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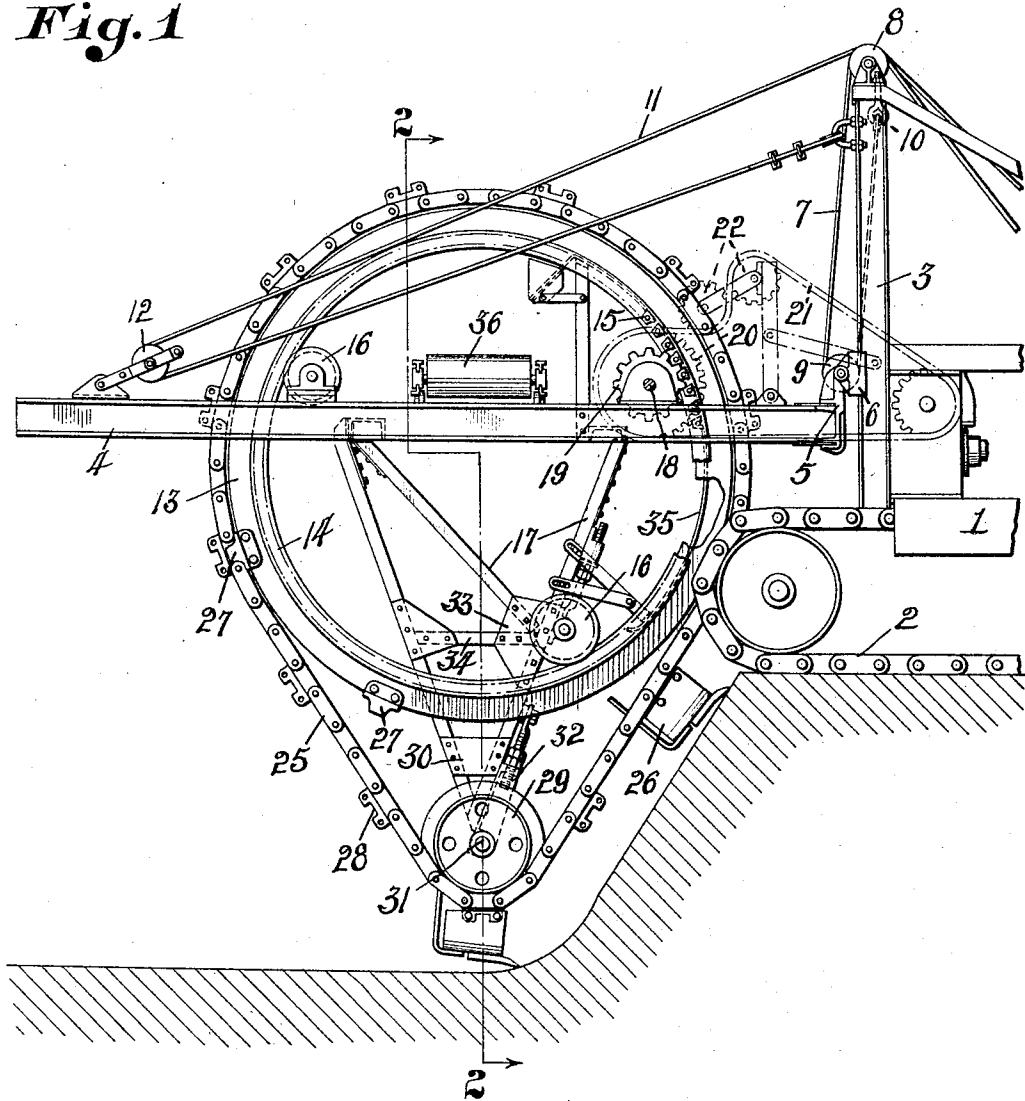
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TRENCHING MACHINE

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3 Sheets-Sheet 1

Fig. 1



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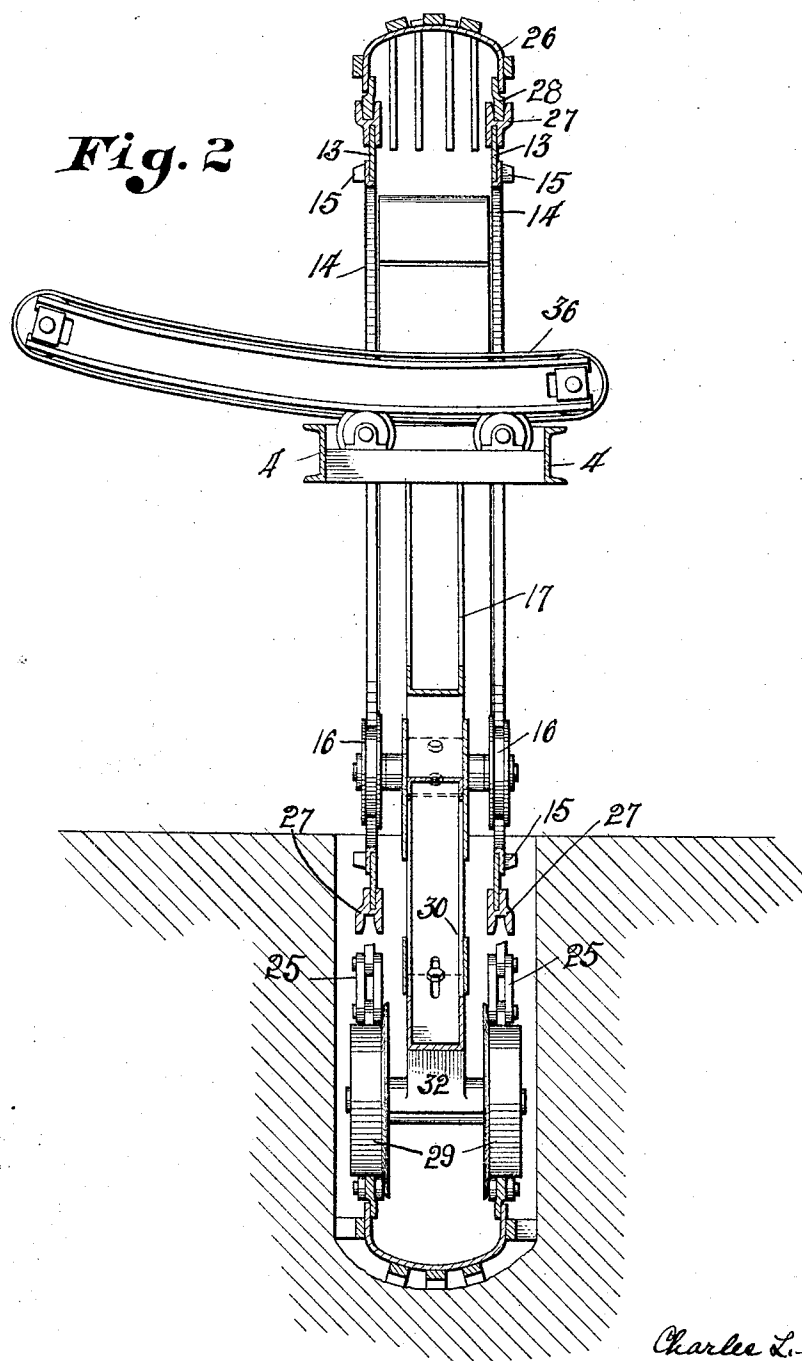
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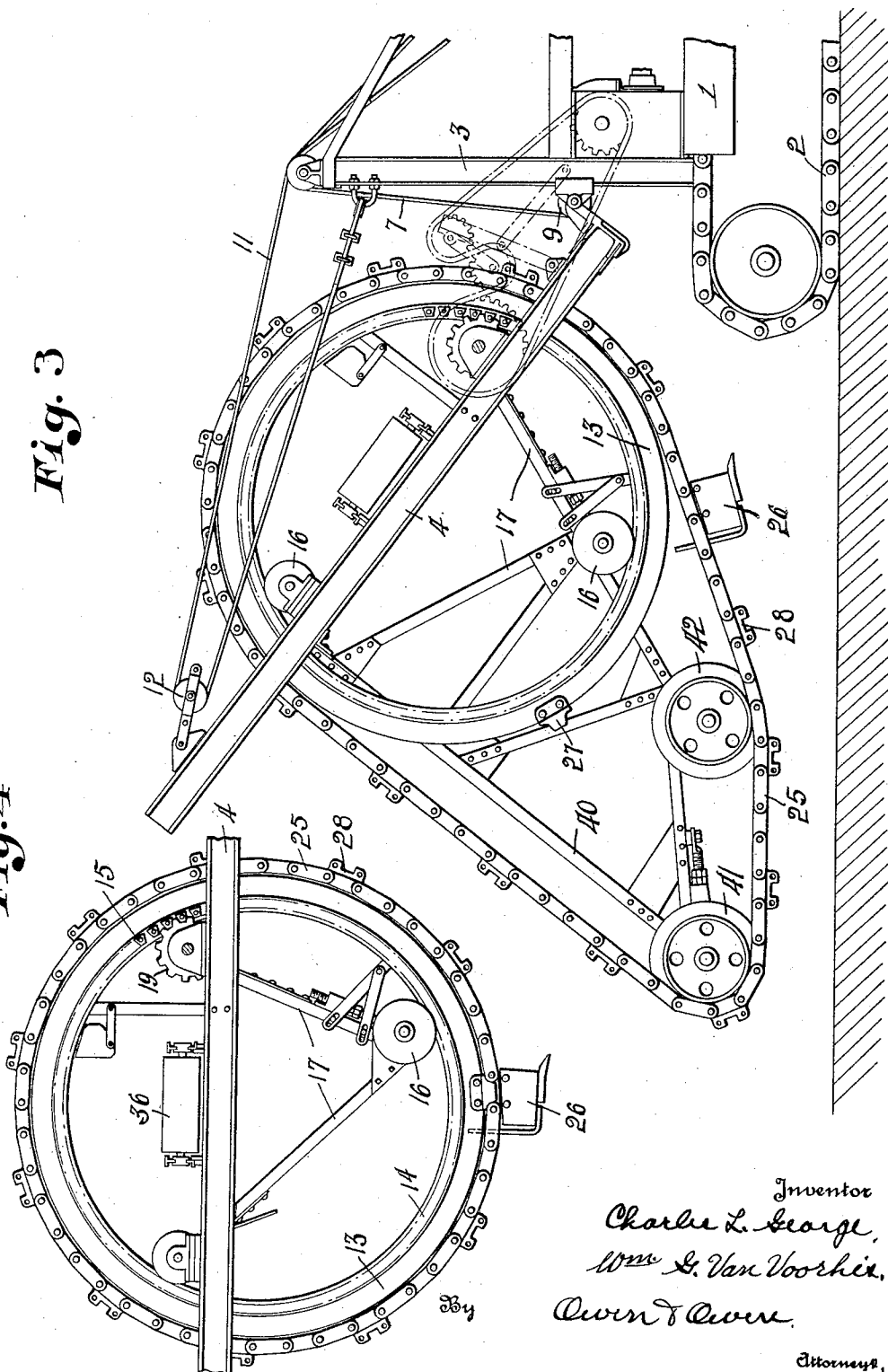
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Fig. 3

Fig. 4



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UNITED STATES PATENT OFFICE

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TRENCHING MACHINE

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This invention relates to open-ditch trenching machines, and has for its object to provide such a machine which combines the advantages of both wheel-type and boom-type excavators. The wheel-type excavators have many advantages in use not present in boom-type excavators, but on the other hand, the depth of digging by the wheel-type excavator is limited over that of the boom-type, and it has, therefore, been found necessary, where making deep cuts, to use the boom-type with loss of efficiency in other respects, for instance, greater spillage of material, less backing rigidity for the buckets when operating in hard, stony or frozen soil, and consequently less capacity and efficiency. By combining the advantages of the two machines, greater economy, efficiency and capacity in operation is obtained.

The object of our invention is the provision of a wheel-type of excavating means which will obviate, or at least minimize, the above objections, and will combine, to a large extent, the advantages of excavators of both the wheel and chain and bucket types.

The invention is fully described in the following specification, and while in its broader aspect it is capable of embodiment in various forms, a few embodiments only thereof are illustrated in the accompanying drawings, in which—

Figure 1 is a side elevation of a machine embodying the invention, with parts removed and broken away, and with the digging means partially lowered in digging position, and with the main frame only partially shown. Fig. 2 is an enlarged cross-section on the line 2—2 in Fig. 1. Fig. 3 is a side elevation similar to Fig. 1 of a slightly modified form of the invention, with parts removed and with the excavating means elevated to inoperative position, and Fig. 4 is a side elevation of an excavating wheel and its mounting, with parts removed and with the bucket-carrying chain closely embracing the wheel and substituted for the customary wheel-buckets.

Referring to the drawings, 1 designates the frame of an excavating machine of the wheel-type, and 2 one of the customary tractor tread supports therefor. Rising from the rear end

of the frame 1 is an upright frame 3 constituting a vertical guide for the inner or forward end of the boom 4 carrying the excavating wheel.

The boom 4 is composed of two beams rigidly secured together in laterally spaced parallel relation and is provided at its inner or forward end with a bracket 5 pivotally connected for vertical swinging movements to slides 6 guided for vertical adjusting movements on the vertical members constituting the upright frame 3, as well understood in the art.

The inner end of the boom is raised and lowered on the frame 3 by a control cable 7 extending from a suitable operating source on the main frame over one of a plurality of sheaves 8 on the top of the frame 3, thence down around a sheave 9 on the boom bracket 5 and up to a suitable anchoring point 10 on the guide frame. Vertical adjustment of the outer end of the boom is controlled in the usual or any suitable manner by a cable 11, which is anchored at one end to the upper portion of the frame 3, then extends around a sheave 12 at the free end of the boom and forward therefrom over one of the sheaves 8 and to a suitable control source on the main frame.

The customary excavating wheel is mounted for rotation between the members of the boom 4 and comprises two annular laterally spaced rim members 13 rigidly connected at their outer edges by the digging buckets (not shown), and having at their inner edges rack bars 14 forming an annular series of rack teeth 15 around the inner edge portions of the respective rim members at the outer sides thereof. Each rim is carried by the boom through the medium of peripheral grooved idler pulleys 16, two of which are mounted on the boom and one below the boom on a frame 17 suspended from the boom, as well understood in the art.

One of the pulleys 16 is mounted on a shaft 18 which carries two rack pinions 19, one for each series of rack teeth 15 in mesh therewith, and also carries at one end a sprocket-wheel 20 engaged by a sprocket-chain 21, which extends from a suitable source of pow-

er on the main frame 1, as well understood in the art.

It is understood that each rim member 13 has an individual mounting on a respective set of guide pulleys 16, so that they may have relative rotary movements if not connected by the excavating buckets, and that each rim member has individual driving connection with the driven shaft 18. The chain 21 has the loose-run thereof guided by idlers 22, which, in the present instance, have compensating connection with both the boom 4 and upright frame 3 to adapt the idlers to accommodate themselves to the adjusted position of the boom relative to the frame and at the same time prevent slack in the chamber.

In changing a wheel-type excavating means to embody the present invention, the buckets are removed from the rim members and a pair of bucket-chains 25, with a series of equi-distantly spaced cross connected digging buckets 26, are substituted therefor, each chain being mounted on a respective rim member 13 of the wheel and having engagement with a series of teeth 27 attached to the rim in suitable spaced equi-distant relation therearound. Some of the buckets 26 and of the teeth 27 are omitted from the drawings. The buckets 26 are attached at their sides by rivets or bolts to brackets or extensions 28, provided on certain links of the respective chains.

In adapting the excavating means for digging a greater depth than would be possible with the excavating wheel itself, the bucket chains are of greater length than the peripheral length of the rims 13, to adapt the chains to be extended a desired distance below the rims, and are guided in such extension by respective idler wheels 29 carried by a supplemental frame 30, attached, in the present instance, to the boom 4 and frame 17, and projecting therefrom down between the rim members 13. The shaft 31, by which the wheels 29 are carried, is itself carried by an adjusting block 32, which is adjustably carried by the supplemental frame 30, so that adjustment of the guide-wheels 29 may be effected to take up any slackness in the bucket-carrying chains.

The supplemental frame 30 has one arm extended up to and removably attached to the boom 4, while its other upright arm is connected to the lower ends of the members constituting the frame 17, by plates 33, which are substituted for similar triangular plates customarily employed to connect the lower ends of the members of the frame 17. The upright members of the supplemental frame 30 are connected, in the present instance, near the upper end of one of such members by a cross-member 34. The members of both frames 17 and 30 are preferably of channel-bar form, as shown in Fig. 2.

It is evident that the digging takes place from the lower reach of the bucket-chains

to a point which may be well up on the forward side of the wheel-rims 13, depending on the extent of lowering of the boom and associated excavating means; that a major portion of the digging operation thus effected is in a straight line, with the buckets free from the backing contact of the wheel rims, thus permitting them to have limited yielding movements relative to the wheel rims and lessen the liability of breakage incident to contact of the buckets with heavy or stationary objects when the buckets are originally attached to the rim members.

It is also evident that when operating in frozen ground, the excavating means may be lowered sufficiently for the rim members to directly oppose the frozen portion of the soil, thereby holding the buckets in firm contact with such portion of the soil, thus obtaining in this respect the advantage of wheel-type excavators in connection with chain-carried buckets. It is found in practice, that by the use of the present chain and bucket excavating means with a wheel-type excavator that about 40% greater depth of digging can be obtained than with the use of the wheel-carried buckets alone, and that the buckets have greater capacity and less spillage during excavating operations, and also that less material is carried over with the buckets after the dumping operation, thus resulting in greater speed and efficiency of operation. The latter advantage is probably due to the fact that the buckets are carried by chains and are, therefore, capable of some movements relative to the rim members, thus tending to more readily free the soil from the buckets than is the case where the buckets are rigid to the rim members.

The customary guard-plate 35 is disposed between the rim members 13 at the forward side thereof and extends from near the bottom portion of the wheel to a point short of the top center of the wheel, so as to prevent material dropping from the buckets in their upward movements and from falling on the parts disposed within the wheel. This feature is common to wheel-type excavators. 36 designates the conveyor onto which the material is discharged from the buckets at the top of the wheel and by which it is delivered to one side or the other of the trench.

In Fig. 3 the construction and arrangement of parts is the same as above described, except that the extension of the chain and bucket means below the main wheel is slightly greater than that in the arrangement shown in Fig. 1, and is rearwardly inclined with respect to a diametrical line of said wheel when the boom is in horizontal position. The purpose of this rearward extension of the excavating means from the wheel is to enable it to be raised entirely above the ground by a less upward tilting movement of the boom than would be the case if the

bucket and excavating means were extended from the wheel, as shown in Fig. 1. In the form shown in Fig. 3, the means 40 forming the extension frame of the chain-guiding means is provided with two sets of chain-guiding rollers 41 and 42, the rollers 42 being interposed between the rollers 41 and the wheel-rims 13 to guide and brace the chains 25 during the digging run thereof.

In Fig. 4 the supplemental frame constituting the extension means for the bucket-chains is removed as well as are some of the links and buckets of the chains, so that the chains may closely embrace the periphery of the wheel-rims 13. This arrangement provides all of the advantages of a wheel-type excavator with the added advantage of the buckets being mounted in a more or less yielding manner on the rims instead of being rigidly attached thereto, thus permitting the buckets to give to some extent when striking heavy or stationary objects. By this arrangement the breakage of the buckets by reason of striking stones and other stationary obstructions is materially lessened.

It is found in the use of this invention that the advantages of the wheel-type excavator are retained and has combined therewith some of the advantages of bucket and chain type excavators; that it enables considerably greater depth of cut to be made than is possible with wheel-type excavators, and also materially facilitates the digging operations over those of wheel-type excavators. It is also found that a combined wheel and chain bucket excavator of this character has greater capacity than the wheel-type excavator, and that there is less spillage of material from the buckets during the ascent of the buckets to dumping position. It also has the additional advantage that less material adheres to and is carried over with the buckets from the dumping position.

It will be understood that our invention is not limited to any specific arrangement or form of the parts, as it is capable of numerous modifications and changes without departing from the spirit of the claims.

Having thus described our invention, what we claim as new and desire to secure by United States Letters Patent is:

1. In a wheel-type excavator, a boom, a rotatable wheel carried by the boom for projecting into a trench being dug, a chain and bucket excavating means, and means carried by and projecting below the boom and co-operating with the wheel to guide the course of movement of the excavating means and causing a portion thereof at the trench side of the boom to be extended a greater distance from the wheel center than others.

2. In a wheel-type excavator, a boom, a wheel carried by the boom and projected below the same for entry into a trench, drive means for the wheel, endless chain means

mounted on and driven by the wheel, buckets carried at intervals by the chain means, and guide means carried by the boom at its trench side for coaction with the chain means to project a portion thereof a predetermined distance below the wheel periphery to increase the effective digging depth.

3. In a wheel-type excavator, the combination with the excavator wheel and boom, of a guide attachment detachably connected to the boom and projected beyond the trench side of the wheel, and chain and bucket excavating means mounted on the wheel in substitution for the customary wheel buckets, and coacting with said guide attachment to project a portion of the course of movement of said means beyond the trench side of the wheel periphery to increase the effective depth of digging of the machine.

4. In a wheel-type excavator, the combination with the excavating wheel and boom, of a supplemental frame attached to the boom and projecting below the boom and wheel, and chain and bucket excavating means mounted on the wheel and coacting with said frame to project a portion of the course of movement of said means beyond the trench side of the wheel periphery to increase the effective depth of digging of the machine.

5. In a wheel-type excavator, a boom, a wheel, means carried by the boom and forming a rotatable mount for the wheel with a portion of the wheel projecting in digging position below the boom, a supplemental guide means carried by the boom and projecting below the wheel, and chain and bucket excavating means mounted on the wheel in substitution for the customary wheel buckets and coacting with said supplemental guide to project a portion of the course of movement of said excavating means beyond the trench side of the wheel periphery to increase the effective depth of digging of the machine.

6. In a wheel-type excavator, a boom having laterally spaced beams, separate annular wheel rim members disposed in laterally spaced concentric relation between said boom members, means carried by the boom for separately guiding the rotary movements of the rim members, supplemental guide means projecting downwardly from the boom a predetermined distance below the rim members, and chain and bucket excavating means mounted on the rim members in substitution for the customary wheel buckets and coacting with said supplemental guide means to project a portion of the course of movement of the excavating means below the trench side of the rim members to increase the effective depth of digging of the machine.

7. In a wheel-type excavator, a boom having laterally spaced beams, a vertically disposed wheel carried by the boom and mounted for rotary movements between the members

of the boom, a detachable guide means carried by the boom and projecting below the trench side of the wheel periphery, and chain and bucket excavating means mounted on the
5 wheel in substitution for the customary wheel buckets and coacting with said guide attachment to project a portion of the course of movement of the excavating means below the wheel to increase the effective depth of digging of the machine.

8. In a wheel-type excavator, a wheel comprising independent rim members carried in laterally spaced relation and for independent rotation in a vertical plane by the boom, with
15 a portion projecting therebelow, a supplemental guide means carried by the boom intermediate said rim members and projecting below the same, drive means for the rim members, and chain and bucket excavating
20 means mounted on the rim members in substitution for the customary wheel buckets and coacting with the supplemental guide to project a portion of the course of movement of the excavating means below the wheel to
25 increase the effective depth of digging of the machine.

9. In a wheel-type excavator, a boom, a wheel comprising separate rim members carried for rotation by the boom and adapted
30 to be connected by buckets, a guide means projecting downwardly from the boom below the wheel, and endless chains mounted on the wheel and guide means whereby a portion of the course of movement of each chain
35 is projected a distance below the wheel and excavating buckets connecting the chains at intervals.

10. In a wheel-type excavator, a boom, a wheel comprising separate rim members, means for rotatably mounting the rim members in vertical position on the boom comprising a plurality of guide rolls and including a frame carried by and projecting below the boom and carrying at least one of said
40 guide rolls, a supplemental guide means attached to said boom and frame and projecting below the wheel rims and including guide rollers at the lower end thereof, and chain and bucket excavating means mounted on the
45 wheel in substitution for the customary wheel buckets and coacting with said supplemental guide means to project a portion of the course of movement of the excavating means below the wheel to increase the effective depth of
50 digging of the machine.

In testimony whereof we have hereunto signed our names to this specification.

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