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Manor

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[54] **GRADER-LEVELER ADAPTED FOR TRAILING BY TRACTORS**

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[51] **Int. Cl.**[2] **E02F 3/12**

[58] **Field of Search** 37/108; 172/780, 781, 796, 172/446, 447, 263, 705

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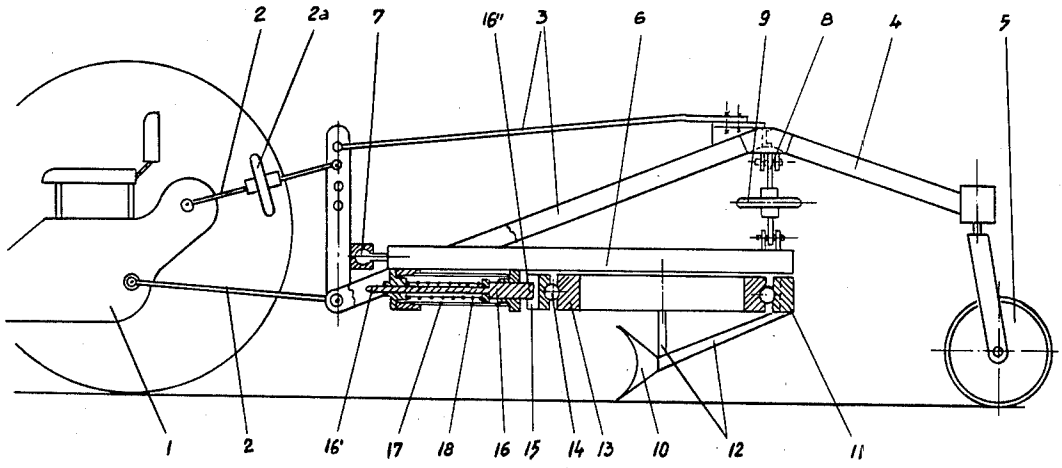
Attorney, Agent, or Firm—Flynn & Frishauf

[57] **ABSTRACT**

A chassis, adapted to be connected to a farm tractor, supports a blade for grading and levelling; the blade is rotatable with respect to the chassis, and can be fixed in position by engaging tooth-and-detent elements, one of them being respectively fixed to the chassis and the other formed on a turntable which is rotatable with the blade. The tooth-and-detent elements include inclined surfaces, and they are held in engagement by adjustable mechanical, hydraulic, magnetic, or other force means so that, when an obstruction is encountered by the blade which exerts a force on the blade in excess of the holding force, the blade can swivel out of position and thus prevent damage to the grader-leveler, or to its pulling tractor.

14 Claims, 7 Drawing Figures



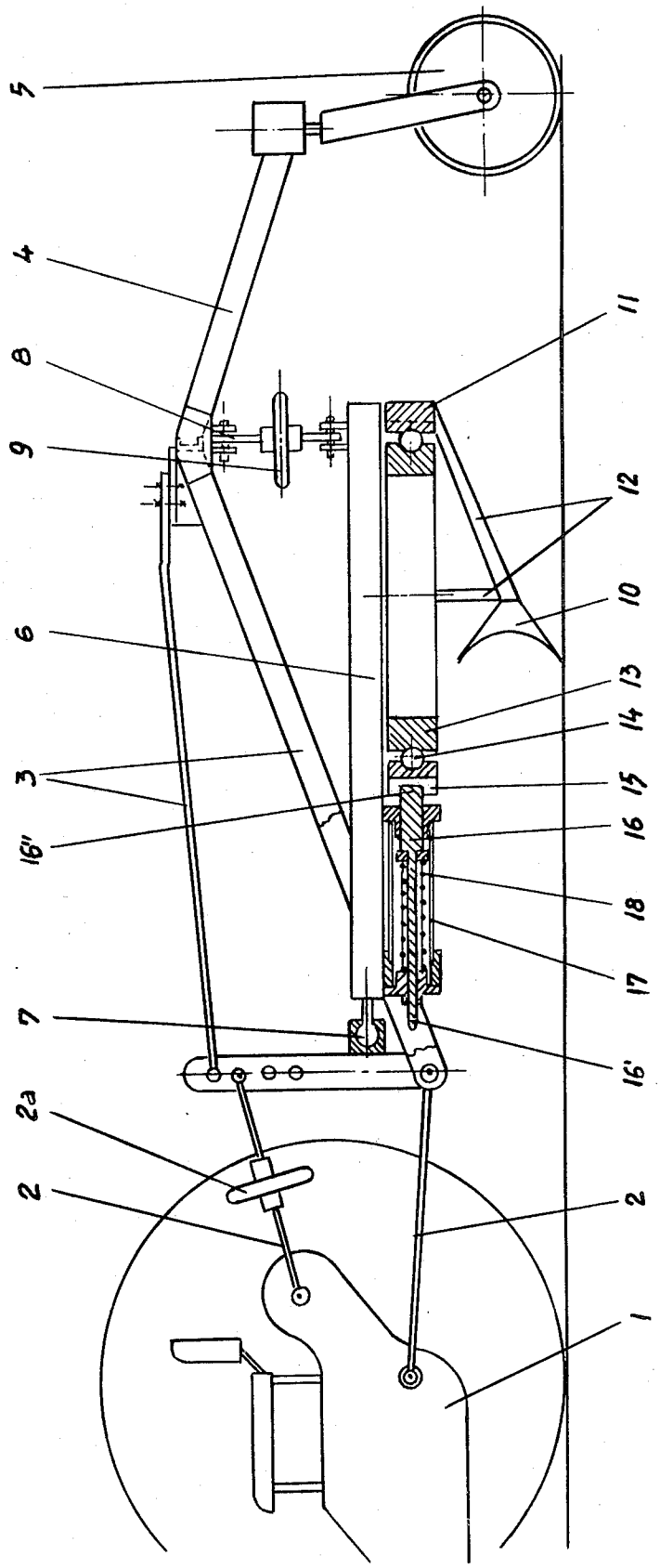


FIG. 1

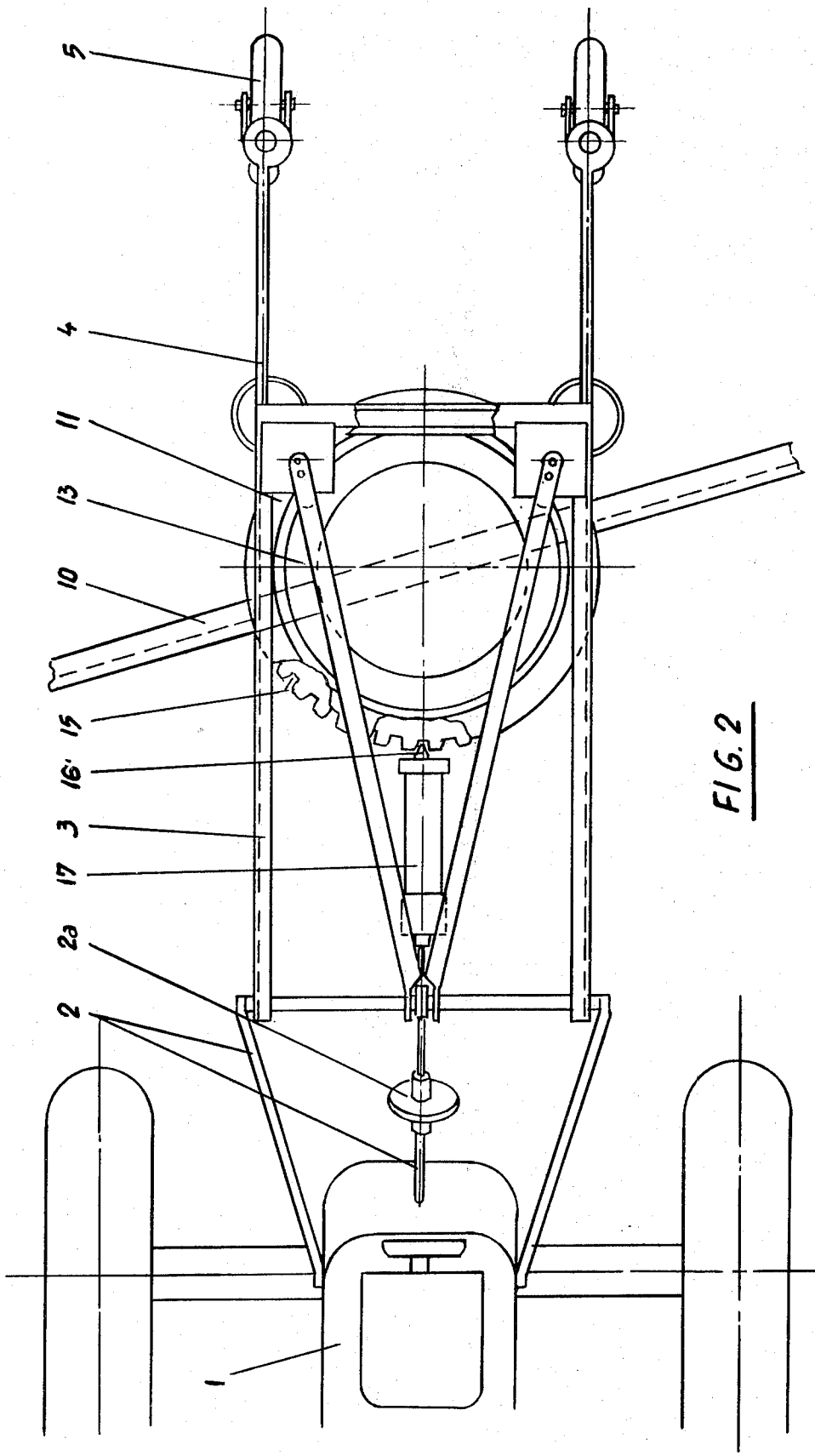


FIG. 2

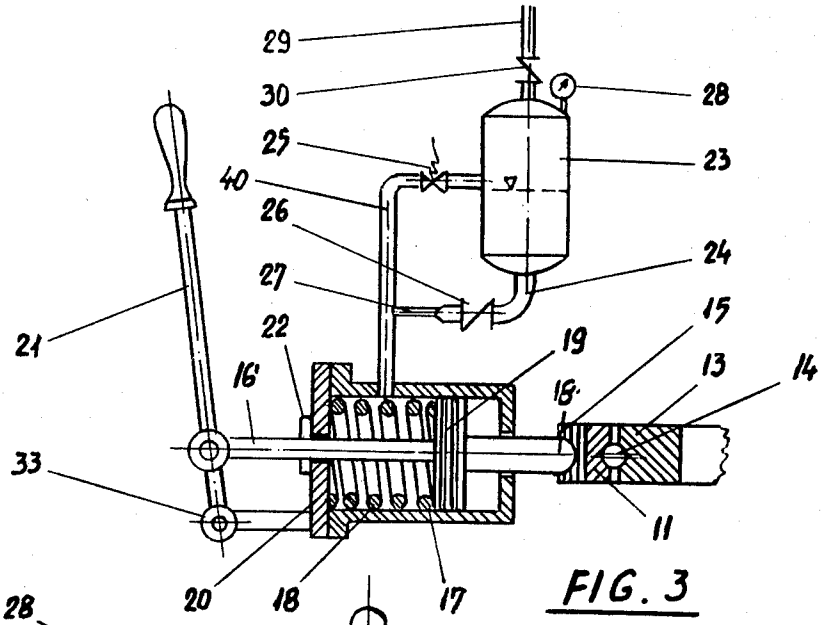


FIG. 3

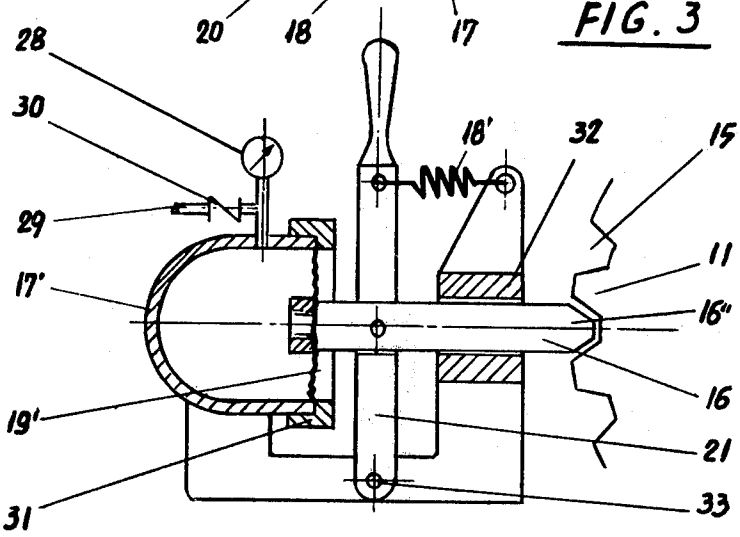


FIG. 4

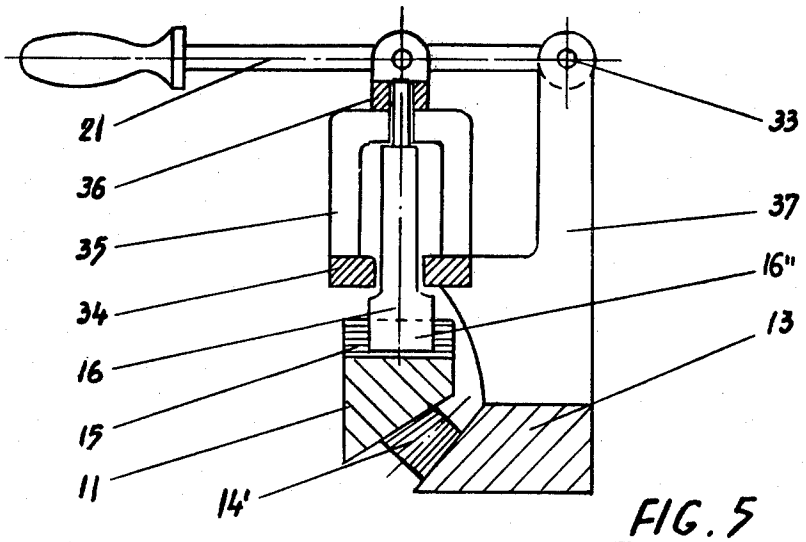


FIG. 5

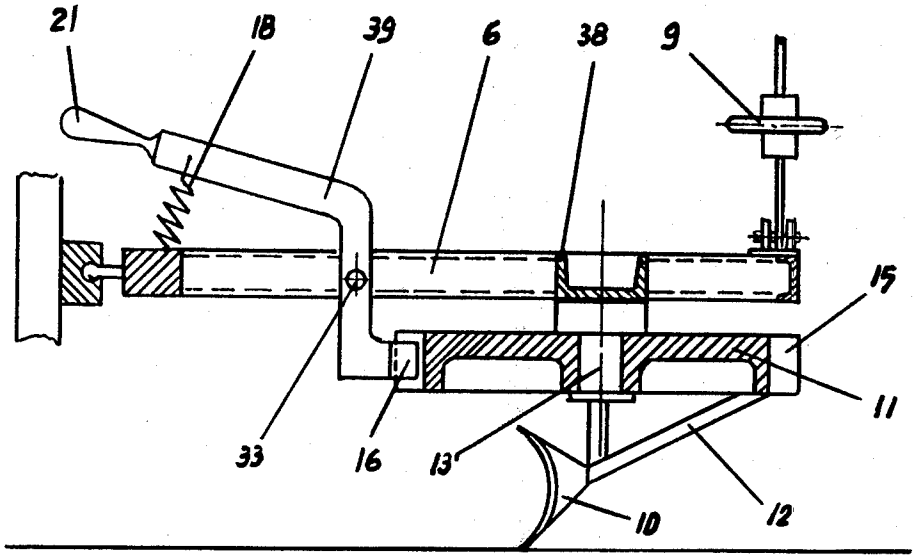


FIG.6

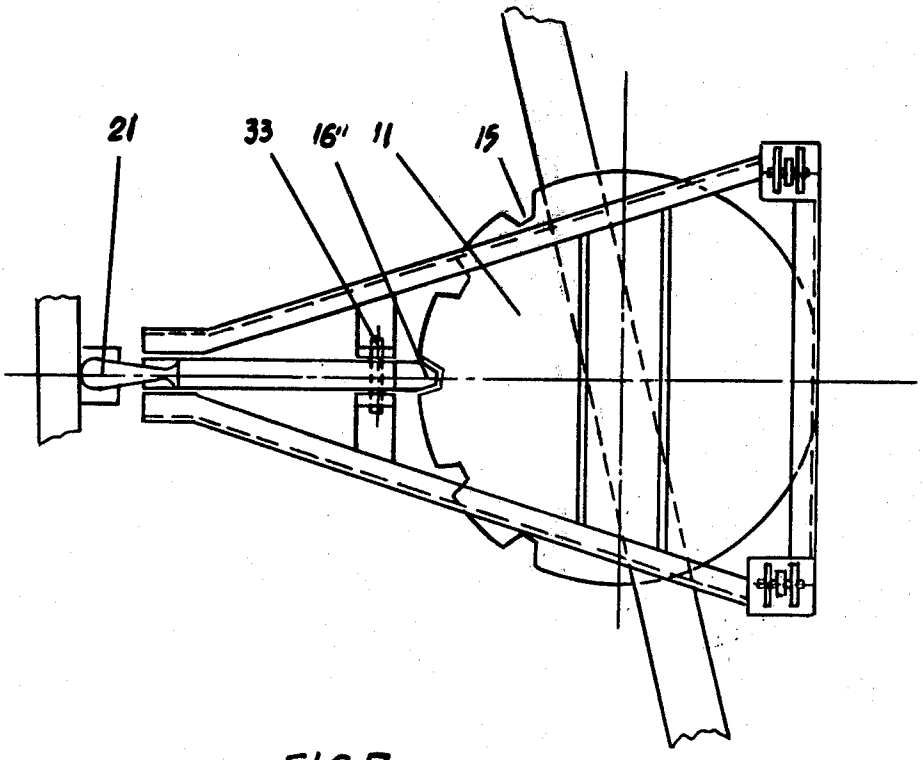


FIG.7

GRADER-LEVELER ADAPTED FOR TRAILING BY TRACTORS

This invention relates to an agricultural implement capable of serving both as a grader and as a leveler and adapted to being attached to a farm tractor by a three-point hitch.

In the relevant art the implement known as a grader consists essentially in a heavy, oblong blade of curved cross-section drawn across uneven ground while fixedly positioned at an angle between zero degrees and a right angle to the direction of movement, an arrangement which enables the implement to cast aside those parts of the soil that protrude above a certain predetermined level. The implement known as a leveler, on the other hand, consists essentially in a blade similar to that used in the grader but drawn across the ground while at a right angle to the direction of motion, with two rigid aprons or side-shields of strong material on either side of the blade preventing the soil being carried forward during operation from being cast aside, thus using it for filling out cavities in the path of the implement, the entire operation resulting in a clearly defined strip of land substantially more even than prior to the operation.

Several types of both kinds of implement are known to the art:- The four-wheeled trailed type has the advantage of being simple and relatively inexpensive, but it is long, heavy and unwieldy especially when taken together with the tractor. The self-propelled motor grader-leveler has an adjustable blade that may be positioned in the two manners appropriate to grading and leveling respectively, the blade being provided with side aprons required for a successful grading action. It is convenient to use, all operations being readily surveyed and manipulated from the driver's seat, but it represents a large investment in an essentially single-purpose aggregate.

The three-point hitched grader seeks to overcome the drawbacks of the implements described above by being shorter, the blade being carried on a wheelless frame and fixed to the tractor by a three-point hitch. This type is relatively inexpensive and its action is continually controllable by hand, but it is inconvenient to use and, due to the lack of a support behind the blade, the results of the operation are of a low quality.

The three-point fixed-blade leveler seeks to overcome some of the drawbacks of the last named implement by being provided with a support behind the blade, and it is also an inexpensive trailer but a single-purpose implement.

All the aforementioned machines or attached implements are fitted with a blade fixed, at different angles, to the supporting structure in rigid attachment. The blade and/or the structure are therefore liable to damage whenever the encounters an unsurmountable obstruction, especially if this latter is met by the blade in an off-centre place whereby a bending moment is exerted on the structural parts.

It is, therefore, an object of the present invention to provide a universal leveler and grader which can be trailed by a tractor and constructed to have, with the tractor, an overall length in the order of that of a self-propelled grader, or less, and in which the blade can be set at a desired angle with respect to the forward motion of the implement and yet release when an insurmountable obstacle is encountered.

SUBJECT MATTER OF THE INVENTION:

A combined leveler and grader attachment for a farmtractor, to which it can be secured, for example, by a three-point hitch is provided, in which the blade can be readily set at any angle required for the particular soil working operation by engaging latch and detent means to adjust the angular position of the blade, and in which a safety device is incorporated to release the setting of the blade and prevent damage to the implement due to off-centre overload or a heavy obstruction.

In accordance with a feature of the invention, the combined grader and leveler comprises a base frame or chassis with means — preferably a three-point hitch — for trailing attachment to a farm tractor and, at its rear end, means for supporting it on the ground. A supporting frame may be attached to the chassis by adjustable means so designed as to enable it to be positioned at different distances from, and different angles to, said chassis; a normally horizontal ring or turntable rotatably attached over the supporting frame to the chassis; it is provided with a plurality of suitably shaped identical notches or serrations in its outer rim. A grading and leveling blade is rigidly attached to the said ring or turntable. A positioning and quick-release mechanism, which includes of a tooth with converging surfaces of a shape and size adapted for engagement with the notches or serrations of the turntable is hingedly or slidingly attached to the supporting frame or the chassis in such a manner that it can be freely moved in or out of said notches. Mechanical, hydraulic, magnetic or other force means act on the tooth, directly or indirectly, to such an extent that the tooth holds the grader blade in position under normal working conditions, but can be forced out of the particular notch it is engaged in by the force exerted by an overload on the blade, for example as the result of an off-centre obstruction, the lateral force being transmitted from the notch to the inclined contacting surface of the tooth.

In one preferred embodiment of the invention the blade is mounted on a rotatable ring with the notches covering a part of its periphery. A horizontal pin, the tooth-shaped end of which engages with said notches, is pressed into these by a helical spring the force of which can be adjusted, a handle being provided for disengaging the tooth manually in order to enable the ring and the attached blade to be turned to the desired angle.

In another embodiment the notches are provided in the upper or lower surface of the rim of said rotatable ring, a substantially vertical sliding tooth and pin engaging these notches.

In yet another embodiment the tooth is rigidly connected by a rod to a piston movable in a close-fitting cylinder containing a fluid under pressure forcing the piston and the attached tooth into one of the notches, means being provided for releasing the fluid pressure upon a predetermined lateral load exerted on the tooth by the inclined side of the notch resulting in a proportional axial force on the piston.

In a similar mechanism the tooth is connected to one side of a diaphragm covering the open end of an otherwise closed pressure vessel, means being provided for filling said vessel with a fluid under pressure and for releasing this pressure upon a predetermined lateral load being exerted on the tooth.

In a fourth embodiment the tooth, or its extension, is connected to a permanent magnet, the corresponding armature of which is fastened to the supporting frame. In normal working the tooth is in engagement with a notch, but when the magnet is separated from the armature through the action of an obstruction in the path of the implement, the tooth is disengaged.

In the accompanying drawings which illustrate, by way of example, several embodiments of the invention and wherein the same numbers are utilzed to denote identical or similar parts,

FIG. 1 is a vertical section through a tractor-drawn grader-leveler in accordance with the invention, in which the blade-positioning device is spring-actuated;

FIG. 2 is a plan view of the implement shown in FIG. 1;

FIG. 3 shows a section through a hydraulically operated positioning and release mechanism;

FIG. 4 is a mechanism similar to that shown in FIG. 3 but actuated by pneumatic pressure;

FIG. 5 shows a positioning mechanism utilizing a permanent magnet and its armature;

FIG. 6 shows the supporting frame and a turntable with a grader blade affixed to it as well as a modified positioning mechanism;

FIG. 7 is a plan view of the parts shown in FIG. 6.

Referring now to FIGS. 1 and 2 of the drawings, the grader-leveler is attached to a farm tractor 1 by means of a three-point hitch 2 which permits the implement to be lifted off the ground. The implement itself consists of a chassis frame 3 built of metal tubes or profiles, its front part being adapted for the three-point hitch, its rear part provided with two backwardly projecting parallel arms 4 which, at their ends, support the swivels of two caster wheels 5.

The front of frame 6, which serves as support for the grader blade, is hingedly attached to the chassis by means of a ball joint 7, while the rear end of frame 6 is connected to two substantially vertical turnbuckles 8, an arrangement allowing said rear end of the frame to be raised and lowered by using handwheels 9. Unequal lengths of the two turnbuckles result in sideways tilting the frame end of the blade 10 attached to it, for grading at an angle. Lateral rigidity of the rear end is achieved by the provision of one or two diagonal turnbuckles.

The upper point of the three-point hitch, at the front end of the implement, is attached to the tractor by means of bars 2, the length of one of which can be changed at will by turning handwheel 2*a*. By turning the turnbuckles 8 and simultaneously adjusting handwheel 2*a* the height of blade 10 from the ground and its angle of attack can be adjusted.

The blade 10 is curved, and its working edge has been specially treated to achieve hardness in any suitable manner known to the art. It is rigidly fastened to a rotatable outer ring or turntable 11 by bars 12. The turntable rotates about a fixed inner ring 13 on a plurality of steel balls 14, the outer and inner rings together with the steel balls forming a large ball bearing. The inner ring 13 is rigidly fastened to the supporting frame — the connections not being shown in the drawing — while the outer ring is free to rotate unless arrested by a positioning device as described in the following:

The outer ring 11 is provided on its outer periphery with a plurality of trapezoidally shaped notches or serrations 15, which are distributed over the periphery in such a manner that they correspond to a predetermined number of angles at which the blade is to be positioned in relation to the direction of travel. The notches 15 are engaged by a tooth 16'' of trapezoidal cross-section forming the end of a horizontally positioned pin 16. This pin slidingly passes through a horizontal cylindrical casing 17 which in turn is rigidly fastened to the supporting frame 6. Inside the casing a helical spring 18 is fitted round the reduced-diameter rear part of the pin so as to force the tooth 16'' in the direction of the notches 15. The rear part 16' of the pin, which projects out of the casing, is provided with an eye enabling it to be hingedly attached to a hand lever (not shown) for withdrawing the tooth 16'' from the particular notch on outer ring 11 in which it is engaged. When the tooth is thus withdrawn, the blade 10 can be adjusted to any desired angle, as governed by the notches provided.

FIGS. 3, 4 and 5, illustrate different embodiments of the positioning mechanism.

FIG. 3 shows the application of a hydraulic fluid for holding the tooth 16'' in its position. A rod 16 passes centrally through a hydraulic cylinder 17, the rear end 16' of the rod 16 projecting through the cylinder cover 20, the toothed end 16'' of the rod 16 emerging from the other end of the cylinder. The tooth in this case — by way of example — is of hemispherical shape. The rod 16 is fixedly attached to a piston 19, which tightly fits into the cylinder; and an auxiliary weak spring 18 between the cylinder cover 20 and the piston 19 pushes the latter towards the outer ring 11. The end 16' of the piston rod 16 projecting beyond the cylinder cover 20 is hingedly connected to a lever 21, which permits the withdrawal of the tooth from a notch on the outer ring 11 for the purpose of changing the blade angle.

An oil seal and gland 22 in the cylinder cover 20 prevents the loss of hydraulic fluid along the piston rod through the bore. The portion of the cylinder between the cover 20 and the piston 19 is filled with a hydraulic fluid, which is held under pressure and replenished from a closed half-filled storage vessel 23. Connection between the storage vessel and the said portion of the cylinder is through two pipes, 24 and 40. Pipe 40, which passes from the cylinder to the side of the vessel, is fitted with an adjustable pressure relief valve 25. The other pipe, 24, runs from the bottom of the vessel to a check-valve 26, which prevents the return of fluid from the cylinder to the vessel. Connection between the check valve and the vertical branch of the rising pipe is established by a short piece of capillary tube 27 or other suitable flow-restricting means. This reduces the flow from the vessel to the cylinder. The top of the vessel is provided with a pressure gauge 28, an air inlet 29, and a check-valve 30, for setting the pressure in the storage vessel to the level sufficient for holding the tooth 16'' in the notch on the outer perimeter of the outer ring 11 which determines the appropriate angle of the blade. Should the grader blade meet a major off-centre obstruction, which would be liable to cause damage to the implement, the moment created results in a tangential force at the periphery of the outer ring 11 and on the inclined face of the notch and the tooth 16''. The resultant of that force acts on the fluid in the cylinder and increases its pressure until the relief valve 25 opens and some fluid spills into the vessel 23. The tooth and the notch become disengaged, and the outer ring 11 is free to turn, carrying the attached blade with it. The obstacle is thus easily cleared. The tooth remains in the disengaged position because of the slow

pressure buildup between the piston **19** and cylinder cover **20** assured by the capillary tube (flow restricting means) **27** in the supply line. On the other hand, the counter-pressure having ceased, the relief valve **25** has closed again, and no fluid can enter the cylinder therethrough, so that the tooth will slip several notches, enabling the blade and the ring to turn as far as is necessary to clear the obstacle.

The positioning and release mechanism shown in FIG. **4** is similar to that described with reference to FIG. **3**; however, it uses compressed air and a diaphragm instead of a hydraulic fluid and a piston. The open end of the vessel **17'** containing the compressed air is closed by a flexible diaphragm **19'** held in position by a threaded ring **31.** The elongated stem of tooth **16''** is guided in a bush **32** and can be pulled back by means of a lever **21** turning on its fulcrum **33.** Compressed air is let into the vessel through inlet **29** and check-valve **30,** a pressure gauge **28** indicating the pressure in the system.

The operation of this embodiment of the invention is similar to that of a substantially similar mechanism based on a spring-loaded tooth, as the tooth will snap back into the adjacent notch when the ring is turned by an obstruction, to be pushed out again if the moment has not abated.

The positioning mechanism illustrated in FIG. **5** uses the force of a permanent magnet for keeping the tooth in the notch. The outer ring **11** rotates about a fixed inner ring **13** on tapered rollers **14'**, and the notches **15** are, by way of example, cut into the upper surface of the ring. The notches are engaged by the tooth-shaped tapered head of a vertical pin **16** guided by a bore in the armature **34** of a permanent horse-shoe magnet **35.** The magnet is rigidly connected to the upper part of pin **16** by means of an eye-nut **36,** which serves as a link with the hand lever **21** turning on its fulcrum **33.** The armature **34** and the fulcrum **33** are fixedly connected to the inner ring **13** by way of a metal support **37** integral with this ring.

In this mechanism the tooth is kept in its notch as long as magnet and armature are in close contact with each other. When a lateral force, caused by an off-centre obstruction in the path of the implement forces the tooth out of its notch, it lifts the magnet off the armature, the induction force disappears, and the tooth is free to move wholly out of the notch impelled by the lateral force exerted on the side of the tooth by the obstacle encountered. The outer ring **11** and the attached blade are thus permitted to rotate freely. The blade is reset by lifting the magnet with the aid of the hand lever **21.**

The grader-leveler shown in FIGS. **6** and **7** differs from that shown partly in FIGS. **1** and **2** in the suspension of the blade. Instead of a rotatable outer ring and a fixed inner ring, a turntable **11'** turns about a vertical shaft **13'**, which is fixedly attached to a cross-member **39** of the supporting frame **6.** The periphery of the turntable is provided with a plurality of trapezoidal notches **15,** which are engaged by a conforming tooth **16,** a positioning mechanism thus being formed. The tooth constitutes the lower extremity of an approximately 8-shaped lever **39,** the other end **21** of which is handle-shaped. The lever turns about a horizontal pin **33** fixedly attached to the supporting frame, while a helical spring **18'** in the vicinity of the handle pulls the handle towards the frame and thus the tooth in the direction of the notches. The release mechanism works similarly to the arrangements described with reference to FIGS. **3, 4** or **5,** in that an off-centre obstacle pushes the tooth **16** out of the notch, the tooth returning to, or sliding over, successive notches until the obstacle is cleared. The turntable and the blade are set while handle **21** is lifted.

The above descriptions are to be regarded as illustrative examples only. Other modifications and alterations, as well as combinations of different parts of the devices described, will readily suggest themselves to a person skilled in the art without thereby departing from the spirit of the invention described herein. A possible modification is to replace the rear support wheels **5,** as shown in FIGS. **1** and **2,** by a float or floats of the type used in connection with smoothers. Another modification would be substitution of these wheels by rollers or roller packers, whereby these arrangements would carry out the additional task of seed bed preparation, and the equipment will be chosen accordingly.

In any of the embodiments detachable side-shields or aprons for attachment to the ends of the blade may be supplied for conversion from grader to leveler and vice versa.

I claim:

1. A grader-leveler comprising

a chasses (**3, 6**) having means at its forward end for trailing attachment to a farm tractor (**1**) and, at its rear end, means (**5**) for supporting the chassis above ground;

a normally horizontal turntable means (**11**), and means (**13**) securing the turntable means (**11**) to the chassis (**3, 6**) while permitting selective angular positioning thereof with respect to said chassis;

a grading and leveling blade (**10**) secured to the turntable means (**11**);

wherein the improvement comprises

quick-release and force overload means (**15, 16, 17**) locating the turntable means (**11**) and hence the blade (**10**) in angularly adjusted position with respect to the chassis (**3, 6**) comprising

a tooth element (**16''**) and a detent element (**15**), one of said elements being secured to the turntable means (**11**) and the other to the chassis (**3, 6**), said elements having respectively converging slide surface and being relatively movable for mutually releasable engagement with each other;

and releasable force means located on one of said elements, acting in the direction of movement on at least one of said elements and constraining said converging surfaces into engagement to hold the grader blade (**10**) in selected angular position under normal working conditions, but permit disengagement of said tooth and detent elements by relative sliding movement of said converging surfaces upon disengagement forces exerted by an overload on the blade as the result of an obstruction in excess of the engagement force exerted by said force means, the disengagement force being transmitted between the converging engaging slide surfaces of said elements.

2. A grader-leveler according to claim **1** wherein the turntable means (**11**) is rotatable with respect to said chassis (**3, 6**) and formed with circumferential notches (**15**) forming said detents, the blade (**10**) is rigidly secured to the turntable means (**11**), and the tooth element (**16''**) is supported on the chassis.

3. A grader-leveler according to claim 1 wherein the tooth element (16'') is formed with said converging slide surfaces.

4. A grader-leveler according to claim 1 wherein the turntable means (11) is formed with notches (15) on part of its periphery to provide said detent element;
and the tooth element (16'') comprises a substantially horizontal pin (16) having a tooth-shape end located to engage said notches (15);
the forece means comprising a spring (18), acting on the pin (16');
the blade (10) being secured to said turntable means (11); and a handle (21) for disengaging the tooth (16'') manually in order to enable the turntable means (11) and the attached blade (10) to be turned to a desired angle.

5. A grader-leveler according to claim 1 wherein the turntable means (11) is formed with notches (15) or serrations in a face thereof forming said detents;
and the tooth element (16'') comprises a movable tooth engaging with the notches or serrations (15) and having a direction of movement in essentially vertical direction with respect to the plane of rotation of the turntable means.

6. A grader-leveler according to claim 1 wherein the force means comprises a piston movable in a close fitting cylinder and containing a fluid under pressure, the piston being connected to one of said elements and forcing the elements together and into engagement;
and means are provided connected to the cylinder for releasing the fluid pressure upon a predetermined load being exerted between the elements by the inclined side of the respective element and resulting in a proportional force on the piston.

7. A grader-leveler according to claim 1 wherein the force means comprises a diaphragm connected at one side thereof to one of the elements, the diaphragm being attached to the open end of an otherwise closed pressure vessel;
means for filling said vessel with a fluid under pressure;
and means for releasing said pressure upon a predetermined load being exerted between said elements.

8. A grader-leveler according to claim 1 wherein the force means comprises permanent magnet means connected to one of said elements and armature magnet means located to hold said elements in engagement.

9. A grader-leveler according to claim 8 wherein one of said magnet means is movable with said tooth element and the other is connected to be non-rotatable with respect to the chassis.

10. A grader-leveler according to claim 1 wherein the means for supporting the chassis above ground comprises at least one wheel attached to its rear end.

11. A grader-leveler according to claim 1 wherein a plurality of wheels are provided, said wheels being directionally self-adjusting caster wheels.

12. A grader-leveler according to claim 1 wherein the means for supporting the chassis above ground level consist of one or more floats attached to its rear end.

13. A grader-leveler according to claim 1 wherein the means for supporting the chassis above ground level consist of one or more rollers or roller-packers attached to its rear end.

14. A grader-leveler according to claim 1 wherein the blade is rotatable about a substantially vertical axis which is substantially centrally located with respect to the chassis;
and the tooth-and-detent element are located off-centre with respect to said axis, the force means retaining said tooth-detent elements in engagement under normal working conditions but permitting disengagement of said elements by lateral forces exerted by an overload of the blade as a result of off-centre obstructions being encountered by said blade, said lateral disengagement force being transmitted between the inclined engaging surfaces of said element.

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