June 10, 1930. H. H. BARBER 1,762,568

DITCH DIGGING MACHINE

Original Filed Aug. 8, 1924 3 Sheets-Sheet 1

Fig. 8.

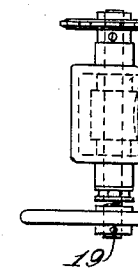


Fig. 1.

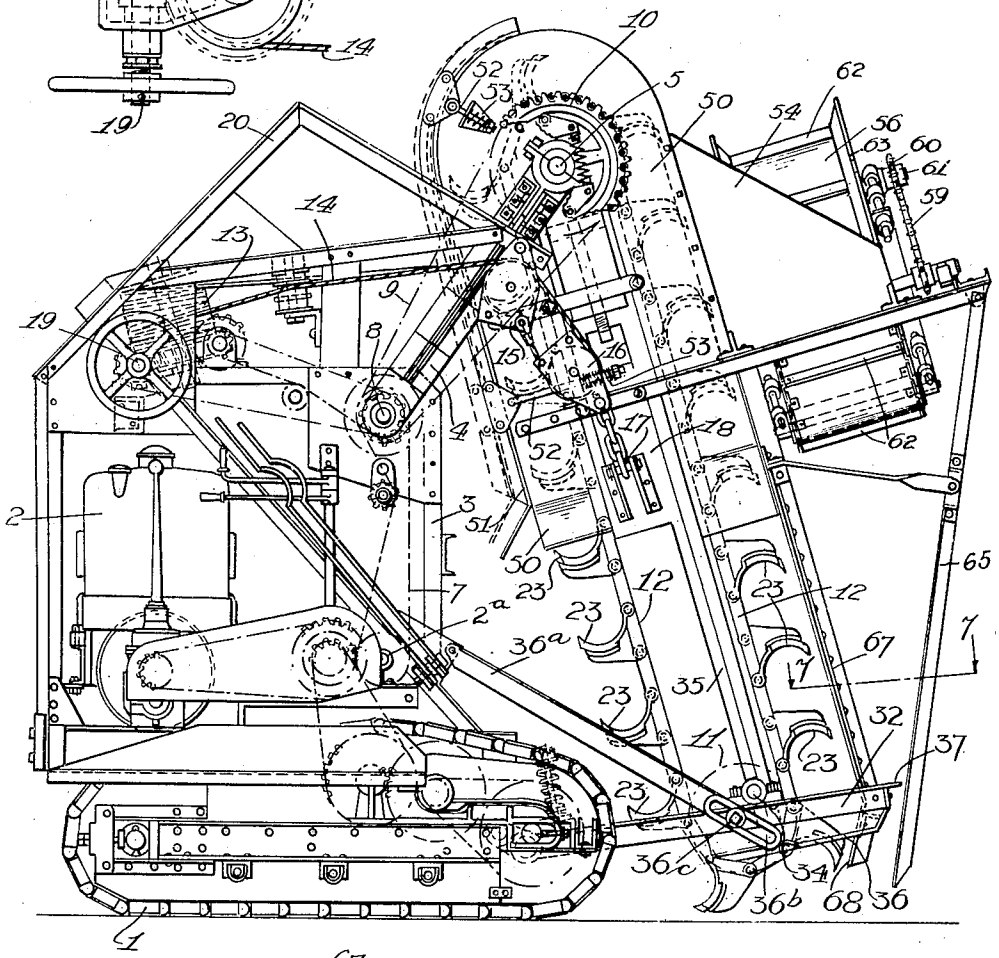
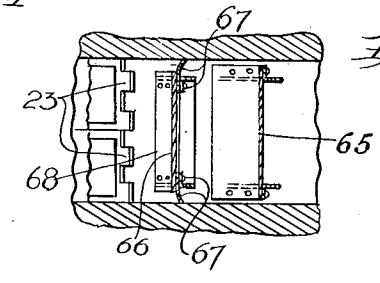


Fig. 7.



Inventor.
Harry H. Barber,
by Burton & Burton
his Attorneys.

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DITCH DIGGING MACHINE

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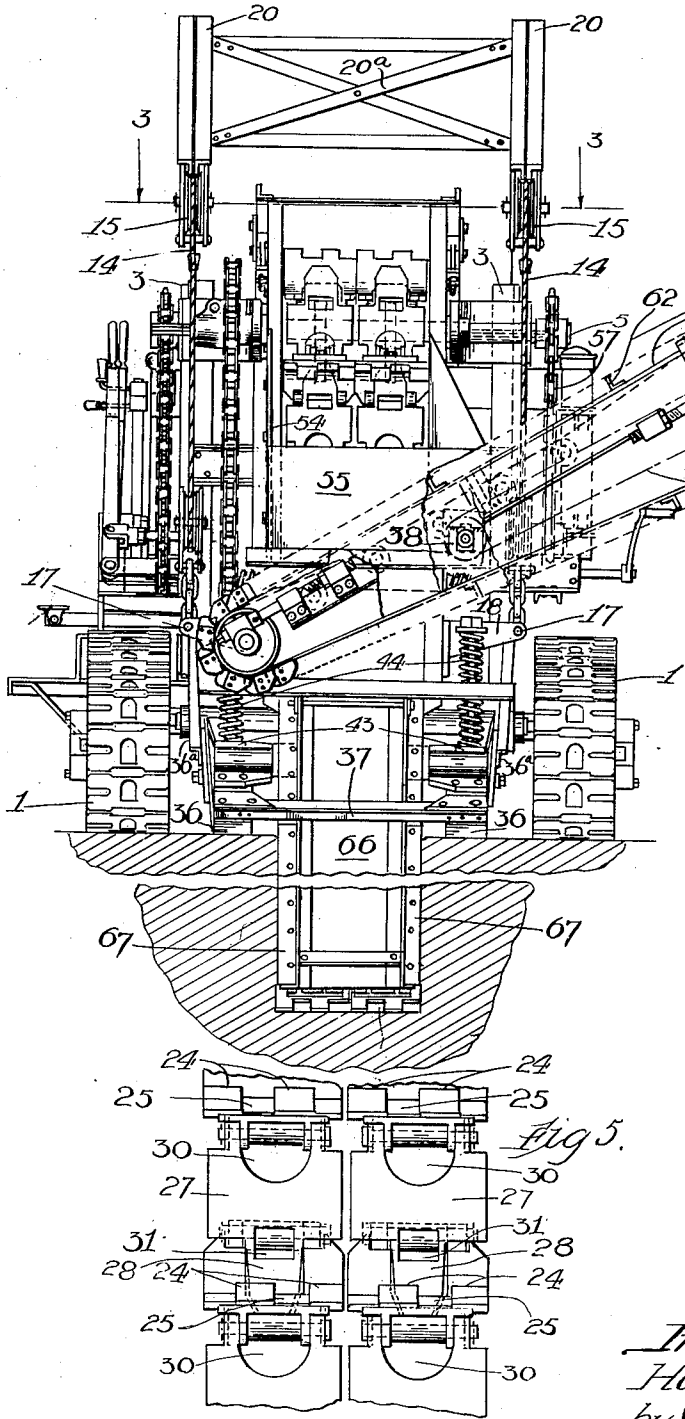


Fig. 2.

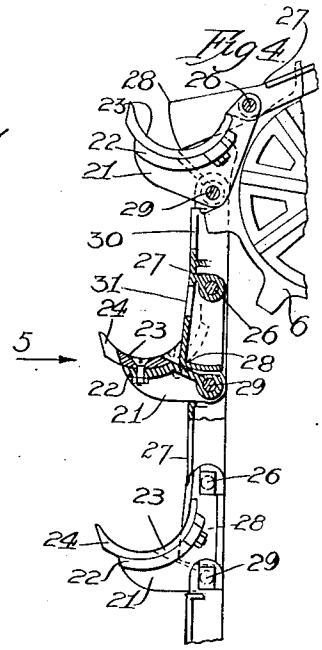


Fig 4.

Fig 5.

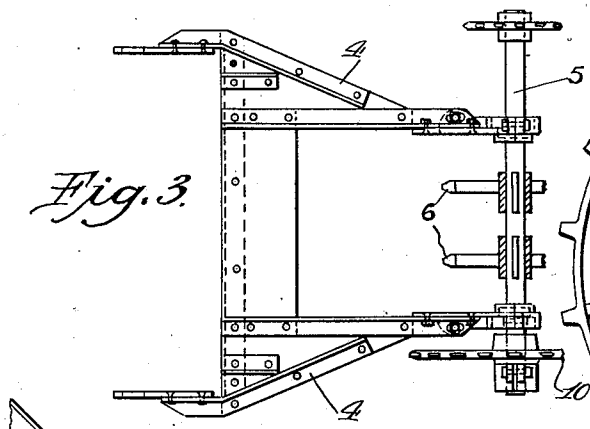
Inventor:
Harry H. Barber.
by Burton & Burton
his Attorneys.

June 10, 1930. H. H. BARBER 1,762,568

DITCH DIGGING MACHINE

Original Filed Aug. 8, 1924 3 Sheets-Sheet 3

Fig. 3.



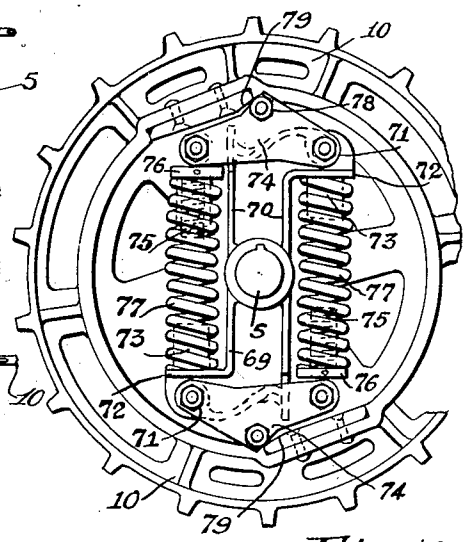


Fig. 10.

Fig. 6.

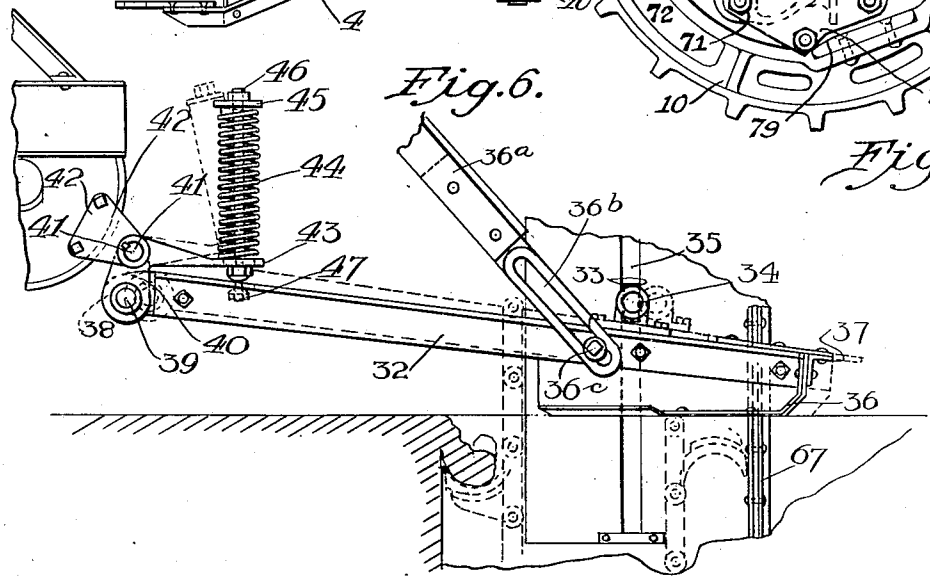
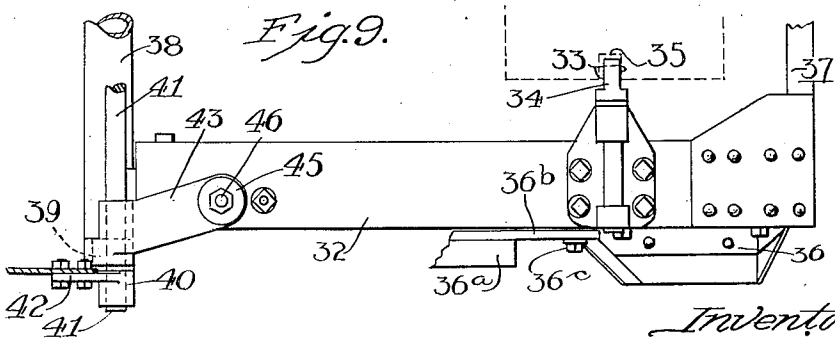


Fig. 9.



Inventor.
Harry H. Barber.
by Burton & Burton
his Attorneys.

Patented June 10, 1930

1,762,568

UNITED STATES PATENT OFFICE

HARRY H. BARBER, OF AURORA, ILLINOIS, ASSIGNOR TO BARBER-GREENE COMPANY, OF AURORA, ILLINOIS, A CORPORATION OF ILLINOIS

DITCH-DIGGING MACHINE

Application filed August 8, 1924, Serial No. 730,813. Renewed January 9, 1928.

This invention relates to a ditch digging machine and concerns itself primarily with a structure adapted for vertical digging.

One of the main characteristics of this improved machine resides in its ability to dig down straight in substantially a vertical direction in starting a trench, and in finishing a trench with a vertical end wall whereby much time and labor is saved over ditching machines that start digging upon a slope and require manual labor to dig away the slope. Due to this characteristic of the machine, it is possible to start a trench very close to a wall or building. This characteristic arises from the fact that the digging boom is raised and lowered in substantially a vertical plane.

Due to the construction of the machine, it is possible to dig trenches from the curb of a street to the middle thereof in cases where a service pipe is laid in the middle of the street without blocking traffic upon one side of the street. In general, the machine is short and compact and very mobile and susceptible of operation in limited areas and in places which other ditching machines cannot reach.

Another characteristic of the machine resides in a digging mechanism consisting of a plurality of flexible and independent digging members or chains side by side, so that the strain arising in one due to an obstruction is not transmitted to the other, and which provides greater flexibility over a single digging element.

A further characteristic of the machine resides in a yielding drive which is susceptible of applying a hammering action to any of the separate members in case an obstruction is encountered in operation in order to dislodge such obstruction.

Other features of the invention reside in means for returning spillage or scrapings to the sphere of action of the digging conveyors and for protecting the loaded buckets against spillage.

These are only some of the main characteristics of the machine, other characteristics and advantages will be pointed out as the description proceeds.

The invention comprises the novel structure and combination of parts hereinafter described and more particularly pointed out and defined in the appended claims.

In the accompanying drawings, which illustrate a preferred form of this invention and in which similar reference numerals refer to similar features in the different views:

Figure 1 is a side elevation of a ditching machine embodying this invention showing the digging boom raised above the level of the ground to allow free travel of the machine.

Figure 2 is an end elevation viewing the machine from the rear with respect to the direction in which it advances in the digging operation.

Figure 3 is a detail section taken as indicated at line 3—3 on Figure 2.

Figure 4 is a detail elevation partly in section showing the construction of the digging chain buckets.

Figure 5 is a face view of a portion of the digging chain looking in the direction of the arrow 5 on Figure 4.

Figure 6 is a detail side elevation of the guide yoke for the digging boom.

Figure 7 is a detail section taken as indicated at line 7—7 on Figure 1.

Figure 8 is a detail view of the hoist mechanism for raising and lowering the boom.

Figure 9 is a fragmental detail plan view of the guide yoke for the digging boom.

Figure 10 is an enlarged face view of the yielding driving sprocket.

As shown in Figure 1, the vehicle by which the digging mechanism is carried is preferably of the crawler type with crawler chains 1, 1 surmounted by a frame structure which supports a power plant in the form of an internal combustion engine enclosed in a suitable hood, as indicated at 2, and connected by transmission gearing for driving the crawler and also the digging mechanism.

There is a super-structure 3 upon the crawler and to the upper rear corner of this superstructure is pivoted a yoke comprising the radius arms 4 which are pivoted at their free ends to the upper part of the ditcher boom at the axis of a shaft 5 which carries the driving members 6, 6 for the digging chains. As the boom is raised and lowered,

the upper part will necessarily move in an arc defined by the radius rods 4. It will be noted that these rods 4 are pivoted to the crawler frame at a considerable elevation and when the ditching boom is lowered, they are in a substantially horizontal position and absorb the full thrust with respect to the upper part of the boom. In the inoperative position of the boom, the radius rods merely incline upwardly and it will be noted that the upper part of the boom has been drawn forwardly slightly from a true vertical plane. The boom, however, is suspended in a substantially vertical plane, so that as it is lowered, it will move downwardly in a general vertical plane in order to start to dig vertically.

As diagrammatically shown in Figure 1, the engine is geared to a jack shaft 2^a which is geared to the shaft 8 by suitable sprocket gearing including the sprocket chain 7. Suitable sprocket gearing including the sprocket chain 9 connects shaft 8 with the sprocket 10 on the head shaft 5. In view of the fact that that shaft 8 is the center upon which the radius arms 4 swing, the driving mechanism will be unaffected by changes in the angular adjustment of the boom.

The boom consists of suitable framing for supporting the shaft 5 carrying the head wheels 6, 6 and for also supporting the tail or foot sprockets 11. A continuous or endless digging chain 12 is trained over the sprockets 6 and 11. In the present instance, two such digging chains are shown side by side. The two reaches of the chains travel in substantially vertical planes when the boom is lowered into digging position.

The raising and lowering of the boom is accomplished by hoisting mechanism comprising a winding drum 13 around which two cables 14 are wrapped and from which they respectively extend around guide pulleys 15 to tackle blocks 16 which are anchored by suitable chains to the side plates 18 on the boom as indicated at 17.

The guide pulleys 15 are supported by a pair of frames 20 attached to the superstructure 3 and connected by cross braces 20^a.

A worm shaft 19 to which a hand wheel is attached is geared to the drum 13 as clearly shown in Figure 8, while the shaft 19 may be manually rotated, it is generally operated by the power plant 2, and for this purpose, the shaft 19 may be geared to the aforementioned shaft 8 by suitable sprocket gearing.

As before related, the endless digger is shown as consisting of two separate and independent digging chains arranged side by side and which may be of similar construction. Briefly, each chain consists of jointed units comprising a digging bucket member 21 formed with a seat 22 to which is secured a hardened blade 23 notched at its sharpened edge so as to present two separate teeth 24. The spaces 25 between the teeth 24 register vertically with the teeth 24 of the next succeeding link of the chain so that the full width of the chain thus acts upon the ground by the successive attack of these staggered teeth upon alternate vertical strips of the soil. Pivotally connected with the member 21 at the hinge axis 26 above the digging face of the blade 23 is the clean-out member 27 whose lower portion 28 extending adjacent the blade 23, is of less width than said blade, but extends across a sufficient portion thereof to effectively loosen and break up the material adhering to the digging portion of the chain when the same pass over the head sprocket. This movement automatically causes the clean out link 28 to swing about the hinge axis 26 and across the material-carrying surface of the digging portion of the chain, as shown in Figure 4. The upper end of the member 27 is pivoted at 29 to the lower end of the next succeeding member 21. and this connection serves merely as a jointed coupling between successive links of the chain.

By making the endless digger in separable units arranged side by side, any desired width of trench may be formed. This multiple feature adds flexibility to the endless digger, especially when a snag is encountered, as it permits one part of the digger to hold back under the over-load without transmitting the stress laterally to break or twist the parts. To prevent any accumulation of mud or clay on the under side of the digger links from interfering with their travel around the sprocket wheels, each link member 27 is formed with clearance openings 30 and 31 opposite the pivotal connections at 26 and 29 respectively, so that the teeth of the sprockets 6 can force such mud or clay through these openings as they engage the chain members.

When the boom has been lowered to the desired depth and the tractor crawlers 1, 1 are set in motion, the machine travels forward at a relatively slow speed for feeding the upwardly traveling reach of the digging chain against the forward end of the trench and continuing the formation of the trench as the machine travels. Under such operation, the thrust of the upper portion of the boom is absorbed by the radius arms 4 which will be substantially horizontal at such time, while the thrust of the lower end of the boom is absorbed by a drag yoke comprising the arms 32 which are slidably connected with the boom. To this end, each side of the boom has a vertical slot or guideway 35 into which the flattened ends of bolts 34 carried by the arms 32 extend. These guideways are of sufficient extent to allow for complete up and down movement of the boom. These arms 32 are preferably provided with shoes 36 which normally slide upon the ground at

the margins of the trench. Check links 36[a] are provided for limiting the downward movement of the shoes in travelling over depressions in the ground. Each check link 36[a] is attached at one end to the super-frame and the other end of each link is slotted, as indicated at 36[b], for receiving suitable studs 36[c] on the arms 32. The outer ends of the yoke arms 32 are connected by a tie rod 37 and at their inner ends they are joined by a tubular casting 38 pivotally carried on hangers 40 in the form of bell crank levers fulcrumed at 41 upon bracket 42 on the crawler. One arm of each bell crank lever forms the hanger proper while the other arm extends parallel to the arms 32 and overhangs one of them. This second arm reacts against a compression spring 44 whose opposite ends abut washers 45 on strain rods 46 anchored at 47 to the arms 32. This arrangement makes it possible for the ditcher boom to yield rearwardly under heavy work or in the event of encountering an obstruction in the ground.

It will be noted that the yoke arms 32 are located as low as possible in order to effectively hold the working end of the boom at its work. When the boom is raised, it will slide relatively to the arms 32 until the bottoms of the guideways 35 strike the studs or bolts 34. Further elevation of the boom will then cause the yoke arms 32 to swing upwardly clear of the ground as shown in Figure 1. It will also be appreciated that the arms 32, by means of the studs 34, control the lower end of the boom when the same is elevated in that it prevents the same from swinging inwardly against the end of the trench or the crawler, and maintains the boom in proper spaced relation.

The drive sprocket 10 of the head shaft 5 is loosely mounted upon the shaft 5 and is connected therewith by means of a yielding or slip clutch of the type disclosed in the Evans Patent, No. 1,562,442. This clutch is illustrated upon the gear 10 in Figure 1 and is shown in larger view in Figure 10. In referring to Figure 10, it will be observed that a spider or casting 69 is keyed upon the shaft 5 adjacent the gear 10. This spider has a pair of downwardly extending arms 70 which terminate in a boss 71 and a seat 72 above the boss. A spring-confining stud 73 extends from the seat. These parts comprise an integral casting. A similar casting with arms 70, boss 71, seat 72 and stud 73 comprises the upper part of the spider. A lever 74 is pivoted at one end to the lower boss and a simliar lever 74 is pivoted at its opposite end to the other boss. The free end of each lever 74 has a pivotal stud 75 projecting inwardly thereof and a seat 76 at the base of the stud. A coil spring 77 is confined between each pair of seats 72 and 76 and surrounds the aforementioned studs. Each lever 74 has an outer V-shaped periphery at the apex of which a roller 78 is mounted. The rollers 78 are diametrically opposite each other and engaging sloping shoulders 79 on the interior flange of the wheel 10. The shoulders 79 obviously slope in opposite directions.

The endless digger is hence driven through the yielding clutch, above described, and if a bucket should encounter a stone or obstruction whereby sufficient resistance would be created to overcome the tension of the springs 77, the latter would yield and allow the rollers to slip over the inclined shoulders 79. The gear would then rotate 180 degrees when the rollers respectively abut the opposite shoulders, at which time the bucket will again be forced against the stone or obstruction. If the stone or obstruction does not yield or give way, the clutch will slip again and the gear will rotate another 180 degrees, at which time the rollers again engage the first inclined shoulders and again urge the bucket against the stone or obstruction. This operation produces a hammering action of the bucket against the stone or obstruction and it will continue until the stone or obstruction yields or gives way. It is therefore obvious that the slip clutch not only yields when the endless digger encounters a stone or obstruction, but also exercises a hammering action to dislodge the stone or obstruction.

In connection with the aforedescribed structure, attention is directed to the fact that the boom in its elevating and lowering movements moves endwise in a substantially vertical plane. While the upper end of the boom has a slight arcuate movement due to the radius arms 4, the movement of these arms causes only a slight deviation of the boom from a vertical line movement.

Further, the arms 32 cause only a negligible arcuate movement. Consequently, when the boom is lowered into contact with the ground, it will only be slightly inclined and will be susceptible of starting at once to dig a vertical trench. On the other hand, if the boom were constructed to swing downwardly through a large arc so as to strike the ground upon a much lesser incline, the trench would be started with a slope that would have to be dug out by hand.

The boom is normally held in elevated position by the cables 14 and the radius arms 4. And on account of the endwise movement of the boom without any substantial swinging movement, it is possible to lower the boom close to a building or wall to start a trench. It will further be noted that on account of the vertical boom and its mounting, a short compact machine is provided which is very mobile and susceptible of cross digging in streets without blocking traffic on one side of the street. Due to this characteristic of the ma-

chine, it is possible to use the same in limited areas and in places where other machines cannot be moved or operated.

As the bucket blades, 23, emerge from the trench, they pass between lateral guard plates, 50, and a front guard plate, 51, so that as much as possible of the material lifted from the trench shall be retained in the buckets and carried over the head wheels, 6. At the lower ends the guard plates, 50 and 51, are flared outwardly as indicated in Figure 1 to allow for the easy entrance of stones or chunks of material which may extend slightly beyond the edges of the buckets and the front cover, 51, is mounted yieldingly by means of rods, 52, and springs, 53, to permit such oversize lumps of material to force it outwardly up to a certain limit as indicated in dotted outlines in Fig. 1 so that such larger lumps may be transported safely to the point of discharge,—that is, over the head wheel, 6, and into the hopper formed by the plates, 54 and 55 at the rear side of the ditcher boom adjacent the downwardly traveling ply of the digging chains.

This hopper confines the discharged material upon a conveyor belt, 56, which may be inclined upward and is directed for delivery of the material at one side of the path of travel of the ditcher so that it may be received either in trucks or wagons traveling along with the ditching machine, or may be simply deposited in a pile extending at one side of the ditch. As indicated in Figure 2, this conveyor belt, 56, may be driven from the head shaft, 5, of the ditcher boom through a chain, 57, and bevel gear transmission at 58, operating a chain, 59, upon the sprocket indicated at 60, on the head shaft, 61. The belt, 56, may be of any suitable type, but is preferably provided with transverse flights 62, at intervals and articulated lateral flanges, 63, for retaining the material during its travel to the point of delivery.

In spite of the guard plates and hopper plates there is always likely to be some spillage of the dirt discharged by the ditcher buckets and in order to leave the trench clean-cut and clear of loose material, such spillage is collected by a slightly inclined follow-up scraper plate, 65, extending downwardly from a point below the conveyor, 56, and reaching into the trench substantially to the bottom thereof at a point just rearward of the buckets, 23, as they travel about the foot wheels, 11. Any falling material thus slides down this incline, 65 to the bottom of the trench and is carried forward along the bottom by the lower end of the scraper, 65, until the accumulation of such material is sufficient to reach into the path of the buckets, 23, and be picked up thereby. Any chunks or particles which may stick to the buckets, 23, as they travel downward and which may be jarred loose in such travel, are closely confined to the path of the buckets by a rear guard wall, 66; but to prevent such wall from breaking out the side walls of the trench, its marginal portions are made of flexible material such as strips of fabric or rubber belting, 67. The lower end of the guard plate, 66, is inclined forwardly at 68 for the same purpose as the scraper, 65, namely, to carry the spillage into the path of the buckets, 23, as they pass around the foot wheels, 11.

I claim:—

1. In combination with a vehicle a substantially vertical boom with an endless digging belt mounted thereon, means extending rearwardly from the vehicle attached to the upper portion of the boom and supporting its weight, said means being vertically adjustable for raising and lowering the boom, said boom having a vertical slot in its lower portion, an arm extending rearwardly from the lower part of the vehicle and provided with means engaging said slot.

2. In combination with a vehicle a substantially vertical boom with an endless digging belt supported thereon, means extending rearwardly from the vehicle attached to the upper portion of the boom and supporting its weight; a yoke pivotally connected to the lower portion of the vehicle having arms extending rearwardly at each side of the boom, said boom being vertically slotted at each side at its lower portion and said arms having means pivotally engaging the slots, and means on the vehicle adjustable for raising and lowering the boom.

3. In a ditching machine comprising a vehicle and an endless digging belt carried thereby on a boom at the rear of the vehicle, a member carried by the boom rearwardly of the digging belt to extend down into the trench made by said belt and substantially across said trench, the lateral margins of said member being adapted to yield for passing stubborn protuberances in the walls of the trench.

4. In the combination defined in claim 3, the lateral marginal portions of the member being made of flexible material adapted to yield as described.

5. In combination with a vehicle a substantially vertical boom and an endless digging belt supported thereon, means extending rearwardly from the vehicle to which the upper portion of the boom is pivotally attached for support thereby, and a draft member connected to a lower part of the vehicle extending rearwardly therefrom and engaging the boom at a distance below its pivotal support, the connection of said member to the vehicle comprising a vertically disposed link pivoted to the vehicle and pivotally supporting the member at a distance from its vehicle pivot, said link having an arm and a spring engag-

ing said arm to yieldingly oppose the swing of the link about said vehicle pivot.

6. In the combination defined in claim 5, said arm overhanging the member which engages the boom, and said spring reacting between said arm and said member.

7. In the combination defined in claim 5, said link being in the form of a bell crank with its link portion depending from its vehicle pivot and its arm approximately perpendicular thereto, overhanging the member which engages the boom, a rod extending upwardly from said member through said arm, and a coil spring in compression between the upper end of the rod and the top of the arm.

8. In a ditching machine embodying a boom, an endless digger upon said boom and driving mechanism for said digger embodying a slip connection having relatively yieldable coacting parts intermittently brought into coacting relation for exercising a hammering action between said endless digger and an obstruction.

9. In a ditching machine embodying a boom, an endless digger upon said boom, and driving mechanism for operating said digger comprising an intermittently yielding connection exercising a hammering action upon each intermittent engagement for dislodging an obstruction in the path of said digger.

10. In a ditching machine embodying a boom, a digger upon said boom and mechanism for operating said digger comprising relatively yieldable parts adapted to be intermittently brought into yielding coacting relation when a predetermined resistance is encountered, for causing said digger to exercise a hammering action with respect to said predetermined resistance.

11. In a ditching machine embodying a boom, an endless digging conveyor upon said boom, a cross conveyor for receiving the material from the first conveyor and a sloping member extending downwardly from said cross conveyor for intercepting spillage and conveying the same adjacent the endless digging conveyor.

12. In a ditching machine embodying a boom, an endless digging conveyor upon said boom, a cross conveyor for receiving material from the digging conveyor, and a combined scraper and spillage collector extending at an inclination from said cross conveyor for directing spillage and scrapings to said digging conveyor.

13. In a ditching machine including a vehicle, a boom, a radius rod pivotally connecting the upper part of said boom with said vehicle, a draft member pivoted to said vehicle and slidably connected to the lower part of said boom, and means for elevating said boom, said draft member and boom having coacting parts adapted to be brought into coacting relation during the elevating movements of said boom for elevating said draft member.

14. In a ditching machine including a vehicle, a boom, a radius rod pivotally connecting the upper part of said boom with said vehicle, a draft device between said vehicle and a lower part of said boom, means for slidably connecting said boom and draft device and means whereby said draft device is elevated during the final elevating movements of the boom.

15. In a ditching machine including a vehicle, a boom, a radius arm pivotally connecting the upper part of said boom with said vehicle, a hoisting cable attached to said boom for raising and lowering the same in an endwise direction, a draft member connected to said vehicle and slidably connected to a lower portion of said boom, a diagonal member connecting said vehicle and draft member, said diagonal member being constructed to allow said draft member to be elevated.

16. In combination with a vehicle, a substantially vertical boom with an endless digging belt supported thereon, vertically adjustable means supporting the boom at the rear of the vehicle, means for guiding the upper portion of the boom throughout its vertical adjustment and arms extending from the lower portion of the vehicle adjacent the boom at opposite sides respectively, with vertically slidable connections between said boom and arms, and a shoe on each arm adapted to ride upon the surface of the ground at the rear of the vehicle.

17. In combination with a vehicle, a substantially vertical boom with an endless digging belt supported thereon, vertically adjustable means supporting the boom at the rear of the vehicle, means for guiding the upper portion of the boom throughout its vertical adjustment and arms extending from the lower portion of the vehicle adjacent the boom at opposite sides respectively, with vertically slidable connections between the boom and said arms, means on said arms adapted to pass close to the surface of the ground, said arms being pivotally connected to the vehicle to permit lifting said means clear of the ground when the vehicle travels with the boom in elevated position.

18. In a ditching machine, a frame, a boom, a radius rod pivotally connecting said boom with the upper part of said frame whereby said boom may be raised and lowered endwise in substantially vertical directions, means for maintaining the lower end of the boom at its work, said boom having a slidable and pivotal connection with said means, and cable means attached to said boom for raising and lowering the same, said radius rod providing only a limited arcuate movement to maintain the boom substantially vertical in all positions.

19. In a ditching machine, a frame, a boom,

a radius rod pivotally connecting said boom and the upper part of said frame, said radius rod providing only a limited arcuate movement whereby said boom is maintained in a substantial vertical position during all adjustments thereof, a pair of members, one on each side of the boom, a pivotal and slidable connection between said boom and each member for maintaining the boom at its work, and for allowing free upward and pivotal movement, and cable means attached to said boom for elevating the same.

HARRY H. BARBER.