

The present invention relates to machines which enable trenches of great depth to be dug in the ground by means of cylindrical cutters which are arranged at the lower portion of the machine and are driven in rotation in order to break up the ground.

These machines of a type known in particular from the document DE-A-2 362 425, have in general two identical cutters turning in opposite directions, each consisting of two half-drums supported by a plane core arranged vertically.

The cutters may be driven by hydraulic or electric motors located along their axes. They may equally well be driven by mechanical devices such as shafts with bevel gears or chains, or by means of motors which are located above the cutters in the body of the machine.

In the machines of known type the two half-drums equipped with tools which form a cutter, are driven in rotation about one and the same horizontal axis which is perpendicular to the plane core which supports them.

The core must be able to withstand considerable forces, for it is necessary to apply to the cutters a powerful torque in order to be able to break up ground consisting of stones and again very heavy vibrations occur at the level of the cutters, which reflect back onto the core.

The result is that the core must be as strong a piece as possible. It is usually manufactured from cast steel exhibiting high mechanical characteristics.

In the present state of the art, however, it is not possible to manage that the tools mounted at fixed stations on the half-drums break up the ground below the core, so that there persists between the two half-drums a step in the ground, for example, of rock, which has not been subjected to the action of the cutting tools and which must be broken up by the sole fact that the core bears against the upper portion of it.

This step which is thus brought to support part of the weight of the machine normally breaks off by buckling and does so the more easily the less the thickness of the core.

It is with this aim that in order to keep the core at a thickness sufficient to ensure its strength whilst reducing the thickness of the step that the idea has already been conceived of making in the upper portion of the two faces of the core circular notches along which pass cutter tools which at the bottom portion of the machine can then break up the ground, leaving only a step the thickness of which is less than that of the core.

Nevertheless when it is desired to realize cutters of great power and having a high working capacity, the problem posed by the strength of the core was hitherto difficult if not impossible to solve.

The present invention brings a particularly simple and effective solution to this problem.

Machines for digging ditches are likewise known, in particular from the documents DE-A-960 392 and FR-A-1 429 215, which are intended in particular for agriculture and have tools turning about sloping axes. These machines differ from the machines of which the existence has just been called to mind above, by the fact that they work solely from the surface of the ground whereas the machines of the type to which the invention refers are machines which are hung inside trenches of great depth which they are digging.

The object of the present invention is a machine for digging in the ground vertical-walled trenches of great depth, of the type in which two half-drums bearing cutter tools are supported by a plane core arranged vertically, characterized by the fact that the axes of the two half-drums are slightly inclined downwards and outwards from the plane of the core.

In accordance with the invention the axes of the half-drums may, for example, be inclined by 1 to 10 degrees with respect to the horizontal.

Thus thanks to the invention the tools which are located on the half-drums in the vicinity of the core can work at the bottom portion of the machine in the immediate vicinity of one another, eliminating the step or only allowing a step to persist of which the thickness is sufficiently small for its breakage under the action of the bottom portion of the core to arouse no difficulties.

In accordance with a preferred embodiment of the invention the tools arranged at the outer peripheries of the half-drums are offset towards the outside in such a way that when these tools are at the low part of the half-drums they break up the ground over a width which corresponds substantially with the width occupied at their high part by the two half-drums.

In accordance with a preferred embodiment of the invention the ends of the cutting tools arranged on each half-drum are situated on a truncated cone the generatrices of which have the same inclination as that of the axes of the half-drums so that the tips of these tools are situated on one substantially horizontal line when they are at the low part of the drums.

Thanks to the invention the core may be realized with a trapezoidal vertical section which enables the mechanical solidity to be conferred upon it, which is necessary to the transmission of very large forces to the half-drums.

In accordance with one particular embodiment the driving of the two half-drums may be ensured by means of a motor the carcass of which is made integral with the core and which is equipped with a splined hollow shaft inside which a splined shaft engages which drives each of the half-drums in rotation by way, for example, of splines likewise.

Thanks to the play existing between the various splines it is thus possible by means of a motor having a horizontal axis, to drive two half-drums the axes of which are in accordance with the invention, inclined with respect to the horizontal.

With the aim of letting the invention be better understood, by way of illustration and without any restrictive character, an embodiment taken as an example will now be described and represented in the attached drawing.

In this drawing:

- Figure 1 represents a diagrammatic elevation of the bottom portion of a machine to which the invention is applied; and

- Figure 2 is a diagrammatic section along II-II in Figure 1. representing the slope of the tool-bearer half-drums in accordance with the invention.

In Figure 1 there is represented diagrammatically the bottom portion of the body 1 of the machine as well as the two drums 2 which consist of the half-drums mounted on opposite sides of the plane cores 3.

In dash dot line there is likewise represented diagrammatically the outline of the tools 4 located on the drums 2.

As indicated by the arrows the drums 2 turn in opposite directions so as to gather between them the debris torn from the ground, which is eliminated by the suction nozzle 5 of a pump (not shown).

In Figure 2 which represents a section along II-II of an embodiment of the invention, the core 3 may be seen which has a trapezoidal section and is accordingly much thicker at the upper portion of it than at the bottom. The core 3 is equipped with the plate 6 which enables it to be mounted solidly on the bottom portion of the machine body.

In Figure 2 the half-drums 2a and 2b may likewise be seen, which are driven in rotation about axes 7 which are inclined downwards from the core with respect to the horizontal line 8 perpendicular to the central plane of the core. In this embodiment the axes of the half-drums are inclined at from 1 to 10 degrees, where the diameter of the cutter may, for example, be from 120 to 160 cm.

The half-drums 2a and 2b are equipped at their peripheries with conventional tools 4, 4a and 4b.

It may clearly be seen in Figure 2 how the tools 4a arranged towards the centre of the drum are sloped in the direction of the central plane of the core.

Similarly the tools 4b which are located on the outer periphery of the half-drums 2a and 2b are offset towards the outside as far as a vertical line 9 in order to become at their low portion substantially vertically

below the outer edges of the upper portions of the half-drums 2a.

In this way the tools 4, 4a and 4b dig at the bottom part of the machine a trench which corresponds with the maximum drum width which, taking into account the slope of the axes 7, corresponds with that of the upper part of the half-drums 2a and 2b.

Again, the sloping of the tools 4a on the two half-drums towards one another practically enables the formation of a step to be eliminated at the bottom part of the core 3 which nevertheless preserves a considerable thickness at the upper part of it in the vicinity of the plate 6 by which it is mounted on the body of the machine 1.

In accordance with the invention it is likewise preferable that when they are situated at the bottom part of the drum the tools 4, 4a and 4b are aligned substantially along a horizontal line so as to ensure a uniform depth of the trench.

The half-drums 2a and 2b may be driven in rotation in any manner.

They may, for example, be driven by means of two hydraulic motors fed through pipework arranged in the thickness of the core, being motors which are coaxial with the half-drums.

In a variant it is possible to employ only one motor having a horizontal shaft, which is arranged symmetrically with respect to the core 3 and the shaft of which may be connected to the sloping shafts of the two half-drums by articulated devices of any type. For this purpose one may, for example, employ a motor having a hollow splined shaft which is connected by one or two splined shafts to the two half-drums, the play existing at the level of the splines enabling the angularity between the shafts of the half-drums and that of the motor to be accommodated.

In another variant it is likewise possible to ensure driving of the half-drums by mechanical means consisting, for example, of chains or else of vertical transmission shafts passing through the core and having bevel gearing towards the shafts of the half-drums, the driving motor or motors being assumed to be arranged in the body of the machine above the core.

It may be seen that thanks to the invention it is possible to eliminate all of the problems which are due to the existence of the step which the cutters necessarily allow to persist below the core in the machines previously known.

It is clear, however, that in accordance with the invention it is not indispensable to suppress the step totally between the two half-drums but that it is sufficient that this step be of sufficiently little thickness for it to break down under the action of the vibrations or under the action of the weight of the machine which is resting upon it by the bottom part of the core.

C L A I M S

1. A machine for digging in the ground vertical-walled trenches of great depth, having at least one cutter consisting of two half-drums (2a, 2b) bearing tools (4, 4a, 4b) at their peripheries and supported by a vertical core (3) arranged between them, the machine being characterized by the fact that the axes (7) of the two half-drums (2a, 2b) are slightly inclined downwards and outwards from the plane of the core (3).
2. A machine as in Claim 1, characterized by the fact that the axes (7) of the half-drums are inclined by about 1 to 10 degrees.
3. A machine as in one of the Claims 1 or 2, characterized by the fact that the tools (4a) situated on the half-drums (2a, 2b) in the vicinity of the core (3) work in the immediate vicinity of one another when they are situated at the bottom part of the machine.
4. A machine as in any one of the preceding Claims, characterized by the fact that the tools (4b) arranged at the outer peripheries of the half-drums (2a, 2b) are offset towards the outside in such a way that when they are at the low part of the half-drums they break up the ground over a width which corresponds substantially with the width occupied at their high part by the two half-drums.
5. A machine as in any one of the preceding Claims, characterized by the fact that the ends of the cutting tools (4, 4a, 4b) arranged on each half-drum (2a, 2b) are situated on a truncated cone the generatrices of which have the same inclination as that of the axes (7) of the half-drums so that the tips of these tools are situated on one substantially horizontal line when they are at the low part of the drums.
6. A machine as in any one of the preceding Claims, characterized by the fact that the core (3) has a trapezoidal vertical section.
7. A machine as in any one of the preceding Claims, characterized by the fact that the two half-drums are driven by a motor integral with the core and equipped with a splined horizontal hollow shaft inside which a splined shaft engages which drives each of the half-drums in rotation, the angular divergence between the axis of the motor and those of the half-drums being compensated by the play existing in the splines.



8. A machine as in any one of the preceding Claims, characterized by the fact that the core (3) supports two pairs of half-drums the axes of rotation of which are situated substantially at the same level and which are driven in opposite directions.

