Title: IMPROVED EQUIPMENT OF A MOUNTED TYPE, DESIGNED TO CARRY OUT TILLING AGAINST DESERTIFICATION OF THE LAND

Abstract: Improved equipment of a mounted type, designed to carry out tilling against desertification of the land, comprises, in combination, a subsoiler (10) with two or more scarifiers associated to a reversible single-furrow tilling body or plough (1) set at the rear, as well - as means for controlling the reciprocating and synchronized, action of lifting and penetration into the soil of the subsoiler (10) and of the tilling body or plough (1) to obtain open holes alternating with water-collecting and retaining pockets buried in the ground constituted substantially by subsoil areas in which the soil is completely broken up so as that it can be easily impregnated by the water coming from said open holes. Said means for controlling lifting and penetration into the soil comprise a hydraulic distributor located above a wheel (13), from which it receives the command for opening and closing, via a gear change and a cam, as well as sequence valves.
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**IMPROVED EQUIPMENT OF A MOUNTED TYPE, DESIGNED TO CARRY OUT TILLING AGAINST DESERTIFICATION OF THE LAND**

The present invention relates to the agricultural sector of tilling land, and in particular constitutes an improvement of a reversible single-furrow plough mounted, by direct attachment, to the tractor, equipped with subsoilers.

In the technical sector of reference, many devices are known for tilling the land.

For example, a non-reversible single-furrow plough is known, which makes open holes: it is a plough formed by a single (right-hand or left-hand) body that enters into and exits from the soil to obtain alternating holes.

Also known are other machines that perform alternate tilling. Amongst these, known to the art is a mounted and non-towed subsoiler with three scarifiers, which oscillate beneath the plane of lie. This subsoiler, which on the other hand has a structure completely different from that of the present invention, provides a working section that is so wide as not to be effective for the accumulation of water. In addition, it is unable to form a delimited buried pocket in the ground constituted by an area of soil broken up and concentrated. In fact, the area tilled by said known apparatus would be too wide for functioning as water-collecting and retaining pocket. For this reason it has never found practical application.

Also known is a non-mounted piece of equipment, towed by the tow hook of the tractor, with two wheels...
as carriage, five scarifiers, which do not oscillate beneath the plane of lie, and that carry out a very extensive work of subsoiling that is altogether different from that of the machine according to the present invention. This known subsoiler, which has a structure completely different from that of the present invention, has proven ineffective. With said apparatus there is not obtained a pocket buried in the ground constituted by an area of soil broken up and concentrated; in fact, the tilled area would be too extensive for functioning as water-collecting and retaining pocket.

Finally, the known art comprises a reversible plough that makes furrows interrupted by diaphragms obtained with surface soil, operation of which is completely different from that of the plough forming the subject of the present invention.

In the light of what has been said above, the main purpose of the present invention is to overcome said drawbacks envisaging an equipment designed to carry out an effective tilling of the land against desertification.

The above has been obtained, according to the invention, by devising an equipment of a mounted type comprising, in combination, a subsoiler with two scarifiers associated to a reversible single-furrow plough set at the rear, as well as means for controlling the reciprocating and synchronized action of lifting and penetration into the soil of the subsoiler and of the plough to obtain open holes alternating with water-collecting and retaining pockets.
in the ground.

A better understanding of the invention will be obtained from the ensuing detailed description and with reference to the attached drawings, which illustrate, purely by way of non-limiting example, a preferred embodiment.

In the drawings:

Figure 1 is a 3D view of a preferred embodiment of the equipment according to the invention;

Figure 2 is a side elevation of the equipment according to the invention of Figure 1;

Figure 3, similar to Figure 1, shows the equipment according to the invention from the opposite side; and

Figure 4 shows the profile of tilling that is performed with the means for controlling reciprocating lifting/lowering of the bodies carrying out tilling.

With reference to the figures listed above, the mounted and non-towed equipment according to the present invention is specifically designed to make open holes via a reversible, programmable, tool that alternate - in the direction of advance - with water-collecting and retaining pockets in the ground constituted substantially by subsoil areas in which the soil is completely broken up so as that it can be easily impregnated by the water coming from the open holes. For this purpose, the level of the bottom of the water-collecting and retaining pockets in the ground is lower than that of the bottom of the open holes. Advantageously, the soil that has been broken up contained in these pockets is impregnated with water and slows down considerably evaporation thereof,
behaving in a way similar to a sponge.

According to the invention, said open holes are made by means of a tilling body 1 constituted by a mounted and non-towed reversible single-furrow plough.

As has already been mentioned, a first peculiar characteristic of the invention lies in the fact that said reversible tilling body 1 is associated to a subsoiler 10 having a particular shape.

Said subsoiler 10 comprises two tines set at a distance from one another of approximately 30 cm and staggered, one further ahead and one further back, so as to maximize the surface of soil broken up without altering the shape of the water-collecting and retaining pocket. Staggering enables a very low power of absorption during tilling.

In addition, the subsoiler 10:

1) enables easy displacement of possible surface stones;

2) enables capture of greater amounts of water by the land broken up;

3) enables greater supply of aquifers;

4) facilitates sowing and transplantation on the land broken up in the areas of the pockets in the ground given that the plants no longer encounter a hard and compact soil;

5) in arid lands is the ideal system for obtaining a facilitated and effective pregermination;

6) enables accelerated development of roots of plants;

7) facilitates sowing;

8) reduces generation of erosion in the land;
9) improves productivity of pastures.

The subsoiler 10 with two tines and the rear tilling body 1 can also work independently on one side and the other.

Two half-wedges A (see Figure 5) can be applied to the two tines of the front subsoiler 10, which till the land before the rear tilling body 1 generating a pocket of tilled land between one hole and another (to obtain said further accumulation of water).

According to a peculiar characteristic of the invention, these half-wedges A, by being dragged over the tilled land, generate two channels for connection between the open hole and the buried pocket, said channels advantageously facilitating the passage of the water from the hole to the pocket.

It is reasonable to deem that, over time, these channels remain open and the water will continue to pass through them. The half-wedges A can be positioned at various heights along the tines 10 to optimize their function.

A second peculiar characteristic of the invention lies in the fact that purposely designed means are provided for governing lifting/lowering of the tilling body 1 and of the subsoiler 10, which are inserted into/extracted from the soil in a programmable synchronized and reciprocating way to obtain formation of said open holes alternating with and adjacent to said water-collecting and retaining pockets in the ground.

So far there does not exist any machine that combines the possibility of making alternating open
holes and water-collecting and retaining pockets in the ground.

In addition to this, there are no known machines that are able to make a tilling profile with a section such as the one shown in Figure 4, in which the pockets in the ground are located beneath the plane of the open holes and alternate with the open holes themselves.

In the preferred embodiment described herein, the equipment according to the invention comprises, in combination, a reversible plough 1 of a mounted type, plus a subsoiler 10 with two scarifiers, with stiffening jack, as well as safety devices on the jack for oscillation of the subsoiler 10. In addition to the above, to enable the desired tilling profile to be obtained, programmable control means are provided that raise/lower with reciprocating motion the plough 1 and the subsoiler 10 at the desired depth and for the desired time/distance according to the type of soil and the speed/power of the tractor.

In the example illustrated, the tilling body 1 for making the open holes (crescents) is constituted by a reversible single-furrow plough 1, which is manoeuvred to obtain holes having an adjustable length \( L \) of approximately 5 m and a maximum depth \( h \) of 50 cm, which is also adjustable.

Visible in Figures 1, 2, and 3 are the right-hand tilling body 1a and the left-hand tilling body 1b of the aforesaid reversible mounted plough.

The tilling body 1 is fixed to a supporting frame 2 and a jack 3 is provided for oscillation of the tilling body 1 and consequent creation of the open
holes (Figure 4, stretch LI). This jack 3 is actuated automatically by a purposely provided independent hydraulic circuit of the plough as a function of the number of revolutions performed by an appropriate wheel 13 that turns on the land following the effective advance of the tractor over the land so as to make the holes and the pockets in the ground with the desired effective length.

To get the tilling body 1 to turn about the axis 17 and to be able to insert the right-hand tilling body 1a or left-hand 1b alternately in the soil (with an operation similar to that of reversible ploughs), a jack 4 is provided actuated by the operator directly from the tractor at each end of pass.

More specifically, the creation of the open holes is obtained by getting the supporting frame 2 to turn, via the jack 3, about the hinge 5.

According to the invention, a main frame 6 of the plough is then provided, anchored on one side of which are the supporting frame 2 that carries the tilling body 1 and frames 8, 9 that carry the double subsoiler 10, and which, on the other side, is coupled to the tractor 16 schematically represented by the dashed line in Figure 2.

A purposely provided stiffening jack 7 renders the apparatuses according to the invention a single body with the tractor and enables the tilling body 1 to penetrate the soil as soon as it is operated without any repercussion on the degree of freedom of the rear attachment 16c, 16b of the tractor. This stiffening jack 7 is operated by the operator directly from the
tractor and has the function of lifting, at the end of each pass, the main frame 6 and of drawing the implements 10, 1a, 1b out of the ground.

The subsoiler 10 tills the land by means of purposely designed blades, or tines, or scarifiers anchored to a blade-holder frame 18 equipped with a top connecting rod 8 and a bottom connecting rod 9. Said blades of the subsoiler 10 on the frame 18 are set apart from one another to obtain a furrow having a width of approximately 30 cm and a maximum depth h2 of 85 cm (Figure 4). As has already been mentioned, said depth h2 is adjustable.

Advantageously, the aforesaid connecting rods 8, 9 have end hinges 11a, lib, 11c, 1id thanks to which they form a parallelogram and enable vertical movement of the blades without altering the tilling angle thereof.

A jack 12 enables oscillation (once again beneath the plane of lie) of the blades of the subsoiler 10 for creating the water-collecting and retaining pockets in the ground (Figure 4, stretch L2). This jack 12 is actuated automatically by the programmable control means of the independent hydraulic circuit of the plough as a function of the rotation of the wheel 13.

In this connection, it should be noted that the aforesaid wheel 13, by rolling over the land during tilling by the plough, actuates a hydraulic distributor via a reducer and a cam. The distributor in turn governs, by means of a series of sequence valves, the jacks 3 and 12 to obtain the tilling profile as in Figure 4.

The independent hydraulic circuit that has the
function of -actuating the jacks 3 and 12 is equipped with a radiator 14 and a tank 15 with a hydraulic pump (not represented in the drawings) actuated by the power takeoff (PTO) of the tractor.

In the figures, designated by 16 is the tractor, by 16a are the wheels of the tractor, by 16b are the bottom arms of the lift of the tractor, and by 16c is the tie rod of the third point of the tractor.

To pass from the right-hand tilling body 1a to the left-hand tilling body 1b, a jack 4 is provided, which causes the reversible plough to turn about an axis of rotation 17 of the tilling body.

There are then provided feet 19 for stability at rest and shims 20 to be inserted in the stem of the jack 12 for limiting the closing stroke and determining the depth of tillage of the blades (Figure 4, h2), i.e., the depth of the pockets in the ground created by the blades.

With particular reference to Figure 4, the section of the tilling profile obtained with the equipment according to the invention is characterized by the following geometrical quantities, where the length L1 of the open holes and the length L2 corresponding to the pockets in the ground are both programmable and hence modifiable.

P Tilling pitch (equal to the sum of the length of the open hole L1. and the length of the stretch where the blades make the buried pocket L2). The length of the stretches L1 and L2 is programmable and consequently is programmable the length of the pitch P is also programmable.
L1 Length (programmable) of the open holes made by the plough or tilling body 1.

L2 Length (programmable) of the pockets in the ground made by the blades of the subsoiler 10.

h1 Depth (adjustable) of the open holes.

h2 Depth (adjustable) of the buried pockets.

The present invention has been described and illustrated in a preferred embodiment thereof, but it is evident that technically and/or functionally equivalent modifications and/or replacements may be made by any person skilled in the branch, without thereby departing from the sphere of protection of the present industrial patent right.
CLAIMS

1. Improved equipment of a mounted type, designed to carry out tilling against desertification of the land, characterized in that it comprises, in combination, a subsoiler (10) with two or more scarifiers associated to a reversible single-furrow tilling body or plough (1) set at the rear, as well as means for controlling the reciprocating and synchronized action of lifting and penetration into the soil of the subsoiler (10) and of the tilling body or plough (1) to obtain open holes alternating with water-collecting and retaining pockets in the ground constituted substantially by subsoil areas in which the soil is completely broken up so that it can be easily impregnated by the water coming from said open holes; said means for controlling lifting and penetration into the soil comprising a hydraulic distributor, which is located above a wheel (13), from which it receives the command for opening and closing, via a gear change and a cam, as well as sequence valves.

2. The improved equipment according to the preceding claim, characterized in that said open holes are made by said reversible single-furrow plough (1), which is of a mounted and non-towed type.

3. The improved equipment according to Claim 1 or Claim 2, characterized in that said reversible tilling body or plough (1) is associated to a subsoiler (10) having staggered tines, one further ahead and one further back, so as to maximize the surface of soil broken up, without altering the shape of the water-collecting and retaining pocket; thus obtaining that,
thanks to the staggered position of the tines, there will be a very low power absorption during tilling of the land.

4. The improved equipment according to the preceding claim, characterized in that means for controlling lifting/lowering of the tilling body (1) and of the subsoiler (10) are purposely provided, which are inserted in/extracted from the soil in a programmable synchronized and reciprocating way to obtain formation of said open holes alternating with and adjacent to said pockets buried in the ground containing the soil that has been broken up for accumulating the water and preventing evaporation thereof.

5. The improved equipment according to the preceding claim, characterized in that the tilling body (1) to obtain the open holes, or crescents, is constituted by a reversible single-furrow plough (1), which is manoeuvred by said control means to obtain holes having an adjustable length (LI) of approximately 5 m and a depth (hi), which is also adjustable, preferably of 50 cm; said mounted reversible plough being substantially constituted by a right-hand tilling body (1a) and a left-hand tilling body (1b) of the aforesaid plough.

6. The improved equipment according to Claim 1, characterized in that the tilling body or plough (1) is fixed to a supporting frame (2), and a jack (3) is provided for oscillation of the tilling body or plough (1) and consequent creation of the open holes (LI); wherein said jack (3) is actuated automatically by a
purposely provided independent hydraulic circuit of the plough as a function of the number of revolutions performed by an appropriate wheel (13) that turns on the land following the effective advance of the tractor over the land so as to make the holes and the pockets buried in the ground with the desired effective length.

7. The improved equipment according to Claim 1, or Claim 6, characterized in that to get the tilling body (1) to turn about an axis (17) and to be able to insert in the ground alternately a right-hand tilling body (1a) and a left-hand tilling body (1b), a jack (4) is provided, operated by the operator directly from the tractor at each end of pass.

8. The improved equipment according to Claim 6, characterized in that the creation of the open holes is obtained by getting, via the jack (3), the supporting frame (2) to turn about a hinge (5).

9. The improved equipment according to Claim 6, characterized in that a main frame (6) of the plough is provided, anchored on one side of which are the supporting frame (2) that carries the tilling body or plough (1) and frames (8, 9) that carry the double subsoiler (10), and which, on the other side, is coupled to a tractor (16).

10. The improved equipment according to the preceding claim, characterized in that it envisages a purposely provided stiffening jack (7) that renders it a single body with the tractor (16) and enables the tilling body (1) to penetrate the soil as soon as it is operated without any repercussion on the degree of freedom of a rear attachment (16c, 16b) of the tractor;
said stiffening jack (7) being operated by the operator
directly from the tractor to lift, at the end of each
pass, the main frame (6) and to draw the implements
(10, 1a, 1b) out of the soil.

11. The improved equipment according to Claim 1,
characterized in that the subsoiler (10) tills the land
by means of purposely designed blades, or tines, or
scarifiers anchored to a blade-holder frame (18)
equipped with a top connecting rod (8) and a bottom
connecting rod (9); said blades of the subsoiler (10)
on the frame (18) being set apart from one another to
obtain a furrow having a width of approximately 30 cm
and an adjustable depth (h2) of up to a maximum of
85 cm.

12. The improved equipment according to the
preceding claim, characterized in that said connecting
rods (8, 9) have end hinges (11a, lib, 11c, lid) thanks
to which they form a parallelogram and enable vertical
movement of the blades of the subsoiler (10) without
altering the tilling angle thereof.

13. The improved equipment according to the
preceding claim, characterized in that a jack (12) is
provided for oscillation, beneath the plane of lie, of
the blades of the subsoiler (10) in order to create the
water-collecting and retaining pockets in the ground;
said jack (12) being actuated automatically by
programmable control means of the independent hydraulic
circuit of the tilling body or plough as a function of
rotation of a wheel (13) that rolls over the ground
during operation of the tilling body or plough.

14. The improved equipment according to Claims 6
and 13, characterized in that said wheel (13) actuates a hydraulic distributor via a reducer and a cam and in that the distributor in turn governs, by means of a series of sequence valves positioned on a main frame (6), the jacks (3 and 12), which cause oscillation of the plough (1) and the subsoiler (10) to obtain the desired tilling profile.

15. The improved equipment according to the preceding claim, characterized in that the independent hydraulic circuit that has the function of actuating the jacks (3 and 12) is equipped with a radiator (14) and a tank (15) with hydraulic pump.

16. The improved equipment according to Claim 3, characterized in that said tines of the subsoiler (10) are equipped with two half-wedges (A), which, by being dragged over the land that is being tilled, generate two channels for connection between the open hole and the pocket buried in the ground, said channels facilitating passage of the water from the hole to the pocket.
# INTERNATIONAL SEARCH REPORT

## A. CLASSIFICATION OF SUBJECT MATTER

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According to International Patent Classification (IPC) or to both national classification and IPC:

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched:

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used):

- EPO-Internal

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>A</td>
<td>US 5 172 768 A (STRAUS REINHOLD [DE]) 22 December 1992 (1992-12-22) column 5, line 3 - column 7, line 25 column 10, line 58 - column 11, line 29 figures 1, 7, 24, 28</td>
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