

Sept. 27, 1938.

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2,131,373

EARTH CUTTING, DIGGING, AND MOVING MACHINE

Filed March 24, 1937

3 Sheets-Sheet 1

Fig. 1.

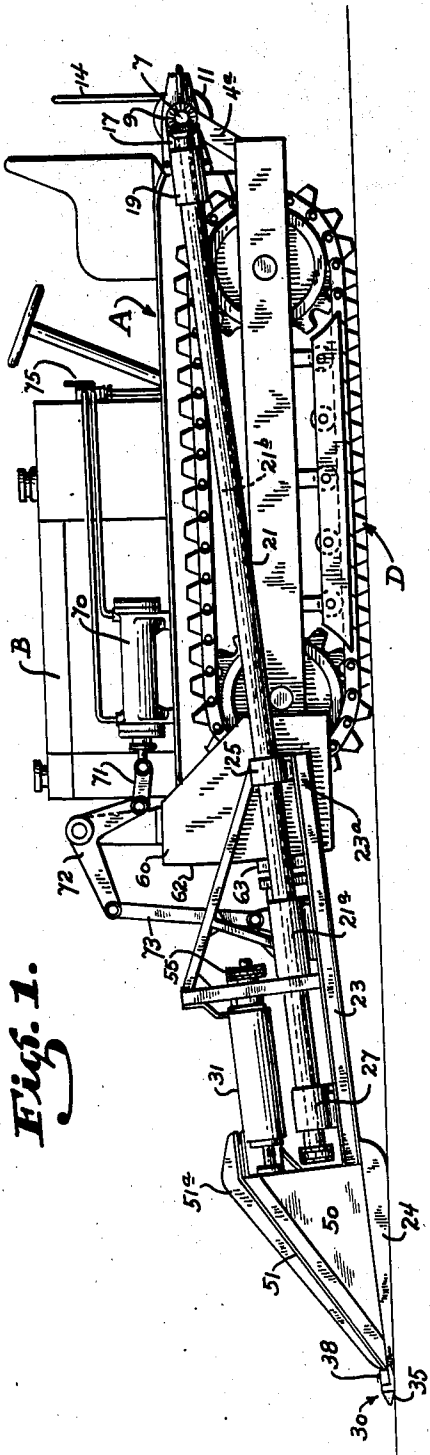
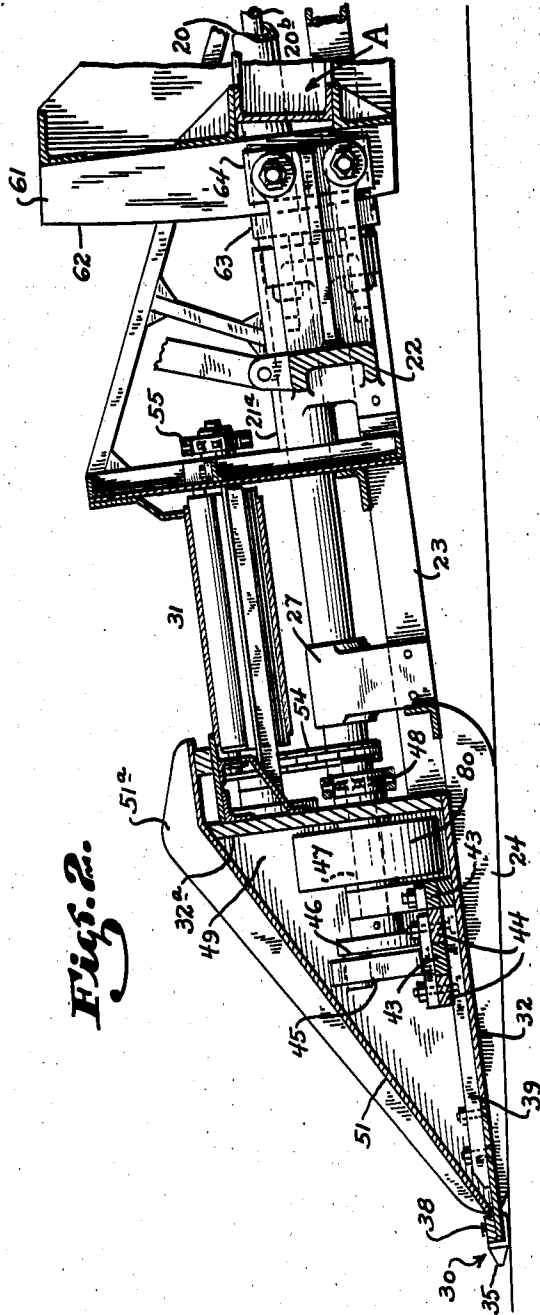


Fig. 2.



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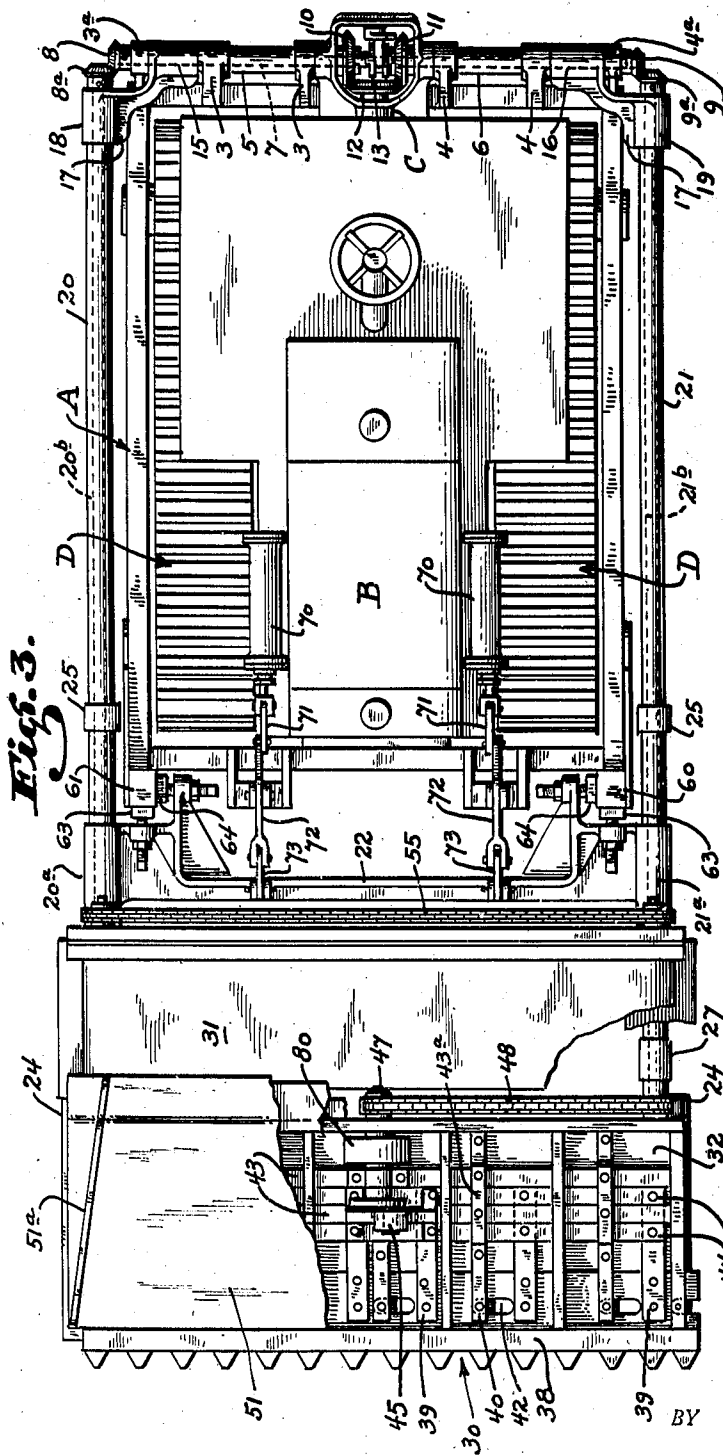
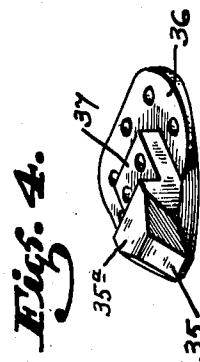
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Fig. 5.

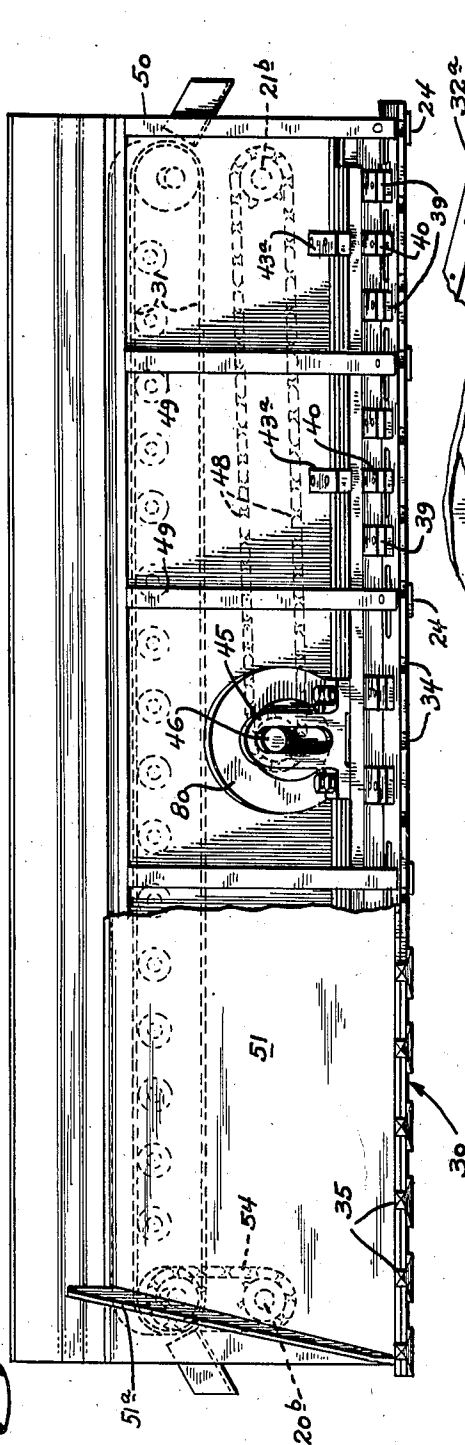
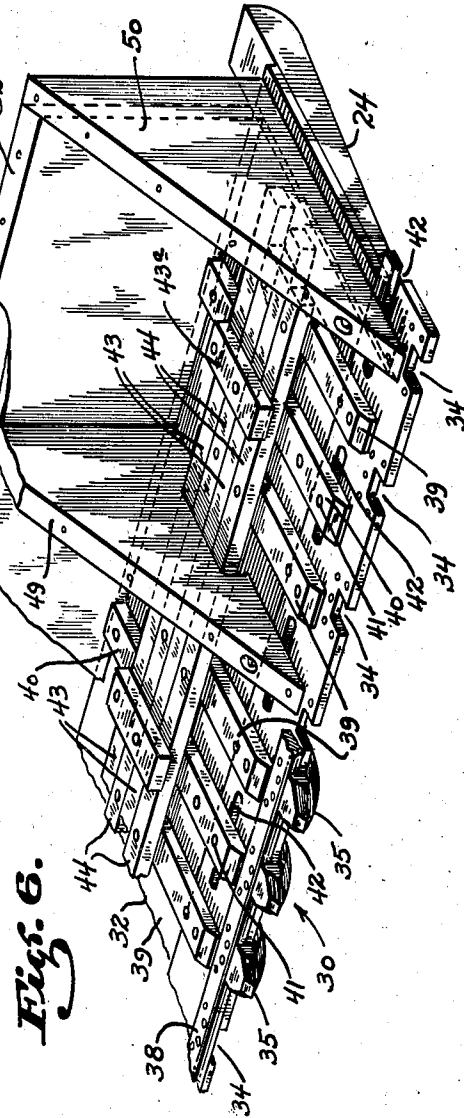


Fig. 6.



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EARTH CUTTING, DIGGING, AND MOVING MACHINE

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11 Claims. (Cl. 37-108)

This invention relates to road building machines, and especially to that type known as bulldozers.

A bulldozer generally consists of a heavy steel blade about seven feet wide and thirty inches high which is disposed in front of a tractor of the self-laying track type. The blade is supported by heavy beams and braces from the main frame of the tractor, but even so the braces will bend or break when large roots and rocks are encountered. Besides that, much time is lost in backing, swerving, etc., as when the tractor moves ahead and scrapes and gathers a pile of dirt the operator must swerve the tractor to one side or another to push the dirt off the road. He must then back up the tractor and straighten it out before he can again go ahead to scrape up another pile. All this maneuvering to scrape up and remove a pile of dirt takes up so much time that the capacity of the machine as a whole is very limited.

The object of the present invention is to generally improve the construction and operation of machines of this character; to provide a cutter blade which reciprocates laterally in the manner of a saw while the tractor is advancing; to provide a cutter blade on which is mounted a series of teeth which cut both in a forward and in a lateral direction as the tractor advances; to provide a drive whereby reciprocal or lateral movement is transmitted to the cutter blade and teeth; to provide a laterally extending conveyor whereby dirt and rocks loosened by the blade and teeth may be discharged to one side or another of the road which is being worked on; to provide means for transferring or elevating the loosened dirt or rocks from the cutter blade to the conveyor; to provide a novel method of transmitting power from the power take-off shaft of the tractor to the cutter blade and the conveyor in unison; to provide means for raising or lowering the cutting and earth conveying mechanism with relation to the tractor; and further, to provide means for taking up both end and lateral thrust exerted by the cutting and conveying mechanism with relation to the main frame of the tractor.

The invention is shown by way of illustration in the accompanying drawings in which

Fig. 1 is a side elevation of the machine;

Fig. 2 is an enlarged vertical section taken longitudinally of the forward end of the machine;

Fig. 3 is a plan view of the machine, said view being partially broken away;

Fig. 4 is a perspective view of one of the cutter teeth;

Fig. 5 is a front view of the cutting and elevating portion of the machine, said view being partially broken away; and

Fig. 6 is a perspective view of a portion of the cutter blade and teeth, said view showing the manner in which the blade and teeth are supported and guided with relation to the frame supporting the same.

Referring to the drawings in detail, and particularly to Figs. 1 and 3 A indicates in general the main frame of a tractor of the self-laying track type, B the engine, C the power take-off shaft, and D—D the tracks upon which the tractor is supported and driven.

Secured to the rear end of the frame are pairs of bearing brackets indicated at 3 and 4. Journalled therein are tubular housings 5 and 6. Extending through the tubular housings 5 and 6 is a shaft 7 on the outer ends of which are secured beveled gears 8 and 9. Substantially centrally of the shaft are loosely mounted beveled gears 10 and 11 which intermesh with a beveled gear 12 secured on the power take-off shaft. Between the gears 10 and 11 is a splined clutch member 13 operated by means of a lever 14, and formed on the faces of the gears 10 and 11 are cooperative clutch members, either of which may be engaged depending upon the direction in which shaft 7 is to be rotated.

Supporting the tubular housings 5 and 6 at their extreme outer ends are bearing brackets 3a and 4a, and disposed between the bearings 3a and 4a and the adjacent bearings 3 and 4 are bearing sleeves 15 and 16 which, through means of angle arms 17, support bearing sleeves 18 and 19. Secured in the sleeves 18 and 19 are tubular housings 20 and 21, the forward ends of which are secured in bearings brackets 20a and 21a formed on opposite ends of a cross frame 22 disposed in front of the tractor. This cross frame, together with tubular housings 20 and 21 and the bearings 18 and 19, is free to pivot about the tubular housings 5 and 6 so as to permit the earth cutting, elevating and conveying mechanism to be raised and lowered with relation to the tractor as will hereinafter be described, the tubular housings 20 and 21, in other words, acting as side arms for the frame to permit raising and lowering thereof and at the same time functioning as housings for the drive shafts extending therethrough. The cross frame 22 has secured to its lower face forwardly extending channel bars 23 which terminate in their forward

ward ends in skid arms or shoes 24. The channel bars are extended rearwardly toward the tractor as shown at 23a and are there secured with relation to the tubular housings 20 and 21 by means of sleeves 25. This forms a rigid connection between the tubular housings 20 and 21, the cross frame 22, and the forwardly extending channel bars 23. The bars 23 and the shoes or skids 24 disposed in front thereof may be formed integral or in separate pieces secured with relation to each other, this being of little importance as it is merely a structural detail. The tubular housings 20 and 21 are extended some distance forward of the bearing sleeves 20a and 21a and their extreme forward ends are secured in bearing brackets 27. The tubular housing 20 forms a housing and bearing for an inner shaft 20b which is driven from shaft 7 by a beveled gear 8a which meshes with the beveled gear 8. The tubular housing 21 similarly forms a housing and bearing for a shaft 21b which is driven from the shaft 7 by means of a beveled gear 9a meshing with the beveled gear 9. The shaft 21b transmits power to a cutter blade generally indicated at 30, while the shaft 20b transmits power to a laterally extending endless conveyor 31. The cutter blade 30 is best shown in Figs. 2, 3, 5 and 6. It is disposed at the forward end of the shoes 24 and is partially supported by said shoes and by a base plate 32. The cutter blade has a length equal to the width of the machine and its forward edge is provided with a series of notches 34 (see Fig. 6) and in these notches are inserted teeth 35 (see Figs. 4 and 6). Each tooth is provided with a base flange 36 which extends in under the cutter blade. These flanges provide means whereby the teeth are secured to the blade and they also serve the purpose of cutting away the earth in front of the shoes 24 thus preventing the front ends of the shoes from catching in rocks or roots. The teeth also have a raised portion 37 to fit the notches 34. The base flange is riveted to the cutter blade while the raised portion 37 receives a clamping bar 38 which extends from end to end of the cutter blade. Each tooth is raised as shown at 35a and a shoulder is formed behind the raised portion to receive the clamping bar. This raised portion is important as it cuts away the soil to form a clear path for the clamping bar. Secured to the cutter blade and disposed at right angles thereto and extending rearwardly over the top surface of the base plate 32 are a series of arms 39. Similarly secured to the top surface of the base plate and in a position parallel to the arms 39 are arms 40. These arms extend over the cutter blade and bolts pass therethrough which are secured in the shoes 24 disposed below them, the attaching bolts being shown at 41. In view of the fact that a reciprocal motion is transmitted to the cutter blade when the machine is in operation, slots 42 must be formed in the cutter blade to clear the bolts 41. The arms 39 and 40 alternate, the arms 40 being the stationary arms and the arms 39 the movable arms as they are attached to and move with the cutter blade; in fact they are the arms by which reciprocal movement is transmitted to the cutter blade, and this is accomplished as follows: Secured to the stationary arms 40 are a pair of transversely extending guide bars 43. Disposed between said bars are a pair of bars 44. These bars are secured to the arms 39 and reciprocal movement is transmitted to the bars 44 by means of a yoke 45 and a crank 46 extending therethrough. This

crank is formed on the outer end of a shaft 47 which is driven from shaft 21b through means of sprockets and a chain 48. In other words, when power is transmitted to shaft 21b it will also be transmitted through the chain 48 to shaft 47, and as this shaft carries a crank 46 on its outer end which extends through the yoke 45, a reciprocal motion will be transmitted to the yoke and the bars 44 to which it is attached. These bars are in turn secured to the arms 39, and as they are secured to the cutter blade 30, reciprocal or lateral movement will be transmitted thereto. The bars 43 really function as guides for the bars 44 and so do the cross bars indicated at 43a; in fact the same may be said of the angle braces indicated at 49, as they are notched to permit the bars 43 and 44 to pass therethrough. These angle bars are secured not only to the base plate 32 but also to a back plate 32a. A suitable number of angle plates are provided and end plates such as shown at 50 of similar shape are also employed. These plates, together with the angle plates 49, form a support for a deflector plate 51 which deflects and elevates material cut or loosened by the cutter blade or the teeth 35 to the conveyor belt 31. By referring to Fig. 2 it will be noted that the front edge of the plate 51 is disposed behind the clamping bar 38, the forward or leading edge of the deflector plate is thus protected and relieved of undue stress. At each end of the deflector plate are end deflectors 51a to prevent the soil from sliding off the ends. The conveyor belt, as previously stated, extends crosswise of the frame and is supported by pulleys or rollers journaled at opposite ends of the frame. The conveyor is driven from shaft 20b by a belt or preferably a chain drive as indicated at dotted lines 54 (see Fig. 5), and in order to prevent slipping, a second drive may be transmitted to the opposite pulley of the conveyor by means of a chain 55. All dirt elevated by plate 51 will be received by the conveyor and as such will be transferred and discharged at one side or another as the machine advances, it being possible to drive the conveyor 31 in either direction depending upon which side the dirt is to be discharged by merely throwing the clutch 14 to one side or another.

The end and lateral thrust produced when a machine of this character is advancing and cutting is rather heavy, and it is accordingly important that the tubular housings 20 and 21 and the shafts extending therethrough be relieved of this thrust as much as possible. This is accomplished in the present instance by placing thrust plates at each front corner of the machine as indicated at 60 and 61. These thrust plates have vertical inner faces and curved outer faces as indicated at 62, the curve of the outer faces being struck from the pivotal point of the shaft 6. These curved outer faces take or absorb the end thrust produced, as the cross frame 22 is provided with adjustable shoes 63 which engage these faces. The lateral thrust is taken care of by adjustable shoes 64 also carried by the cross frame 22. These shoes engage the inner vertical surfaces and all lateral motion is thus taken up.

To raise and lower the digging, elevating and earth conveying mechanism, a pair of cylinders 70 is placed on the tractor as indicated at 70. These cylinders are connected with links 71 and bell-cranks 72. These are in turn connected through links 73 with the cross frame 22. The cylinders are hydraulically actuated with a valve control 75

as indicated at 75, and as this control is within convenient reach of the driver or operator, the cutting, digging, elevating and conveying mechanism may be raised or lowered as conditions demand.

In actual operation the tractor will move slowly in a forward direction, and as it does so, reciprocal movement is imparted to the cutter blade 30 and the teeth 35 attached thereto. This reciprocal motion is comparatively rapid and the stroke short. The blade thus acts as a saw and rapidly cuts its way through the soil. If roots and rocks are encountered, they are readily cut off and dislodged. At the same time as the machine advances the loosened material will pile up on the plate 51 and will gradually work upwardly over the plate and is thus elevated and delivered to the conveyor 31 which in turn transfers and discharges it to one side of the machine. The cutting teeth 35 are sharpened both at their sides and at their forward point, as clearly shown in Fig. 4, and as such will readily cut roots and shatter and loosen rock-impregnated soil providing the rocks are not too large.

A machine constructed and operated in the manner described will have a very large capacity, as no time is lost in backing, swerving, etc. All progress is in a forward direction, and soil is being continuously cut, elevated and discharged; in fact, the capacity is so much greater than that obtained by ordinary bulldozers that a comparison is hard to make. The depth of cut made as the tractor advances will depend to a great extent upon the character or formation of the soil, but in most instances will be deeper than any cut made by an ordinary bulldozer. The power required is at all times furnished by the main motor of the tractor and is taken from the power take-off shaft, and hence there is an ample power supply. As the gears and shafts through which the power is transmitted are relieved of all end and lateral thrusts, power may be efficiently transmitted. The swivel connection formed by the bearings 15 and 16 and 18 and 19 ensures continuous meshing of the beveled gears regardless of the position of the digging mechanism. The cutter blade can be made as heavy as conditions may demand, and as it is covered by the deflector plate 51, protection is provided against the entrance of dust and dirt and as such permits ample lubrication of the reciprocal parts.

The construction provided permits transmission of power to the cutter blade by means of a chain drive as shown at 48, and it permits the use of a flywheel 80 on the crank shaft. This is important, as the flywheel tends to carry through the reciprocal motions of the cutter blade where sudden resistance is encountered, and the chain takes up back lash, thereby reducing wear and tear on the beveled gears through which the power is transmitted. The transmission of power from the crank to the cutter blade is at the center point thereof, thus eliminating any tendency to buckle or bend the cutter blade. The center drive furthermore distributes pressure and weight evenly over the base plate and thereby insures uniform wear. The skids or shoes indicated at 24 not only function as a support for the cutting mechanism when in operation, but they also aid in taking up lateral thrust as they have a tendency to cut into and form furrows in the ground through which they are advancing. This, together with the

shoes 64, takes care of all lateral strain, while the shoes 63 take up all end thrusts.

While this and other features of the present invention have been more or less specifically described and illustrated, I wish it understood that various changes may be resorted to within the scope of the appended claims, and similarly, that the material and finish of the several parts employed may be such as the manufacturer may decide, or varying conditions or uses may demand.

Having thus described my invention, what I claim and desire to secure by Letters Patent is—

1. The combination with a tractor of a frame disposed in front of the tractor, a pair of side arms on the frame, one on each side of the tractor, a pivotal connection formed between the rear ends of said arms and the tractor, means on the tractor for raising or lowering the forward end of the frame with relation to the tractor, a cutter blade disposed transversely of the frame and at the front thereof and mounted for reciprocal movement, and means for reciprocating the cutter blade while the tractor advances.

2. The combination with a tractor having a power take-off shaft of a frame disposed in front of the tractor, a pair of side arms on the frame, one on each side of the tractor, a pivotal connection formed between the rear ends of said arms and the tractor, means on the tractor for raising or lowering the forward end of the frame with relation to the tractor, a cutter blade disposed transversely of the frame and at the front thereof and mounted for reciprocal movement, a shaft journaled on one of said arms, means for transmitting power from the power take-off shaft of the tractor to said shaft, and means for transmitting power from the shaft on the side arm to reciprocate the cutter blade.

3. The combination with a tractor having a power take-off shaft of a frame disposed in front of the tractor, a pair of side arms on the frame, one on each side of the tractor, a pivotal connection formed between the rear ends of said arms and the tractor, means on the tractor for raising or lowering the forward end of the frame with relation to the tractor, a cutter blade disposed transversely of the frame and at the front thereof and mounted for reciprocal movement, a conveyor disposed transversely of the frame behind the cutter blade, a transverse shaft on the tractor, means for transmitting power from the power take-off shaft to the transverse shaft, a pair of longitudinally extending shafts, one on each side arm and driven by the transverse shaft, means for transmitting power from one longitudinal shaft to drive the conveyor, and means for transmitting power from the other longitudinal shaft to reciprocate the cutter blade.

4. The combination with a tractor having a power take-off shaft of a frame disposed in front of the tractor, a pair of side arms on the frame, one on each side of the tractor, a pivotal connection formed between the rear ends of said arms and the tractor, means on the tractor for raising or lowering the forward end of the frame with relation to the tractor, a cutter blade disposed transversely of the frame and at the front thereof and mounted for reciprocal movement, a conveyor disposed transversely of the frame behind the cutter blade, a transverse shaft on the tractor, means for transmitting power from the power take-off shaft to the transverse shaft, a pair of longitudinally extending shafts, one on

each side arm and driven by the transverse shaft, means for transmitting power from one longitudinal shaft to drive the conveyor, means for transmitting power from the other longitudinal shaft to reciprocate the cutter blade, and an inclined plate on the frame between the cutter blade and the conveyor to carry dirt from the cutter blade to the conveyor.

5. The combination with a tractor having a power take-off shaft of a frame disposed in front of the tractor, a pair of side arms on the frame, one on each side of the tractor, a pivotal connection formed between the rear ends of said arms and the tractor, means on the tractor for raising or lowering the forward end of the frame with relation to the tractor, a cutter blade disposed transversely of the frame and at the front thereof and mounted for reciprocal movement, a conveyor disposed transversely of the frame behind the cutter blade, a transverse shaft on the tractor, means for transmitting power from the power take-off shaft to the transverse shaft, a pair of longitudinally extending shafts, one on each side arm and driven by the transverse shaft, means for transmitting power from one longitudinal shaft to drive the conveyor, means for transmitting power from the other longitudinal shaft to reciprocate the cutter blade, an inclined plate on the frame between the cutter blade and the conveyor to carry dirt from the cutter blade to the conveyor, and means for reversing the direction of the conveyor to discharge dirt at either side of the frame.

6. The combination with a tractor having a power take-off shaft of a frame disposed in front of the tractor, a pair of side arms on the frame, one on each side of the tractor, a pivotal connection formed between the rear ends of said arms and the tractor, means on the tractor for raising or lowering the forward end of the frame with relation to the tractor, a cutter blade disposed transversely of the frame and at the front thereof and mounted for reciprocal movement, a conveyor disposed transversely of the frame behind the cutter blade, a transverse shaft on the tractor, means for transmitting power from the power take-off shaft to the transverse shaft, a pair of longitudinally extending shafts, one on each side arm and driven by the transverse shaft, means for transmitting power from one longitudinal shaft to drive the conveyor, means for transmitting power from the other longitudinal shaft to reciprocate the cutter blade, a pair of thrust plates on the front end of the tractor, and means on the frame and engageable with the thrust plates to take up endwise and lateral thrust of the cutter blade when the tractor is advancing.

7. The combination with a tractor of a frame disposed in front thereof, means supporting the rear end of the frame with relation to the tractor, shoes on the frame supporting the front end of the frame, a base plate on said shoes, a cutter blade reciprocally mounted in front of the base plate and also supported by the shoes, means on the base plate securing the cutter blade against vertical movement with relation to the shoes and the base plate, arms on the cutter

blade extending rearwardly over the base plate, a common bar connecting said arms, and means for transmitting a reciprocal movement to the common bar, the arms and the cutter blade secured thereto.

8. The combination with a tractor of a frame disposed in front thereof, means supporting the rear end of the frame with relation to the tractor, shoes on the frame supporting the front end of the frame, a base plate on said shoes, a cutter blade reciprocally mounted in front of the base plate and also supported by the shoes, means on the base plate securing the cutter blade against vertical movement with relation to the shoes and the base plate, arms on the cutter blade extending rearwardly over the base plate, a common bar connecting said arms, and means for transmitting a reciprocal movement to the common bar, the arms and the cutter blade secured thereto, said means comprising a crank shaft and a yoke on the common bar through which the crank extends.

9. The combination with a tractor of a frame disposed in front of the tractor, a pair of side arms on the frame, one on each side of the tractor, a pivotal connection formed between the rear ends of said arms and the tractor, means on the tractor for raising or lowering the forward end of the frame with relation to the tractor, a cutter blade disposed transversely of the frame and at the front end thereof and mounted for reciprocal movement, means for reciprocating the cutter blade while the tractor advances, a conveyor disposed transversely of the frame behind the cutter blade, and means for transmitting power from the tractor to reciprocate the cutter blade and drive the conveyor.

10. The combination with a tractor of a frame disposed in front thereof, a cutter blade disposed transversely of the frame and at the front thereof, teeth secured to the blade, means for transmitting a reciprocal movement to the blade while the tractor advances, an inclined plate carried by the frame and disposed behind the cutter blade to gather and elevate material cut by the blade during advance of the tractor, a recessed shoulder formed behind each tooth, a cross bar seated on said shoulders and secured thereto, said cross bar extending in front of the lower end of the inclined plate and forming a guard to prevent material from passing in under the inclined plate.

11. The combination with a tractor of a frame disposed in front thereof, a cutter blade disposed transversely of the frame and at the front thereof, teeth secured to the blade, means for transmitting a reciprocal movement to the blade while the tractor advances, skid members below the frame and forming a support for the frame while it is being advanced by the tractor, the forward ends of said skid members also forming a support for the cutter blade, and a downwardly and rearwardly extending base flange on each tooth, said base flanges being disposed in front of the skid members and forming guards to prevent material from entering between the skid members and the cutter blade.

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