No. 852,790. PATENTED MAY 7, 1907.

C. C. JACOBS.

TRENCH EXCAVATOR.

APPLICATION FILED APR. 14, 1906.

7 SHEETS—SHEET 1.

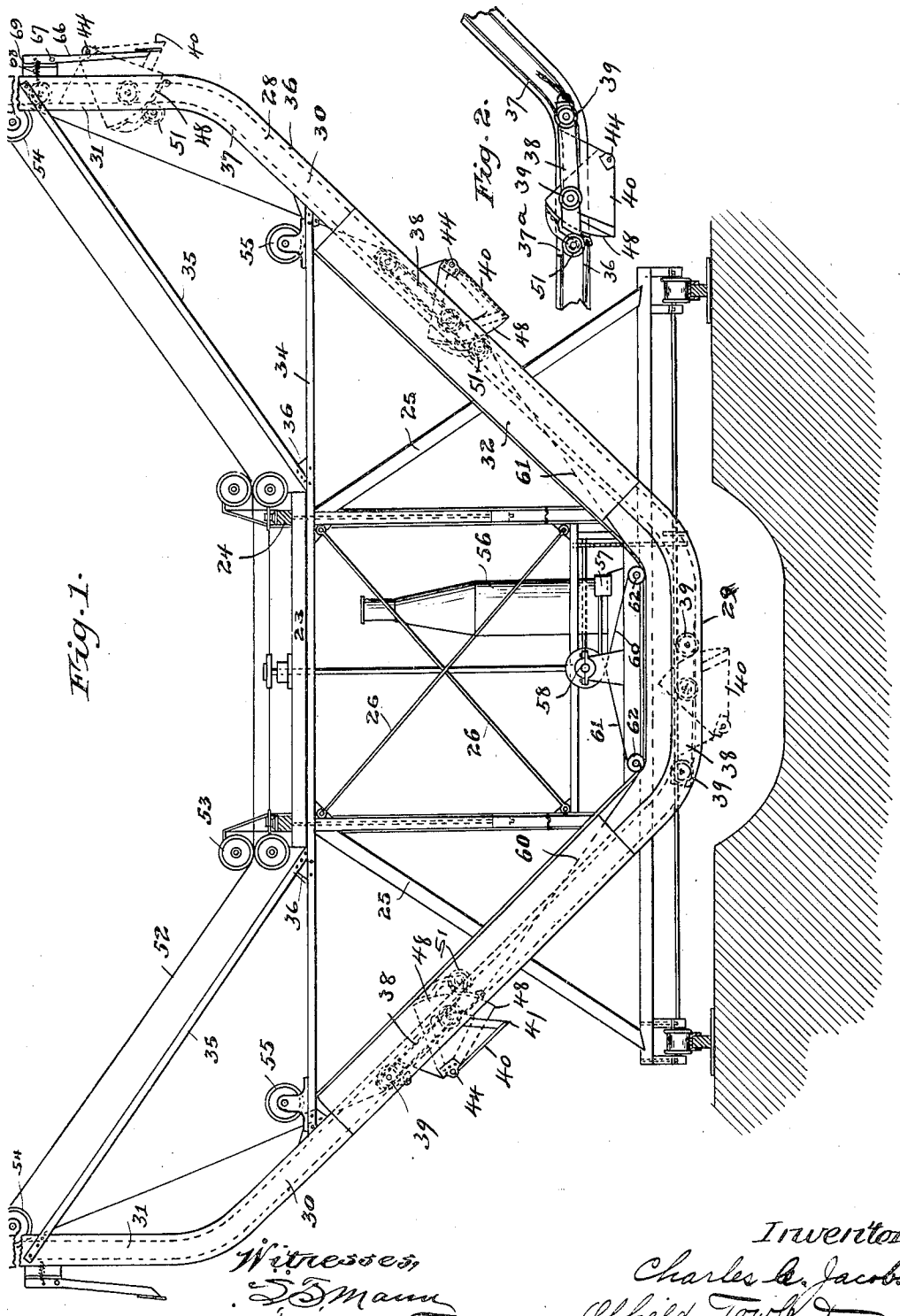

Fig. 1.

Fig. 2.

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7 SHEETS—SHEET 2.

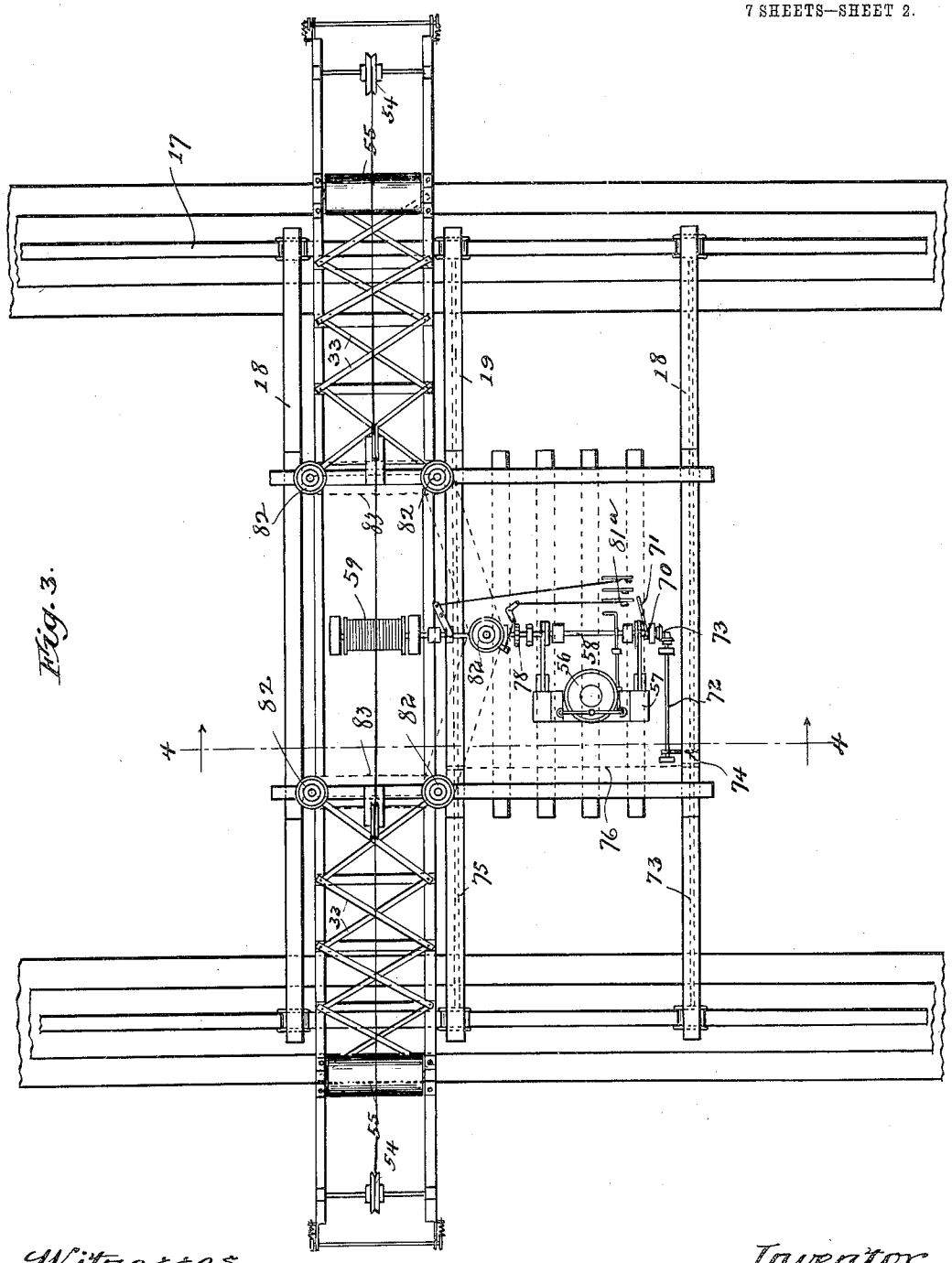

Fig. 3.

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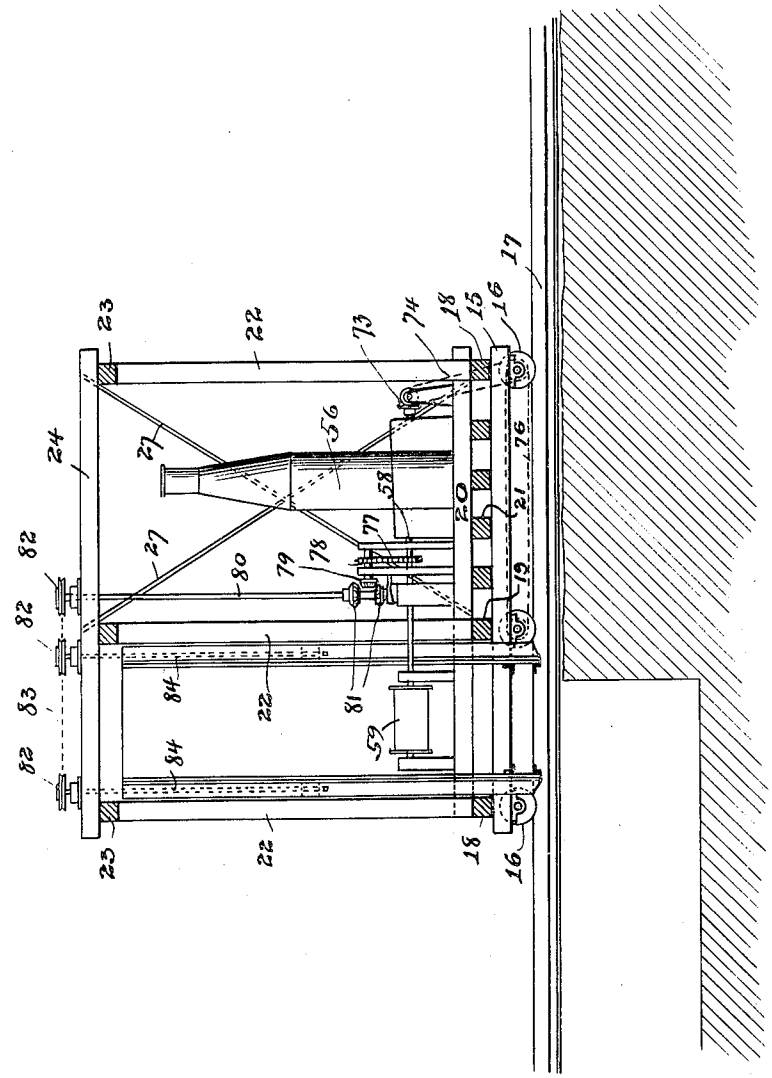
7 SHEETS—SHEET 3.

Fig. 4.



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7 SHEETS—SHEET 4.

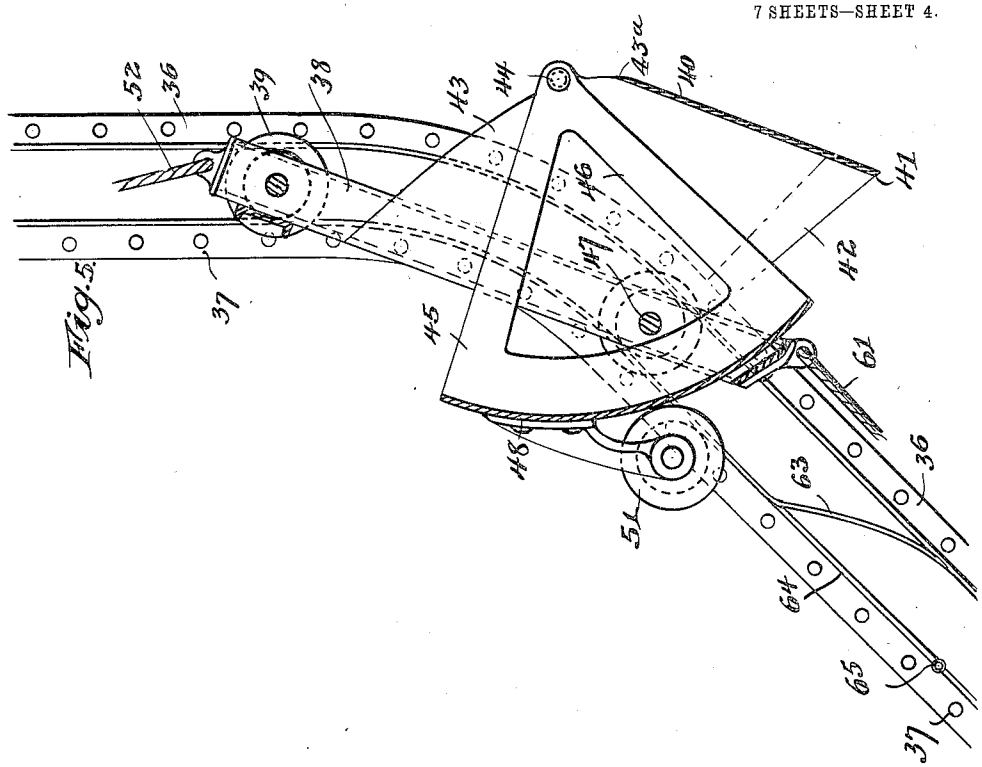

Fig. 5.

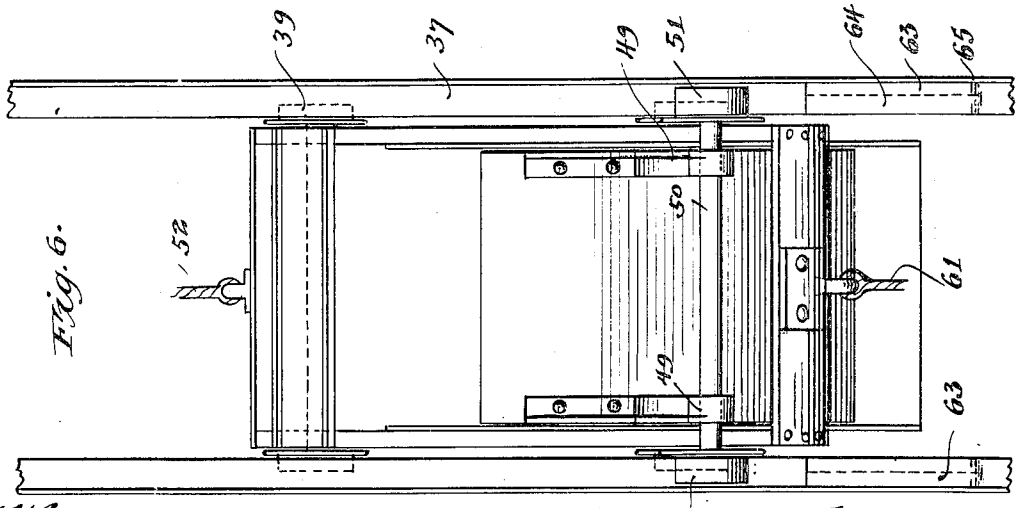

Fig. 6.

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7 SHEETS—SHEET 5.

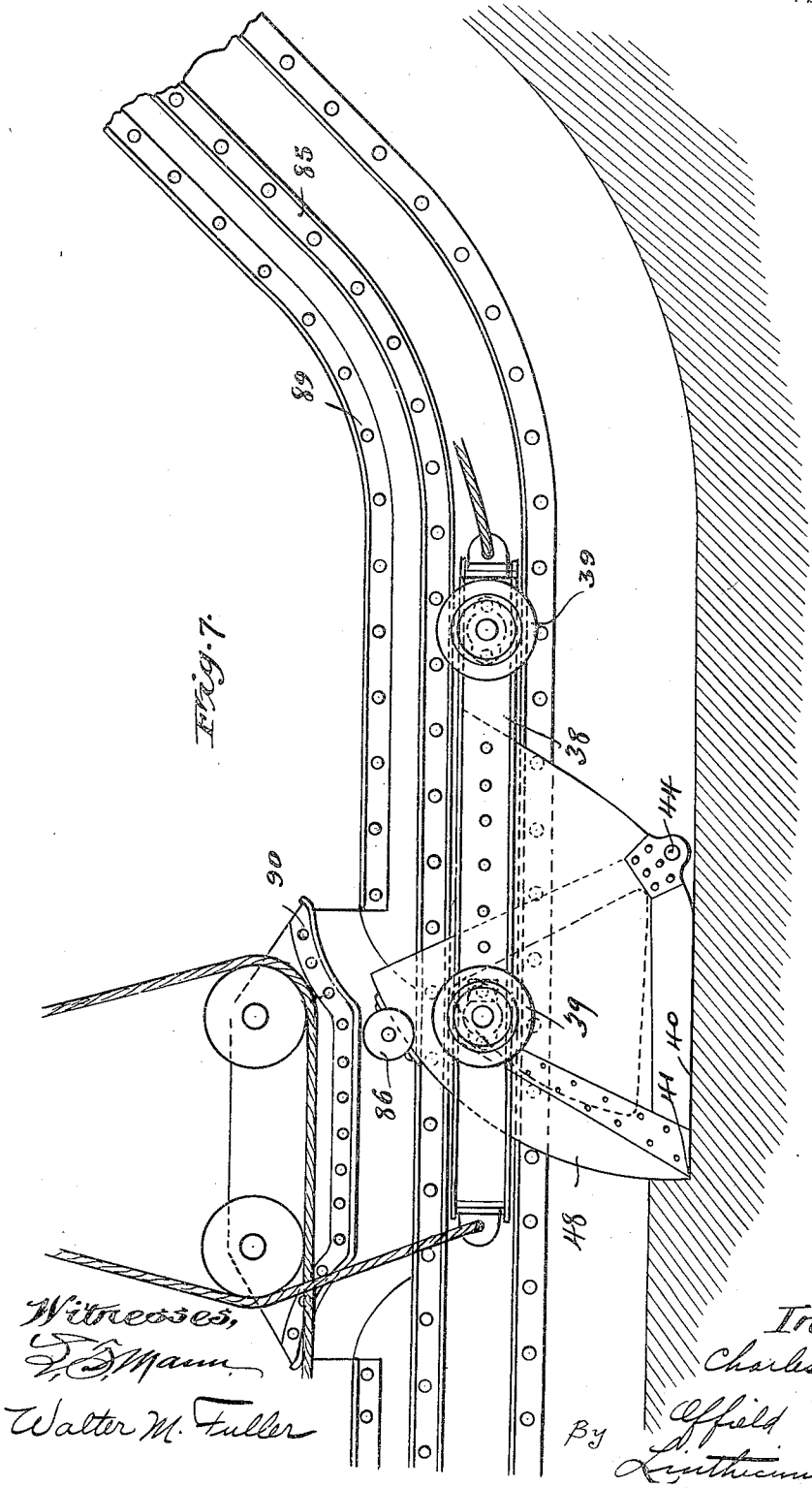

Fig. 7.

Witnesses,
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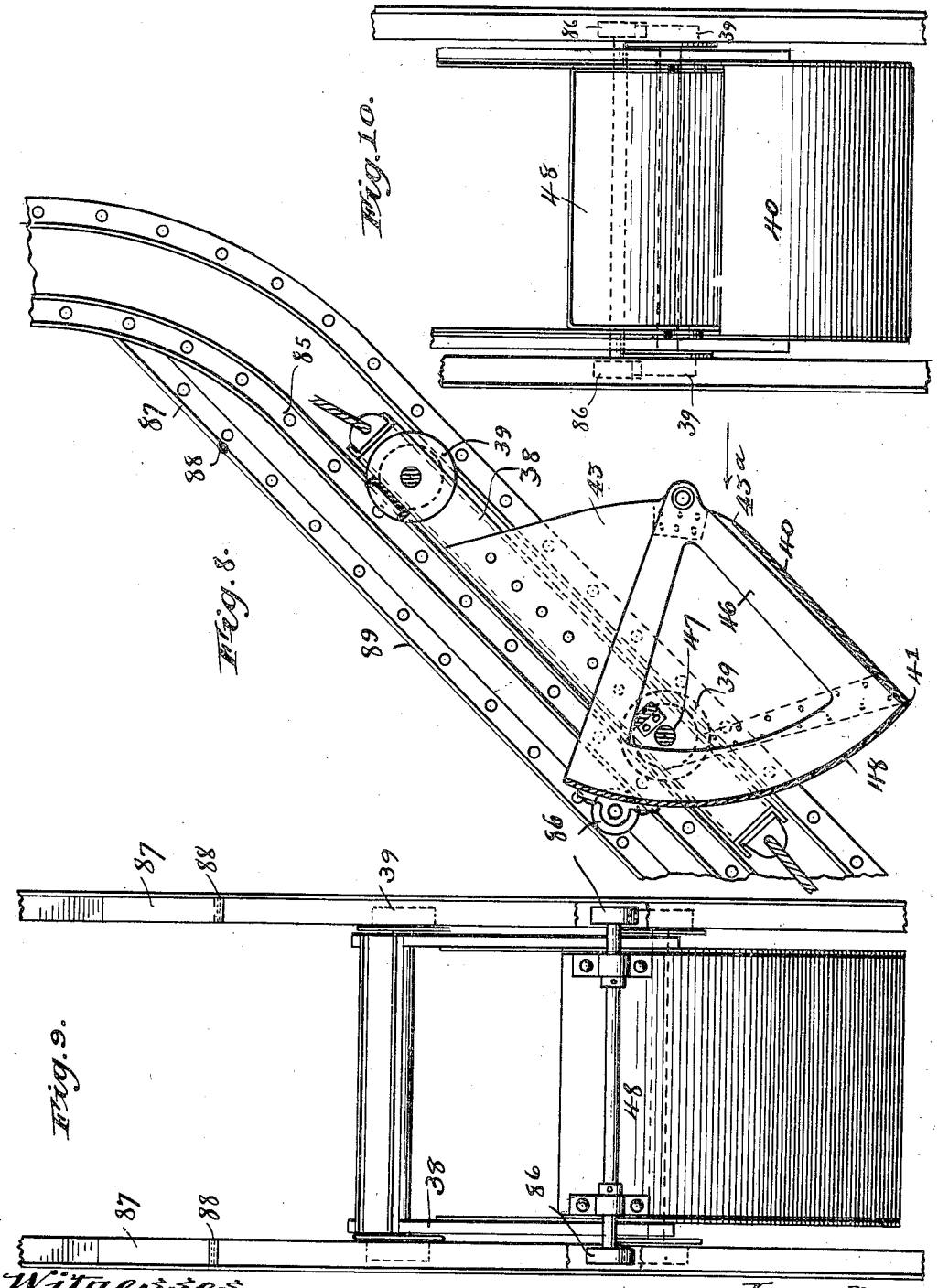
7 SHEETS—SHEET 6.



Witnesses,
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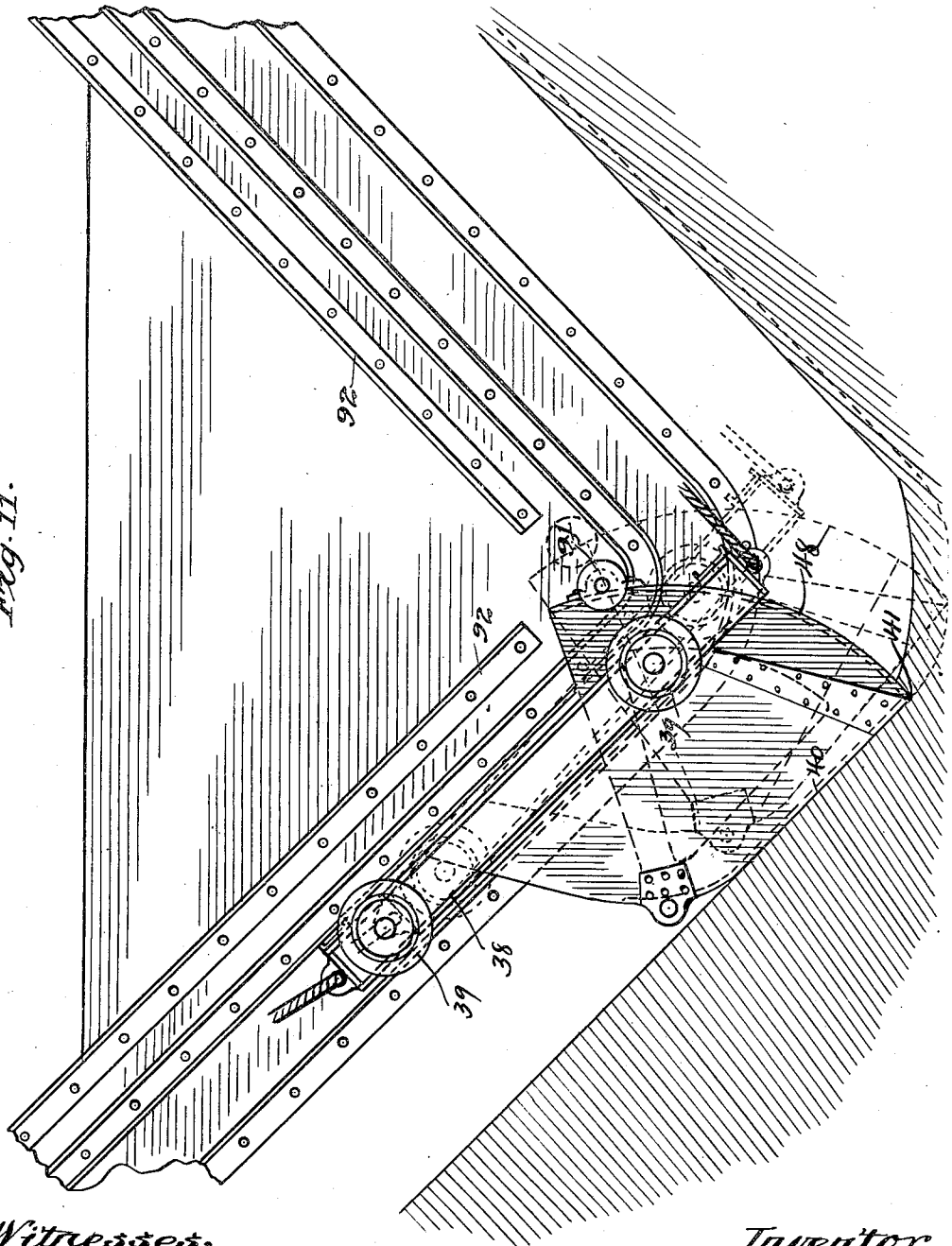
APPLICATION FILED APR. 14, 1906.

7 SHEETS—SHEET 7.

Fig. 11.



Witnesses,
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UNITED STATES PATENT OFFICE.

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TRENCH-EXCAVATOR.

No. 852,790. Specification of Letters Patent. Patented May 7, 1907.

Application filed April 14, 1906. Serial No. 311,772.

To all whom it may concern:

Be it known that I, CHARLES C. JACOBS, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Trench-Excavators, of which the following is a specification.

My improved excavator is equipped with two balanced buckets each having one or more mouths with a sharp edge to shave off layers of dirt from the trench to be dug. By balancing the buckets a large saving of power is effected since the buckets in the present device weigh something like 3000 pounds. To secure this counterpoise of the pair of shovels or scoops a cable is connected at its opposite ends to the buckets or to their trucks which travel on a track shaped to substantially conform to the cross-sectional profile of the trench and the cable is also passed over one or more guiding sheaves. These buckets act alternately to scrape off a layer of dirt to the center of the trench and as one descends accomplishing its shaving off of the dirt its companion ascends carrying away the dirt which it scraped off and loosened up in its previous downward movement. Each of these scrapers or buckets cuts going downward thereby shaving off its layer of dirt which more or less rolls down in loosened condition ahead of it to the bottom of the ditch or trench. When the sharp edge of the bucket's mouth reaches substantially the center of the trench a hood is automatically lowered so as to entrap the accumulated loose dirt and as the bucket is retraced upward it holds its contents securely until the hood is automatically shifted to open the mouth whereupon the earth drops out of the bucket on to the adjacent bank.

My invention also includes a scraper to free the bucket from any lading which adheres to its inner surfaces. By cutting downward the advantage of being able to scrape off a thicker layer with an engine of given power is secured since a definite pull on the bucket's cable permits a thicker shaving of earth to be sliced off when the bucket is moving down substantially without any load than in a construction which cuts going up receiving the dirt in the bucket as it proceeds. In other words the weight of the dirt and the friction of the same in the bucket while cutting is eliminated. When the bucket cuts going up the side of the trench it pushes dirt ahead of it and forms more or less of an embankment at the edge of the trench where it is not wanted, unless special means are used to avoid it, but when the bucket is used cutting going down a neat sharp edge for the trench is attained.

In a structure such as that described above each bucket cuts to the center of the trench and then recedes with its load dumping the same upon the bank, but my invention also includes a construction wherein each bucket cuts to the center of the ditch and then continues on in the same direction, but not cutting, discharging its load upon the opposite bank. When the excavator is made so that one or more buckets cut to the center and then recede the dirt is carried only substantially half as far as in those devices wherein the bucket travels completely across the trench. By using buckets cutting to the center of the trench alternately a narrow trench of substantially V-shape with a comparatively sharp edge at the bottom can be excavated.

Referring to the accompanying drawings which illustrate the preferred embodiment of my invention together with several modifications and wherein like reference characters refer to the same parts throughout; Figure 1 is an elevation of the trench excavator partly in section; Fig. 2 is a detail view showing the central part of the ditch track, and illustrates the manner in which the hood is permitted to close the mouth of the bucket; Fig. 3 is a plan view of the excavator; Fig. 4 is a section on line 4—4 of Fig. 3; Fig. 5 is an enlarged detail view of a portion of the track, the bucket, its hood, and means for lifting the hood when the contents of the bucket are to be dumped; Fig. 6 is an elevation of the mechanism illustrated in Fig. 5; Fig. 7 is an enlarged detail view of the central portion of the ditch track, the bucket, its hood, and means for compelling the hood to close the mouth of the bucket when the latter has reached the center of the trench; Fig. 8 is a section illustrating the upper portion of the track mechanism, the lower part of which is shown in Fig. 7; Fig. 9 is an elevation of the construction illustrated in Fig. 8; Fig. 10 is also an elevation of the mechan-

ism shown in Fig. 8 as viewed from the right hand portion of the sheet; and Fig. 11 illustrates a modified form of the excavator.

The balanced buckets described above are intended to be used in an excavating machine of the general character shown and described in my Reissue Patent No. 12441 of January 30, 1906. This machine includes a skeleton or open-work frame supported at its opposite sides on wheels traveling on tracks disposed longitudinally of and parallel with the trench to be excavated. Within this skeleton frame is a vertically adjustable track section shaped to conform substantially to the cross-sectional profile of the ditch to be dug, and it is on this track that the balanced buckets reciprocate to remove the dirt from the trench and deposit the same on the adjacent bank or banks.

Referring to the drawings for a more specific understanding of the apparatus it will be noted that the main frame includes longitudinal sills 15 in the under sides of which are journaled carrying wheels or rollers 16 adapted to travel on the temporary rails 17 disposed along the side of the ditch, said sills being connected by end sills 18 and an intermediate transverse sill 19. A suitable platform or floor 20 is supported on these end and intermediate sills and also on the joists 21 as is clearly shown in Fig. 4. Rising from the transverse sills are the upright posts 22 connected at their top ends by the cross beams 23 and by the longitudinal beams 24. The top ends of these posts are also braced laterally by the inclined supports 25 which at their lower ends rest upon and are secured to the outer ends of the transverse sills. Diagonal tension bars or rods 26 and 27, shown in Figs. 1 and 4, also aid in forming a firm and substantial framework. Between one of the end sills 18 and the intermediate sill 19 is mounted a vertically adjustable frame comprising two templet plates 28 each of which has a horizontal central portion 29 from which arise the divergent legs 30, the outer ends of which form substantially upright extensions 31. To the parts 30 of these templet or track plates are riveted deeper plates 32 connected together and properly spaced apart by the lattice work 33 [see Fig. 3.] Horizontal bars or beams 34 connect the divergent legs 30 and the upper ends 31 are held in place by the inclined bars 35 which at their lower ends are riveted to to the gusset plates 36 secured to the bars 34. The central parts of these track plates 28 are shaped to conform substantially to the cross-sectional profile of the trench to be dug, and on the inner side of each of these plates near its lower edge is riveted an angle bar 36 upon which the trucks of the balanced buckets are adapted to travel. In order to cause these trucks and buckets to travel in a predetermined path and to prevent them from rising from the angle bars 36 there is employed another angle bar 37 along the top edge of each plate 28.

Each bucket comprises a truck frame 38 [Fig. 5] provided with the wheels 39 which are adapted to roll on or co-operate with the angle bars 36 and 37. Securely fastened to the truck frame 38 is a scoop or bucket 40 having a forward lower cutting edge 41, a forward mouth 42, and a rear open mouth 43 with a cutting edge 43ª. Pivoted at 44 within the bucket 40 are two sector arms 45 with open spaces at their center 46 through which passes the axle 47 of the rear truck wheels. At the free ends of arms 45 and secured thereto is a curved hood 48 to open and close the mouth 42 of the bucket. On the outer surface of this hood are two bearings 49 within which is rotatably mounted a shaft 50 having the wheels or rollers 51 of wider tread than the wheels 39 at the opposite ends of the truck. In the construction illustrated in Fig. 1 two of these buckets are shown, the pair being arranged with their mouths facing each other and, in order to balance these scoops and their trucks, I attach to the ends of the trucks the opposite ends of a cable 52 which passes between the pairs of co-operating sheaves 53 on the top of the skeleton frame, over the guide pulleys 54 at the top of the upright portions 31, and down to the bucket trucks. In order to direct the pull of this cable on the trucks I mount rollers 55 on the cross-beams 34 near their ends. The actuating mechanism of these buckets is so arranged that while one descends into the trench its companion ascends on the opposite end of the track and to accomplish this action of the twin buckets I employ a boiler 56 mounted on platform 20 to supply steam to the engine 57 the latter rotating a shaft 58 on which is placed a drum 59 to wind up and pay out the two cables 60 and 61 attached to the lower ends of the bucket trucks. These cables are wound on the drum in opposite directions so that as one is paid out the other is wound up a corresponding amount. Cables 60 and 61 do not pass directly to the drum 59 but first turn around the guide pulleys 62. It will thus be apparent that as one of these cables is wound on the drum the other is paid out an equivalent amount whereby the bucket operated by the first cable is drawn down into the trench while the other bucket is drawn out of the trench with its load.

As shown in Fig. 2 the top angle bars 37 are interrupted at the center of the ditch track section at 37ª so as to leave spaces to permit the rollers 51 of the hood to pass therethrough down on to the lower angle bars 36, the weight of the hood causing the rollers to pass through the spaces 37ª and thereby permitting the hood to close the mouth of the bucket. When the bucket and

its truck ascends the incline 30 rollers 51 travel on the lower angle bars 36, but when they reach the sloping tracks 63 connecting the lower angle bars 36 with the upper angle bars 37 they pass up these tracks opening the track doors or switches 64 pivoted at 65 which immediately fall of their own weight to close the gaps in the tracks 37 after the rollers 51 have gone up on to the bars 37. In this manner the hood is raised so as to open the mouth of the bucket as is illustrated in Fig. 5. Since the truck wheels 39 are of narrower tread than the rollers 51 they remain on the lower angle bars 36 and escape the inclined tracks 63. During the downward travel of the bucket the hood rollers 51 remain on the upper tracks 37 until they reach the gaps 37ª at which time they descend permitting the closing of the bucket's mouth by the hood. At the two upper ends 31 of the ditch track 28 I provide scrapers 66 each of which is pivoted at 67 and spring-pressed outwardly by the springs 68 which pull the upper ends of the scrapers inwardly as far as is permitted by the stops 69. When the bucket travels up this particular portion of the track the scraper which has a sharp front end enters the rear mouth of the bucket and forces the dirt out through the open front mouth.

As in the construction set forth in my Reissue Patent No. 12441, mentioned above, I also provide in this excavator a means for causing the whole frame to travel on the temporary rails 17 to bring the vertically adjustable frame over an unexcavated portion of ground so that the balanced alternately digging buckets may excavate the same to form a continuation of the trench already dug. To accomplish this I provide a clutch 70 operated by a handle 71 which transmits the rotation of shaft 58 to the jack shaft 72 by means of bevel gears 73. Shaft 72 is connected to shaft 73 on which one pair of the wheels 16 are mounted by means of sprocket wheels on the shafts 72 and 73, respectively, and a connecting sprocket chain 74. Shaft 73 is connected to the parallel shaft 75, also equipped with a pair of wheels 16, by means of an additional sprocket chain 76 passing over sprocket wheels on the two shafts. By throwing the clutch in the proper direction the engine may be caused to make the frame travel on the temporary rails longitudinally of the trench. As the buckets shave off successive layers of earth from the trench it is necessary to feed the vertically adjustable ditch track downwardly step by step and in order that the engine may be used for this purpose I connect a sprocket wheel on shaft 58 by means of a chain 77 to a similar sprocket wheel on a shaft 78, rotatably mounted in suitable bearings and having bevel gear 79 at one end. On an upright shaft 80 and splined thereto are two bevel gears 81 either of which may be so thrown into mesh with the gear 79 by means of a suitable handle 81ª to cause rotation of the shaft 80 in either direction. By means of sprocket wheels 82, one of which is at the top end of shaft 80, and suitable co-acting chains 83 shaft 80 is made to turn the screws 84 which co-operate with fixed nuts so as to raise or lower the ditch track section described above.

The operation of this excavator has been set forth more or less above, but to recapitulate, the buckets are caused to travel up and down the ditch track alternately by means of the winding up and the paying out of cables 60 and 61 on the drum 59. Each bucket while traveling down the track has its front mouth open and when it passes into the trench its sharp cutting edge shaves off a layer of dirt to the center thereof at which time the hood closes over the mouth and as the bucket retracts it carries its load with it. On its upward movement the sharp edge 43ª of the rear mouth 43 picks up any dirt in its path, the same passing into the bucket by which it is conveyed to the bank. If desired, by properly feeding the adjustable track downwardly each of the bucket's sharp edges may be made to shave off fairly thick layers of earth, thus cutting both downwardly and upwardly. The adjustable ditch track is fed downwardly at intervals by the mechanism already described, and after the ditch has been excavated to the proper depth the track on which the trucks travel is raised above the level of the ground as shown in Fig. 1 and with the buckets in the full line position shown the whole frame may be made to roll along on the temporary rails 17 so as to bring the excavator over an undug portion of the ground. The adjustable track is then lowered step by step and the buckets shave off alternately layers of the dirt and dump the same on the adjacent banks.

In Figs. 7 to 10 inclusive I have illustrated a modified form of hood controlling means and in this construction instead of the ditch track angle bars 37 I use channel bars 85 the lower flanges of which co-act with the truck wheels 39 while on the upper flanges travel the rollers 86 secured to the hood near its outer portion. On the upward movement of the bucket the wheels 86 roll on the top flanges of these channel bars and when they reach the pivoted track doors or switches 87 hinged at 88 (Fig. 8) they raise the same which drop as soon as the rollers have passed, and on the downward travel of the bucket these wheels 86 roll on the upper track 89 causing the hood to leave the mouth of the bucket open until the rollers 86 reach the supplemental bent or cam angle bars 90 with the under surfaces of which they co-act whereby the hood is forced down to close the

mouth of the bucket when it has reached substantially the center of the trench.

In Fig. 11 I have shown another modification of my excavator which may be used for digging a trench which is comparatively narrow and the sides of which are substantially V-shaped. This modification is of much the same construction as that shown in Fig. 7 except that the weight of the hood is depended upon to cause the shutting of the bucket's mouth. When rollers 91 leave their tracks 92 the hood drops into the position shown in Fig. 11.

Various minor mechanical changes may be made in a structure of this general character without departing from the substance of my invention as set forth in the claims.

I claim:

1. In a trench excavating machine, the combination of a track, a pair of sharp-edged buckets adapted to travel on said track, means to balance said buckets, and means to operate said buckets so that they will shave off layers of dirt from the trench, substantially as described.

2. In a trench excavating machine, the combination of a track, a pair of sharp-edged buckets adapted to travel on said track, means to balance said buckets, and means to operate said buckets so that they will alternately shave off layers of dirt from the trench, substantially as described.

3. In a trench excavating machine, the combination of a track shaped to conform substantially to the cross sectional profile of the trench to be dug, a pair of buckets each with a sharp edge adapted to travel on said track and shave off and remove layers of dirt from the trench, and means to cause each of said buckets to cut only to the center of the trench, substantially as described.

4. In a trench excavating machine, the combination of a track shaped to conform substantially to the cross sectional profile of the trench to be dug, a pair of sharp-edged buckets adapted to travel on said track and shave off and remove layers of dirt from the trench, and means to cause said buckets to alternately shave off layers of dirt to the center of the trench, substantially as described.

5. In a trench excavating machine, the combination of a track shaped to conform substantially to the cross sectional profile of the trench to be dug, a pair of sharp-edged buckets adapted to travel on said track and shave off and remove layers of dirt from the trench, means to balance said buckets, and means to cause said buckets to alternately shave off layers of dirt to the center of the trench, substantially as described.

6. In a trench excavating machine, the combination of an inclined track, a bucket having a front sharp edge adapted to travel on said track and shave off a layer of dirt from the trench only when moving downwardly on said track, and means to cause said bucket to travel on said track, substantially as described.

7. In a trench excavating machine, the combination of a substantially U-shaped track, a pair of balanced sharp-edged buckets adapted to travel on said track and shave off layers of dirt from the trench when moving downwardly on said track, and means to cause one of said buckets to travel downwardly on said track when its companion bucket travels upwardly and vice versa, substantially as described.

8. In a trench excavating machine, the combination of a substantially U-shaped track, a pair of balanced sharp-edged buckets adapted to travel on said track and shave off layers of dirt from the trench when moving downwardly on said track, and means to cause one of said buckets to travel downwardly on said track when its companion bucket travels upwardly and shave off a layer of dirt to the center of the trench, substantially as described.

9. In a trench excavating machine, the combination of a track, a pair of buckets, a truck for each of said buckets adapted to travel on said track, a balancing cable secured at its opposite ends to said trucks, one or more sheaves over which said balancing cable passes, a drum, a pair of cables secured to said drum adapted to be wound thereon in opposite directions, said pair of cables being also attached to said trucks, and means to rotate said drum in opposite directions, substantially as described.

10. In an excavating machine, the combination of a track, a bucket adapted to travel on said track, and a hood to open and close the mouth of said bucket, substantially as described.

11. In an excavating machine, the combination of an inclined track, a sharp-edged bucket adapted to travel on said track and shave off a layer of dirt when traveling downwardly, means to reciprocate said bucket on said track, a hood, and means to actuate said hood to close the mouth of said bucket in its upward movement to retain the dirt therein and to leave said mouth open during its downward travel, substantially as described.

12. In an excavating machine, the combination of a track, a bucket having a mouth adapted to travel on said track, means to cause said bucket to travel on said track, a hood to open and close the mouth of said bucket, and a supplemental track controlling the operation of said hood, substantially as described.

13. In an excavating machine, the combination of a track, a bucket having a mouth adapted to travel on said track, a hinged hood movable with said bucket to open and close the mouth thereof, a hood track, and means to co-operate with said hood track to

keep said hood away from the mouth of said bucket during its travel in one direction, substantially as described.

14. In an excavating machine, the combination of a track, a bucket having a mouth adapted to travel on said track, a hinged hood movable with said bucket to open and close the mouth thereof, a hood track and means co-operating with said hood track to keep said hood away from the mouth of said bucket during its travel in one direction, and means compelling said hood to close said mouth at a certain point in the bucket's travel, substantially as described.

15. A bucket for an excavator having two open mouths each provided with a sharp cutting edge, substantially as described.

16. A bucket for an excavator having two open mouths each provided with a sharp cutting edge, and means to open and close one of said mouths, substantially as described.

17. A bucket for an excavator having two open mouths each provided with a sharp cutting edge, and a pivoted hood adapted to open and close one of said mouths, substantially as described.

18. In an excavator, the combination of a track shaped to conform substantially to the cross-sectional profile of the trench to be dug, a bucket adapted to reciprocate on said track, said bucket having front and rear mouths each with a sharp cutting edge, and means to reciprocate said bucket on said track whereby one of said sharp edges shaves off a layer of earth on the forward movement of the bucket and the other sharp edge is operative for the same purpose on the rearward movement of the bucket, substantially as described.

19. In an excavator, the combination of a main support, a track shaped to conform substantially to the cross-sectional profile of the trench to be dug and vertically adjustable upon said support, a bucket adapted to reciprocate on said track, said bucket having front and rear mouths each with a sharp cutting edge, means to open and close one of said mouths, and means to reciprocate said bucket on said track whereby one of said sharp edges shaves off a layer of earth on the forward movement of the bucket and the other sharp edge is operative for the same purpose on the rearward movement of the bucket, substantially as described.

20. In an excavator, the combination of a main frame adapted to be moved longitudinally of the trench to be dug, a track shaped to conform substantially to the cross-sectional profile of the trench, said track being vertically adjustable on said main frame, a bucket adapted to reciprocate on said track, said bucket having front and rear mouths each with a sharp cutting edge, a pivoted hood adapted to open and close one of said mouths, and means to reciprocate said bucket on said track whereby one of said sharp edges shaves off a layer of earth on the forward movement of the bucket and the other sharp edge is operative for the same purpose on the rearward movement of the bucket, substantially as described.

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