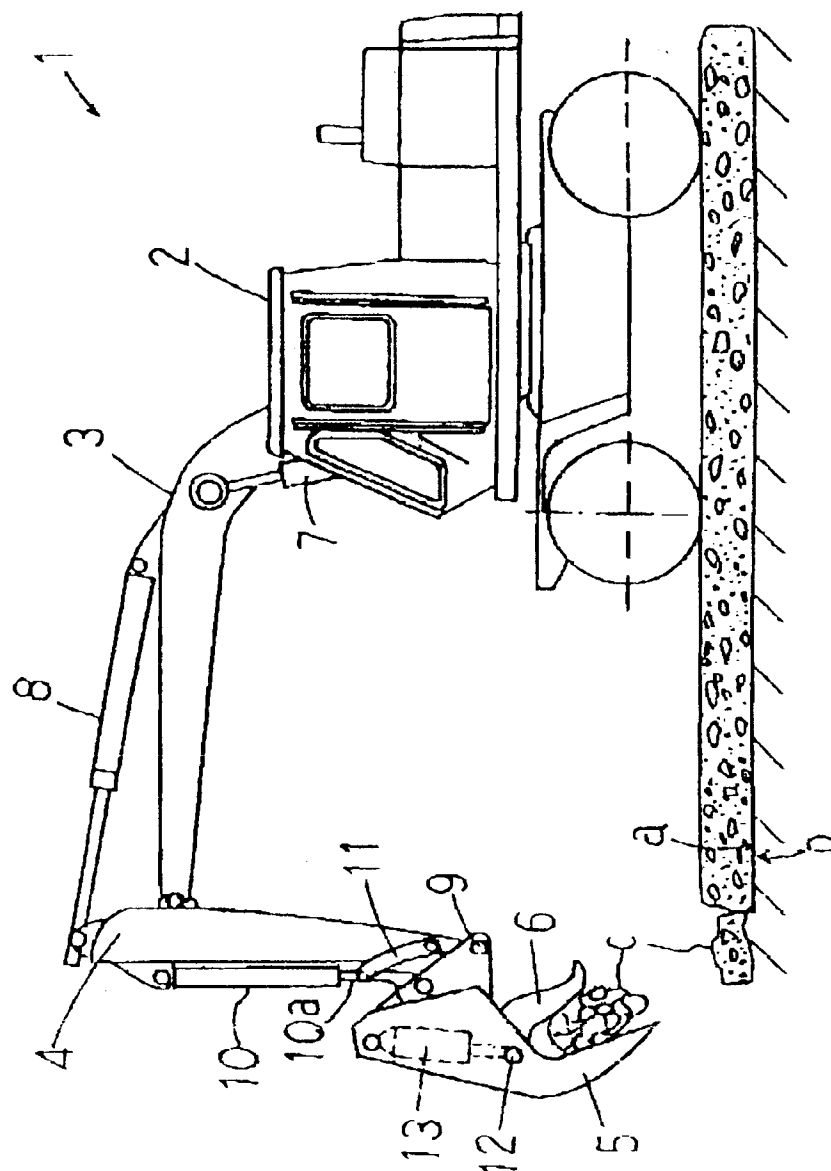


FIG. 8

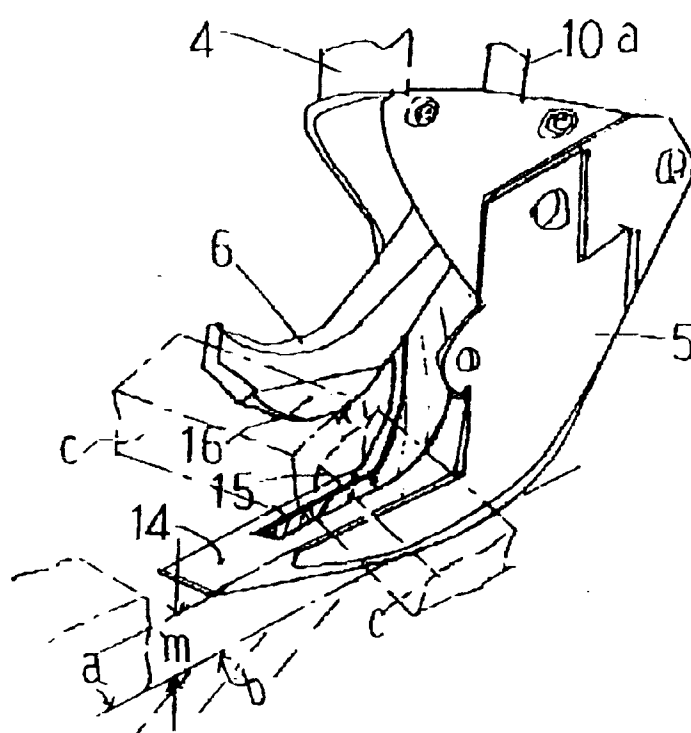
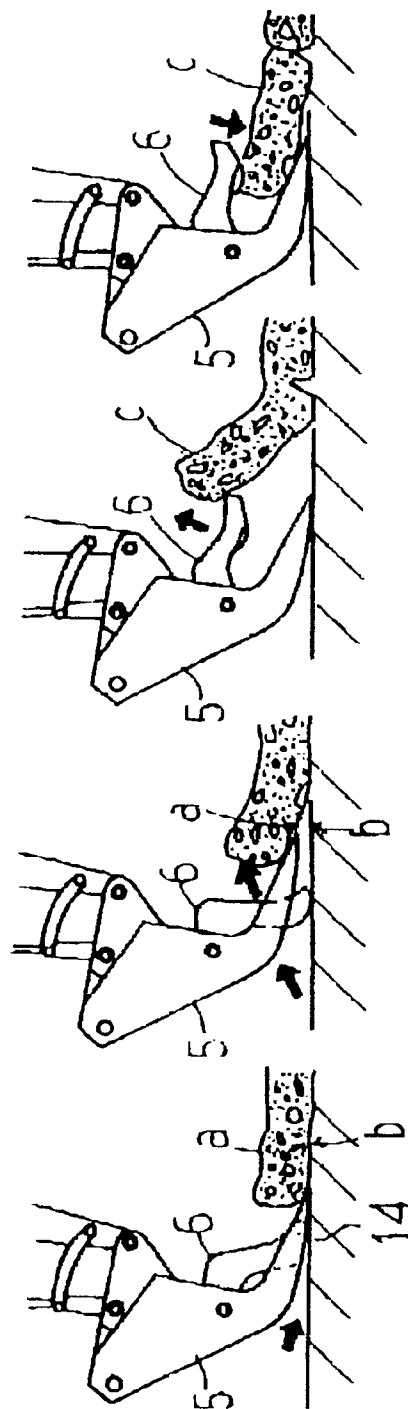


FIG. 9 (a) FIG. 9(b) FIG. 9(c) FIG. 9(d)





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EUROPEAN SEARCH REPORT

Application Number
EP 95 30 5604

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	EP-A-0 582 746 (OHYODO DIESEL CO LTD) 16 February 1994	1,2	E01C23/12
Y	* the whole document * ---	3,4	
Y	US-A-4 932 478 (JONES LARREN F) 12 June 1990	3	
A	* abstract; figure 2 * ---	1	
Y	EP-A-0 404 229 (VERACHTERT BEHEER B V) 27 December 1990	4	
A	* column 2, line 49 - column 3, line 37; figures * ---	1	
X	FR-A-2 648 365 (SAKATO KOSAKUSHO KK) 21 December 1990	1	
Y	* page 4, line 17 - page 7, line 31; figures * ---	2	
Y	WO-A-92 18708 (LABOUNTY MFG INC) 29 October 1992	2	
A	* abstract; figures * -----	1	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.6) E01C E04G E02F
Place of search THE HAGUE		Date of completion of the search 14 November 1995	Examiner Dijkstra, G
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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