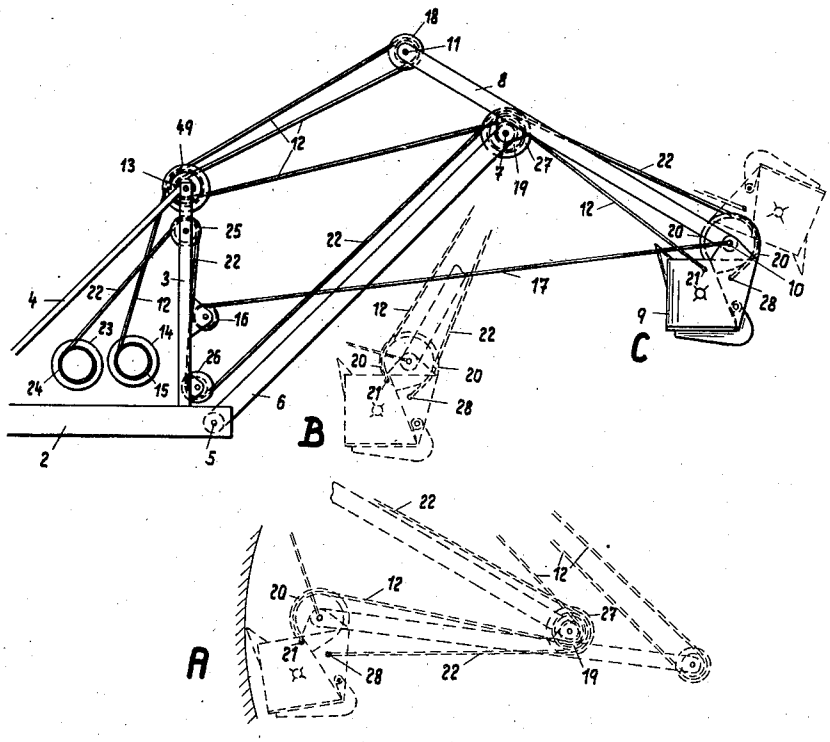
Feb. 27, 1940. J. A. KUHSEL 2,191,569

DRAG SHOVEL

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Fig. 1



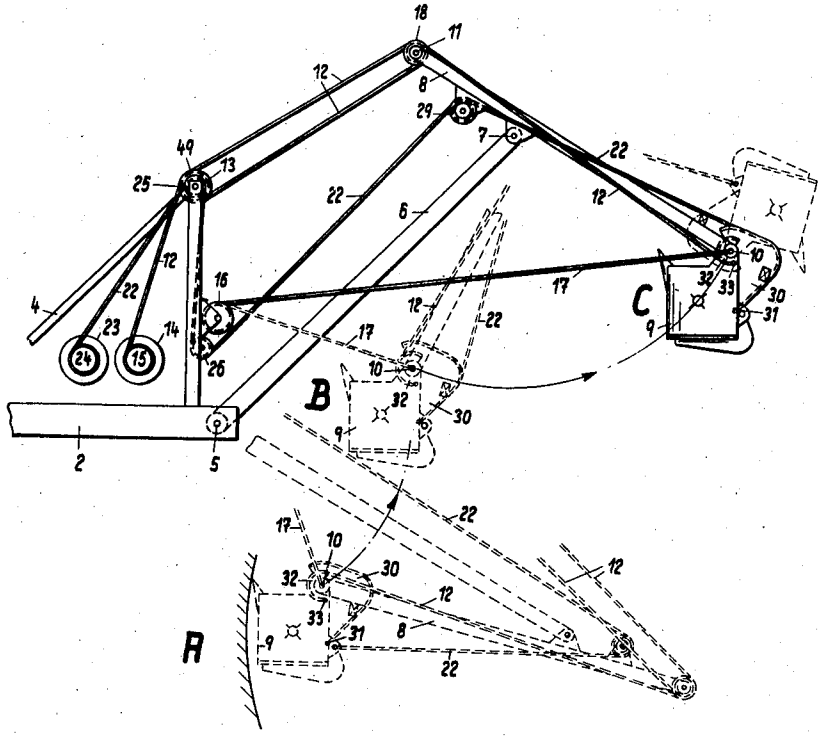
Inventor,
Joseph Albert Kuhsel,
by Frank A. Appleman,
attorney.

Feb. 27, 1940. J. A. KUHSEL 2,191,569

DRAG SHOVEL

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Fig. 2



Inventor,
Joseph Albert Kuhsel,
by Frank S. Appleman,
Attorney.

Feb. 27, 1940. J. A. KUHSEL 2,191,569

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Fig. 3

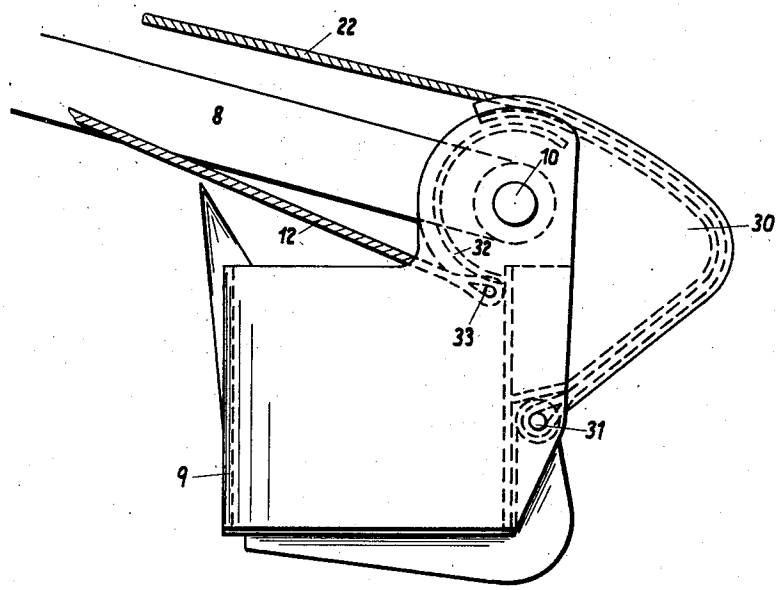
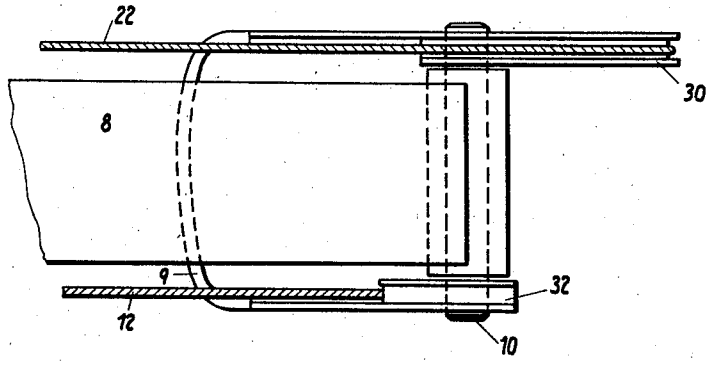


Fig. 4.



Inventor,
Joseph Albert Kuhsel,
by Frank S. Appleman,
attorney.

Feb. 27, 1940. J. A. KUHSEL 2,191,569

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Fig. 5.

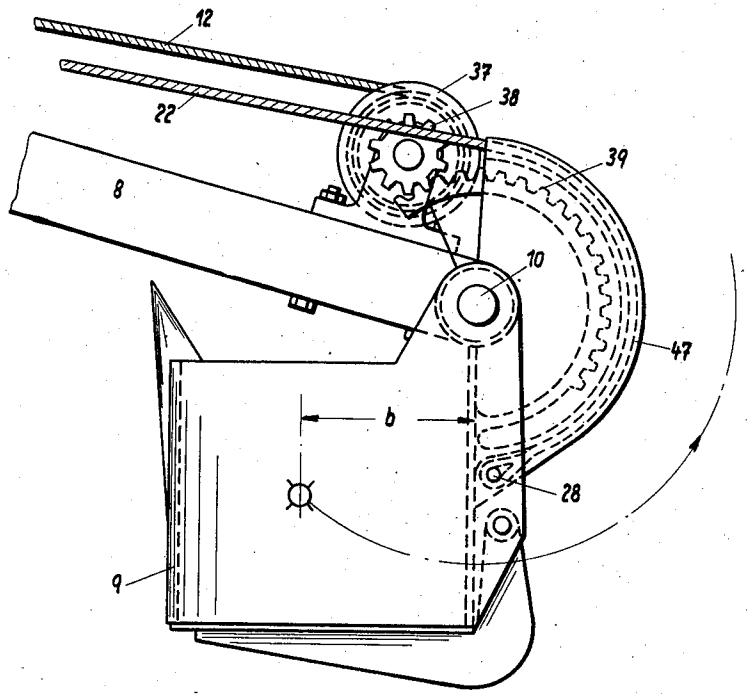
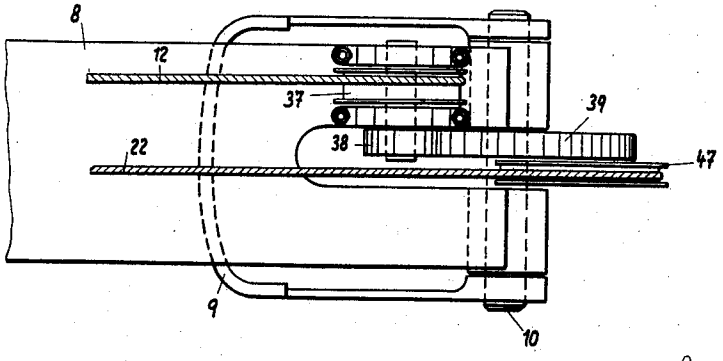


Fig. 6



Inventor,
Joseph Albert Kuhsel,
by Frank S. Appleman,
Attorney.

Feb. 27, 1940. J. A. KUHSEL 2,191,569

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Fig. 7.

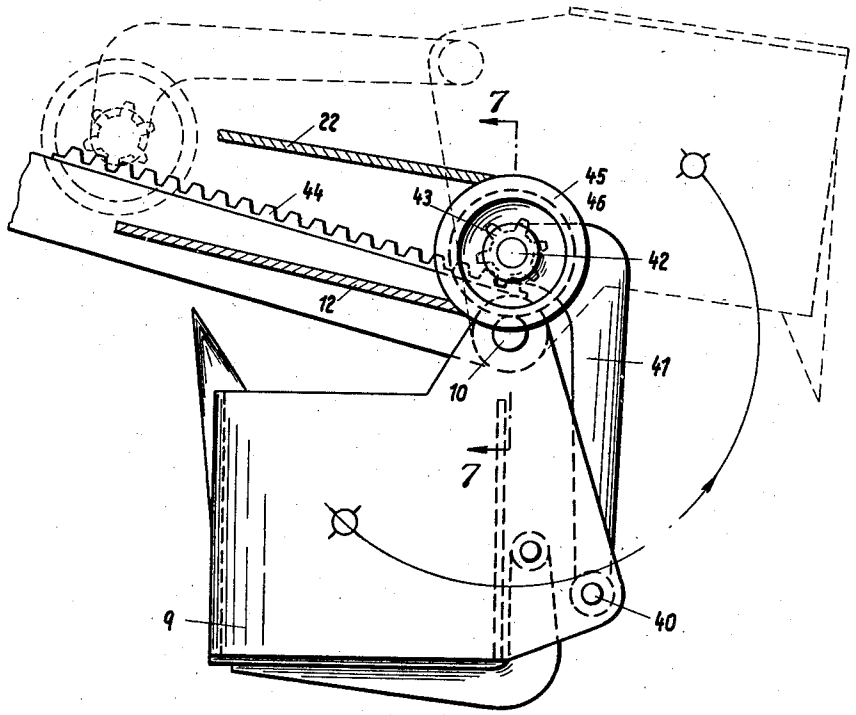
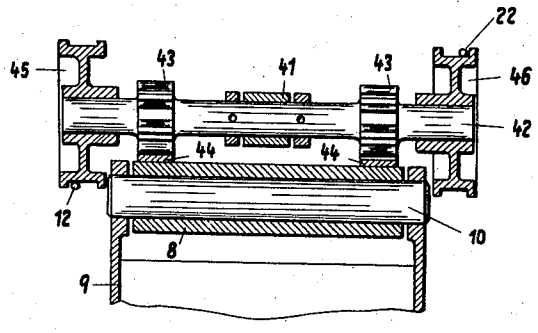


Fig. 8.



Inventor,
Joseph Albert Kuhsel,
by Frank S. Appleman,
attorney.

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UNITED STATES PATENT OFFICE

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DRAG SHOVEL

Joseph Albert Kuhsel, Hamburg-Altona, Germany

Application December 17, 1937, Serial No. 180,437
In Germany March 13, 1936

7 Claims. (Cl. 214—138)

Drag shovels are known the bucket of which is moved from its transporting position into its digging position by means of a digging cable actuating the bucket outside its center of rotation, or in which the bucket is actuated by the lifting cable in such a way that it is tilted from its inoperative or transporting position into its operative or digging position. This means that in such drag shovels the bucket is always moved against the digger stop by means of the tightened cable, while when in transporting position it always can tilt by its own weight to such an extent only until the center of gravity lies below the center of rotation.

It is further known to provide in drag-shovels rigid, parallelogram-shaped guides by which the bucket is conducted in such a way that independently of the different positions of the boom and of the digger-stick the bottom edge of the bucket is always moved on a parallel line in respect to itself. This arrangement excludes any possibility of changing at will the inclination of the bucket for dumping or transporting.

A feature of the invention consists in the fact that the lifting cable directly or indirectly actuates the bucket outside its center of rotation and, that the bucket by the action of such traction cable is raised in its transporting position beyond its center of gravity. Thus, a loss of excavated material during the slewing of the dipper-stick is substantially avoided and at the same time a position of the bucket is obtained permitting of its discharging its contents through an opening in the bottom.

It is a further object of the invention to provide drag shovel buckets which are moved from the transporting position into the digging position by a particular tilting cable. Such a tilting cable is attached to the bucket in such a way that when the boom is raised and the digger-stick slewed, with the bucket in its transporting position the tilting cable will automatically maintain the bucket in the transporting position. This is accomplished by providing a uniformly tensioned cable irrespective of the boom and stick positions without necessitating during such movement any change in the length of such cable by operating the respective cable drum.

The invention is schematically shown in the attached drawings, in which:

Fig. 1 is a side view of a drag shovel in its several respective positions, viz:

(A) With lowered boom, bucket in digging position,

(B) With raised boom and lowered dipper-stick, bucket in its transporting position,

(C) With raised boom and lifted dipper-stick, bucket in transporting position, the hatched lines indicating the digging position.

Fig. 2 is a side view similar to Fig. 1 of a drag shovel showing the same positions but showing a modified guiding of the tilting and lifting cables.

Fig. 3 is a side view of a bucket according to Fig. 2, on enlarged scale.

Fig. 4 is a plan view of Fig. 3.

Fig. 5 is a side view similar to Fig. 3 and shows a further embodiment of the invention with a gearing inserted between lifting cable 12 and bucket 9.

Fig. 6 is a plan view of Fig. 5.

Fig. 7 is a side view similar to Figs. 3 and 5 but showing another form of execution with variable gearing between cable and bucket.

Fig. 8 is a section view taken on line 7—7 of Fig. 7.

In the said drawings 2 is a rotatable superstructure of a shovel with the supporting girder 3 being held in position by a strut 4; at 5 the boom 6 is pivotally arranged and at the top 7 of boom 6 the dipper-stick 8 is pivotally arranged. At the front end of the dipper-stick 8 the bucket 9 is pivotally arranged to be rotated about the center of rotation 10, while at its rear end at 11 pulleys 18 are provided for the lifting cable 12 which passes over pulleys 13 and 49 respectively of girder 3. From there the cable 12 passes to the lifting drum 15 which is provided with a brake 14. From a second drum 16, the digging cable 17 is guided to the digger-stick, so that in a well known manner the boom 6 and dipper-stick 8 may be operated by both cables 12 and 17. My device differs from known devices in that one end of lifting cable 12 is guided either from the rear end 11 of the dipper-stick or from pulley 13 of support 3 directly to a pulley 19 at the boom and from there to the curved surface 20 of the bucket, the said cable end being fixed to the bucket at 21. This cable actuates the bucket from

outside the center of rotation thereof of the bucket, whereby to produce a tilting momentum of the bucket around its center of rotation 10 in clockwise direction by which the bucket being in its transporting position is moved to such a point that the front wall of the bucket is held in a favourable position for both transporting the excavated material and for discharging the latter through an opening in the bottom.

The tilting cable 22 is guided from the drum 24, provided with brake 23, either directly or over the pulley 25 to the pulley 26 at the structure of the drag shovel from whence it may pass over a pulley 27 at the top of boom to the curved surface 20 of the bucket where it may be fixed to the bucket as at 28.

If, after completion of the digging motion the bucket is shifted from position A to position B by lifting the boom by means of lifting cable 12 the bucket is caused to take and maintain respectively, the most favourable position for transporting the material and for discharging it through the opening in the bottom. For this purpose, a part of tilting cable 22 is passed around the curved surface 20. The length of cable required to accomplish this end is obtained by the fact that the center of rotation of pulley 26 is arranged at such a distance and in such a direction from the center of rotation 5 of the boom that when the boom is raised, the cable passes around said pulley, the distance between top 7 of the boom and the center of rotation of pulley 26 being simultaneously reduced to such an extent that, when the pulley 26 is suitably arranged, the difference between the shortening of distance 7—26 and the length of cable passing around pulley 26 is identical to the length of cable passing around the curved surface 20 on its way from A to B. In other words, the length of the tilting cable between drum 24 and fixing point 28 does not change in spite of the alteration of the angle between bucket and dipper-stick, so that once a favourable transporting and dumping position of the bucket is obtained it can be automatically maintained without any actuation of the tilting drum, the tilting cable remaining uniformly tightened at all times.

A further alteration of the angle between bucket and dipper-stick is produced when shifting from position B to position C, that is to say when slewing forward the dipper-stick, so that during this operation a part of tilting cable 22 passes around the curved surface 20. If the pulley 27 is given a diameter identical to that of the curved surface 20 represented as a circle in this figure, the slewing of dipper-stick from B to C will result in a length of cable being uncoiled from said pulley identical to the length of cable coiled on curved surface 20. That is to say, the front wall of bucket 9 on its way from A to B is displaced parallel and thereby maintains its favourable position. When raising the boom and swinging forward the dipper-stick, no matter whether such operations take place one after another or simultaneously, the tilting drum 24 need not be actuated at all, the position of the front wall of the bucket being approximately maintained.

After discharging or for dumping through the opening, the bucket is moved into its digging position, indicated by hatched lines, by tightening the cable 22. It is then lowered for a new digging operation by loosening the lifting cable 12. As during the downward movement of the bucket the latter does not change its position in relation to the dipper-stick, the tilting drum has to uncoil cable, an automatic compensation of the cable lengths as took place during the upward movement by changing the angle between bucket and dipper-stick not being possible any more during this downward movement. It will be understood that during the downward movement any braking work necessary is partly done by the tilting drum brake 23, so that the braking heat produced when lowering the system is distributed on two brakes 14 and 23, thus favourably relieving lifting brake 14 which has so far had to do all the braking work. In this arrangement the shape and the position of the curves or pulleys for the tilting cable can be chosen simultaneously taking into account that a certain amount of braking work is done by the brake of the tilting drum.

A further embodiment of the invention is shown in Fig. 2. In this instance the tilting cable 22 does not pass from pulley 26 over the top of the boom, but is guided over a pulley 29, which is secured to the dipper stick at a certain distance from the center of rotation 7, to a curved surface 30 on the bucket, the said cable being fixed to the bucket at 31. At the same time Fig. 2 shows in which manner the one end of lifting cable 12 passes from the pulleys 18 to a curved surface 32 and is fixed to the bucket at 33. While the efficiency of thus guiding the lifting cable is the same as that of the arrangement shown in Fig. 1, it will be attained by particularly guiding the tilting cable, that is to say by the pulley 29 being arranged outside the center of rotation 7, and by forming the curved surface 30 for the tilting cable to compensate for the variations of cable lengths. Also the length of the lever arm of the tilting cable necessary for tilting the bucket into its digging position is increased, so that the forces produced in such cable are decreased when tilting takes place. At the same time, by such an arrangement of pulley 29, the pulley 26 may be disposed at a greater distance from the center of rotation 5 of the boom, so that by this measure during the downward movement of the whole system the length of cable to be uncoiled from the tilting drum 24 becomes longer, the amount of braking work to be done by brake 23 being increased at the same time.

In practice it will be possible to combine and exchange the arrangement of the various elements of Figs. 1 and 2 without departing from the scope of the present invention, it being possible to reduce the diameter of pulley 27 of Fig. 1, compensating the differences of length of cable 22 resulting therefrom by giving curved surface 20 a shape similar to curved surface 30 of Fig. 2. Besides it will, of course, be possible to guide the lifting cable 12 in Fig. 1 to the bucket in the same way as shown in Fig. 2 without substantially changing the effective operation of such arrangement.

An invention also consists in combining the aforesaid new features. A bucket in its transporting position on which a force is exercised in clockwise direction by the lifting cable 12 being so passed to the bucket and which bucket is guided by the tilting cable as indicated above and is prevented from yielding to said force, offers the advantage, compared with the cable-governed buckets known so far, that it does not alter its position during the slewing of the dipper-stick and during the rotation of the shovel respectively and does not begin to oscillate in the longitudinal direction of the shovel under the action of

the accelerating and centrifugal forces respectively.

Besides during the said movements the tilting cable is always kept tightened if from the beginning the curves 20 or 32 for the lifting cable are so dimensioned that the momentum in a clockwise direction produced by the lowering cable is superior to that one produced in the opposite direction by the center of gravity of the bucket.

The combination further brings about the advantage that the bucket when discharged through its bottom opening cannot react to the action of the displacement of the center of gravity caused by the discharging, the tilting cable, as already mentioned, not permitting a clockwise rotation of the bucket. This means that during dumping the bucket is maintaining its position, so that its contents can be discharged at will at a certain point without any waste on the way.

Fig. 3 represents a bucket according to Fig. 2 on an enlarged scale, showing the manner in which the tilting cable 22 is passed over curve 30 and fixed at 31. The lifting cable 12 passes over a curve 32, which in the present instance is represented as a semi-circle, and is fixed at 33. As already set forth, a momentum in clockwise direction is exercised on the bucket by the lifting cable 12 resulting in a position of the bucket favourable for its being discharged through the bottom opening. At the same time the tilting cable 22 by the shape of curve 30 and the means described above is guided in such a way that when moving the boom and the dipper-stick without operating the tilting drum 24, the bucket maintains its upright position brought about by cable 12.

Figs. 5 and 6 represent a further embodiment of the invention with a gearing inserted between lifting cable 12 and bucket 9. Such design is favourably used when the efficiency of the lifting cable 12 due to the arrangement of the system does not suffice without ado for drawing the bucket into the desired position. In such cases where the curve 47 (Fig. 5) is to be so limited in size that the inlet opening of the bucket is not thereby affected. By using a gearing the center of rotation 10 can be chosen at will. It is possible to have it arranged if desired at a greater distance from the front wall of the bucket without prejudicing the discharging position of the bucket, as by a greater ratio of gearing the momentum at the bucket opposing the center of gravity of the bucket may be increased at will. The lifting cable 12 actuates a drum 37 in such a way that by means of the gearing 38, 39 a turning momentum of the desired degree in clockwise direction is exercised on the bucket.

In this instance the tilting cable 22 is shown passing over curve 47 and being fixed at 28, similarly as shown in Fig. 1. It will, of course, be possible to actuate the said cable at the opposite side of the drum 37, so that the turning momentum exercised on the bucket by the cable 22 for tilting the bucket may be increased according to the ratio of gearing.

The arrangement shown in Figs. 5 and 6 has the disadvantage that the momentum exercised on the bucket from cables 12 and 22 respectively by the constant ratio of gearing does not always have the same relation to the momentum exercised on the bucket by the center of gravity, as by moving the bucket about the center of rotation 10 out of the position shown in the drawings in a counter-clockwise direction. The center of gravity on account of its varying horizontal distance from the center of rotation will at first support the action of cable 22, while when it has passed the dead center it will gradually and increasingly oppose such movement. This inconvenience can be overcome by so arranging the center of the toothed wheel 39 that it does not coincide with the center of rotation 10, but is arranged independently of the bucket on the dipper-stick at a sufficient distance from the bucket proper. When inserting a guide between a point outside the center of said toothed wheel (crank) and a suitable point of the bucket, a variable relation between cable and bucket is attained during the rotation of the bucket. Besides, such design will also be advantageous on account of the fact that the force available in the lifting cable for moving the bucket into its transporting and discharging position will vary according to the distance of the bucket from the center of rotation of the boom. This means that the gearing ratio may be permanently adjusted to the respective position of the bucket in such a way that the available force of the lifting cable will suffice in any case for attaining a favourable position of the bucket when transporting or dumping.

A further embodiment with variable gearing ratio between cables 12 and 22 and the bucket, as shown in Figs. 7 and 8, is obtained by a hook-shaped guide-arm 41 actuating the bucket 9 at 40, the said guide-arm being pivotally mounted on shaft 42. The said shaft 42 is provided with gear pinion or pinions 43 engaging racks 44 secured to the dipper-stick. Furthermore, drums 45 and 46 for the lifting cable 12 and tilting cable 22 are reversibly mounted on shaft 42. If cable 22 is tightened, in order to tilt the bucket into the position marked by hatched lines, pinion 43 will run in the same direction on rack 44. At first the force exerted by the lever arm on the center of rotation 10 for tilting the bucket will be small, while with progressive movement of shaft 42 in the direction of the cable traction, the force exerted by said lever arm increases in the same relation as the horizontal distance of the center of gravity from the center of rotation 10 is increased.

What I claim is:

1. In an excavator including a dipper stick and a bucket pivotally attached thereto, means for actuating said stick and bucket through a digging operation to fill said bucket, means for transporting said filled bucket to a dumping point, said first means including a lifting cable, a drum therefor anchoring one end thereof, a pulley on the rear end of said stick, said cable passing over said pulley, gear means on said stick adjacent said bucket, meshing gear means on said bucket, means associated with said first gear means and engaging said cable whereby to rotate said first gear means and said meshing gear means and said bucket, the length of said cable being such as to raise said bucket above its center of gravity, and means for automatically maintaining said bucket in said raised position throughout the transportation thereof.

2. In an excavator including a dipper stick and a bucket pivotally attached thereto, means for actuating said stick and bucket through a digging operation to fill said bucket, means for transporting said filled bucket to a dumping point, said first means including a lifting cable, a drum therefor anchoring one end thereof, a pulley on the rear end of said stick, said cable

passing over said pulley and the free end thereof being attached to said bucket outside its center of rotation, the length of said cable being such as to raise said bucket above its center of gravity, and means for automatically maintaining said bucket level throughout the transportation thereof, a curved surface on said bucket, said cable passing over said surface before being attached to said bucket.

3. In an excavator, including a boom pivoted to said excavator, a dipper stick pivoted to said boom and a bottom-discharging bucket pivoted to said dipper stick; a tilting cable for holding said bucket in a digging position, means for actuating said stick and bucket through a digging operation to fill said bucket, means for raising said filled bucket to a combined transporting and discharging position with its front edge raised above the center of gravity of said bucket, means for actuating said boom and dipper stick to transport said filled bucket, and means associated with said tilting cable and said bucket raising means for automatically maintaining said bucket in said transporting position irrespective of the position of said boom and dipper stick.

4. In an excavator, including a boom, pivoted to said excavator, a dipper stick pivoted to said boom and a bottom-discharging bucket pivoted to said dipper stick; means for holding said bucket in a digging position, means for actuating said stick and bucket through a digging operation to fill said bucket, a lifting cable for raising said filled bucket to a combined transporting and discharging position with its front edge raised above the center of gravity of said bucket, a drum for said lifting cable anchoring one end thereof, a pulley on the rear end of said stick, said cable passing over said pulley and the free end of said cable being attached to said bucket outside its center of rotation, and means associated with said first named means for automatically maintaining said bucket in said transporting position irrespective of the position of said boom and stick.

5. In an excavator, including a boom pivoted to said excavator, a dipper stick pivoted to said boom, and bottom-discharging bucket pivoted to said dipper stick; a tilting cable for holding said bucket in a digging position, means for actuating said stick and bucket through a digging operation to fill said bucket, a lifting cable for raising said filled bucket to a combined transporting and discharging position with its front edge raised above the center of gravity of said bucket, the ends of said cables being attached to said bucket on opposite sides of the center of rotation thereof to provide means for pivoting said bucket in both directions through the longitudinal plane thereof, and means associated with said cables for automatically maintaining said bucket in said transporting position irrespective of the positions of said boom and stick.

6. In an excavator, including a boom pivoted to said excavator, a dipper stick pivoted to said boom and a bottom-discharging bucket pivoted to said dipper stick; a tilting cable for holding said bucket in a digging position, means for actuating said stick and bucket through a digging operation to fill said bucket, means for raising said filled bucket to a combined transporting and discharging position with its front edge raised above the center of gravity of said bucket, means for actuating said boom and dipper stick to transport said filled bucket, and means associated with said tilting cable and said bucket raising means for automatically maintaining said bucket in said transporting position irrespective of the position of said boom and dipper stick, said transporting position maintaining means including a pulley on said excavator adjacent to but outside the pivotal connection of said boom thereto, a second pulley in the region of the pivotal connection of said boom and stick, said tilting cable passing over both of said pulleys before reaching said bucket.

7. In an excavator, including a boom pivoted to said excavator, a dipper stick pivoted to said boom and a bottom-discharging bucket pivoted to said dipper stick; a tilting cable for holding said bucket in a digging position, means for actuating said stick and bucket through a digging operation to fill said bucket, means for raising said filled bucket to a combined transporting and discharging position with its front edge raised above the center of gravity of said bucket, means for actuating said boom and dipper stick to transport said filled bucket, and means associated with said tilting cable and said bucket raising means for automatically maintaining said bucket in said transporting position irrespective of the position of said boom and dipper stick, said transporting position maintaining means including a pulley on said excavator adjacent to but outside the pivotal connection of said boom thereto, a second pulley in the region of the pivotal connection of said boom and stick, said tilting cable passing over both of said pulleys before reaching said bucket, and cable actuated gearing operatively interposed between the free end of said cable and said bucket.

JOSEPH ALBERT KUHSEL.