Dec. 6, 1938. K. R. BIXBY 2,139,255

EXCAVATING MACHINE

Filed Oct. 27, 1937 3 Sheets-Sheet 1

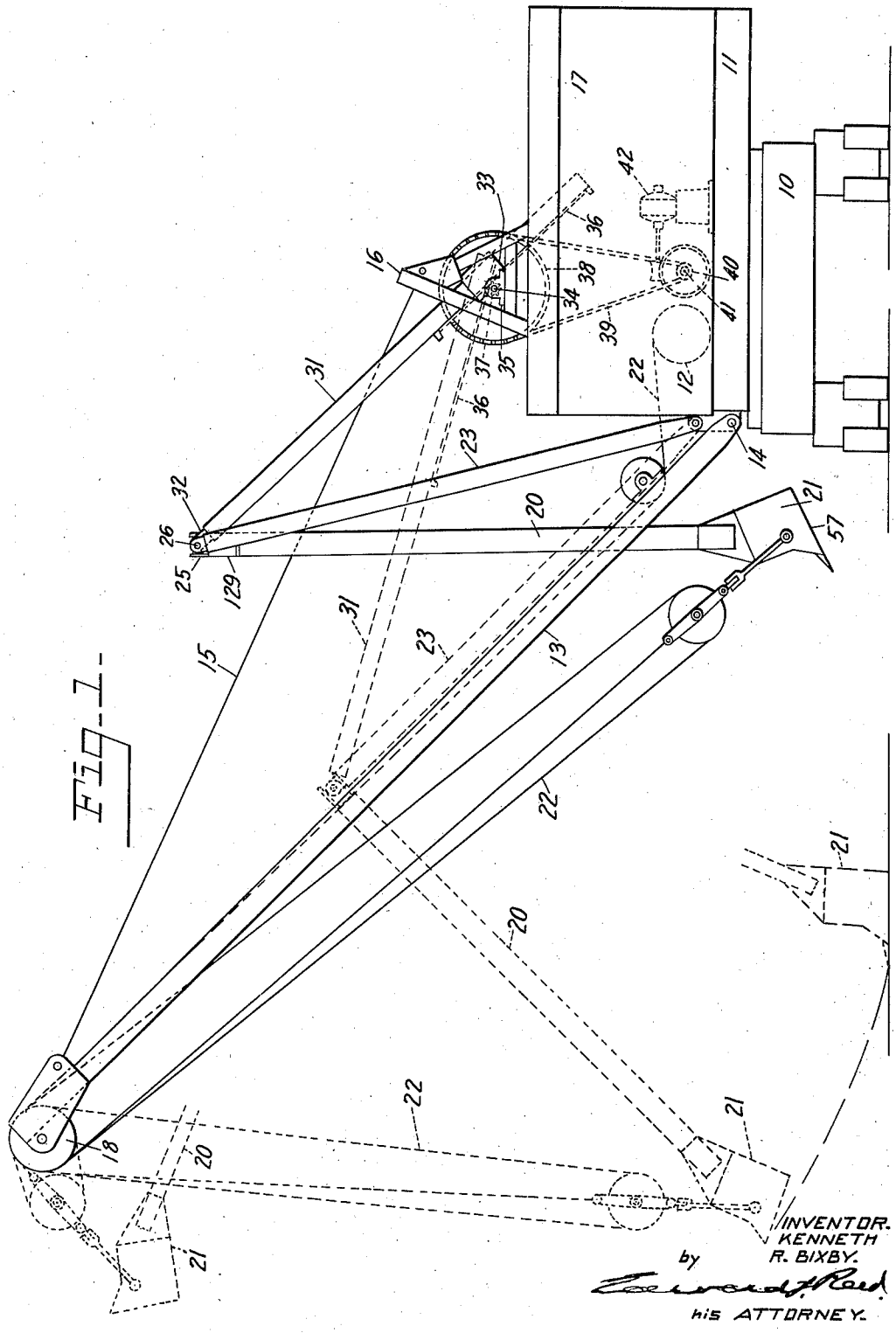

Fig. 1.

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EXCAVATING MACHINE

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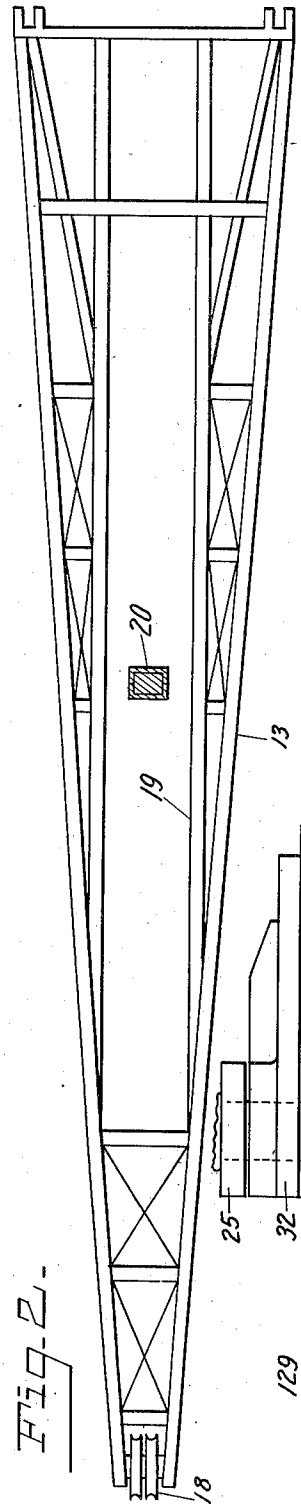

Fig. 2.

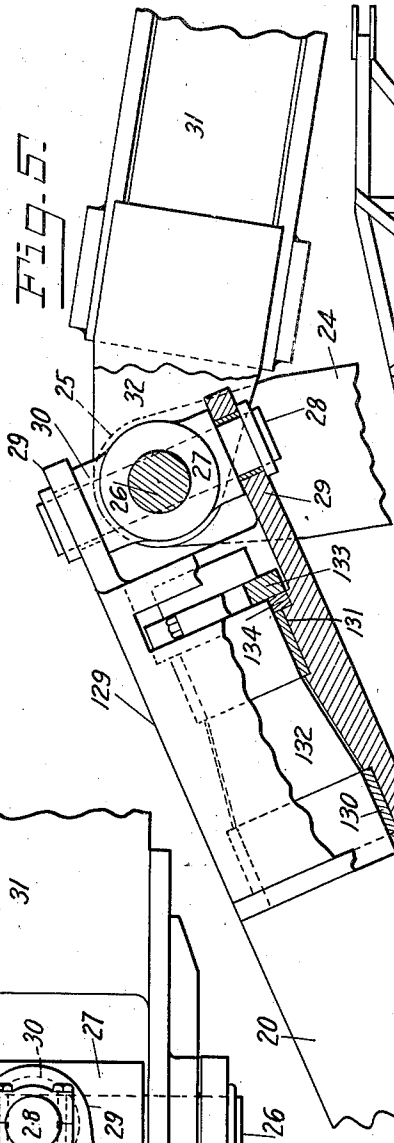

Fig. 5.

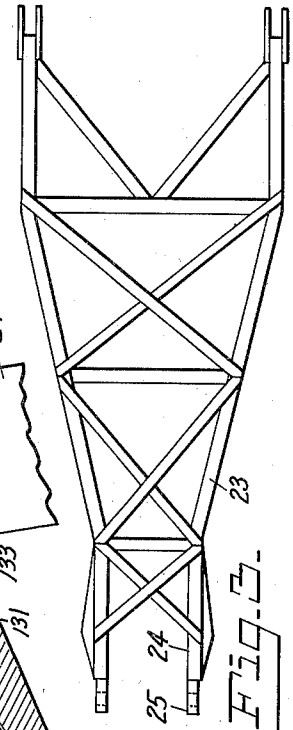

Fig. 3.

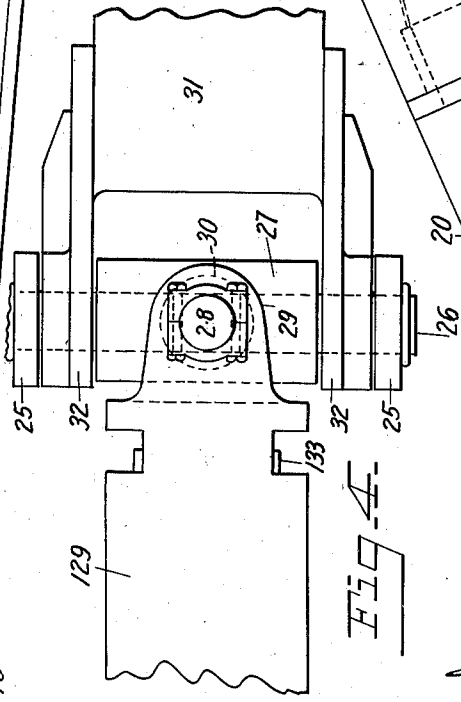

Fig. 4.

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EXCAVATING MACHINE

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Fig. 7.

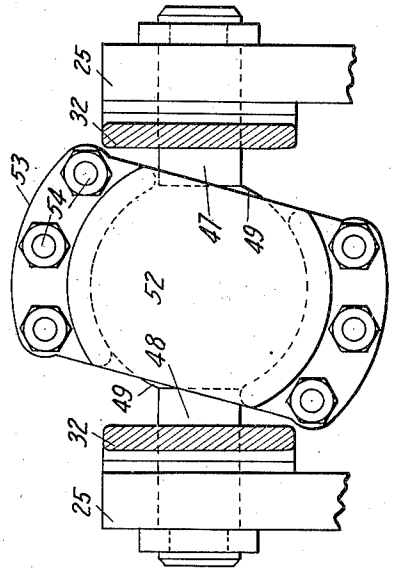


Fig. 6.

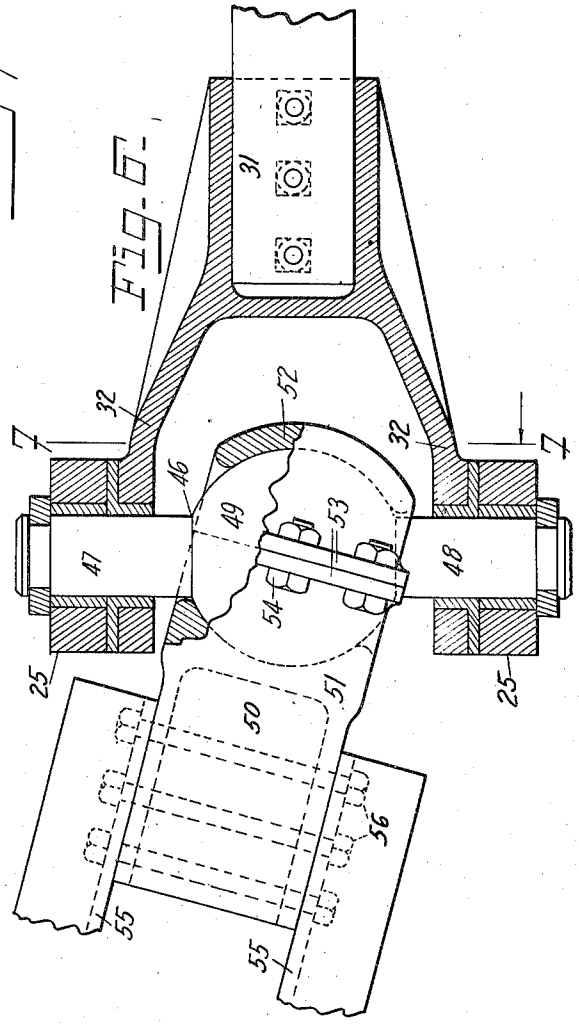
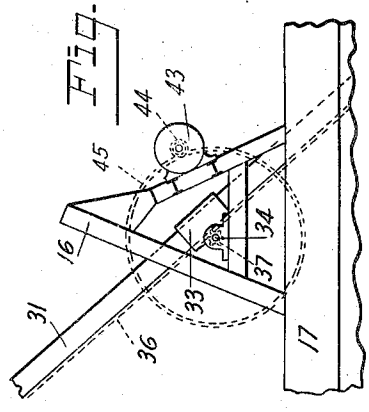


Fig. 8.



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Patented Dec. 6, 1938 2,139,255

UNITED STATES PATENT OFFICE

2,139,255

EXCAVATING MACHINE

Kenneth R. Bixby, Geneseo, Ill., assignor to The Marion Steam Shovel Company, Marion, Ohio, a corporation of Ohio

Application October 27, 1937, Serial No. 171,234

16 Claims. (Cl. 214—136)

This invention relates to excavating machines, such as power operated shovels, and more particularly to dipper supporting and operating mechanism of the type shown in my application for patent, Serial No. 147,530, filed June 10, 1937. In power operated shovels the dipper arm usually extends across and is supported by the boom, crowding mechanism carried by the boom itself being connected with the dipper arm to force the dipper into the material to be excavated during the digging operation. The thrust imposed upon the dipper arm during the crowding operation is transmitted to the boom and tends to flex the same at the point of connection of the dipper arm therewith. Further, during the swinging of the boom to and from dumping position the dipper arm has a tendency to pivot at its point of connection with the boom, due to the inertia of the dipper, and thus imposes severe twisting strains on the boom. To overcome the flexing and twisting strains so imposed upon the boom it has been necessary to make the boom of a very heavy rigid construction which not only adds greatly to the weight and cost of the machine but imposes a very definite limitation upon the length of the boom which can be used. Moreover when the dipper is moved to its retracted position and dropped onto the ground it will rest upon the points of the teeth with the dipper front at a wide angle to the ground, and, as the dipper moves forwardly, the angular position of the dipper front with relation to the ground will change very rapidly so that the dipper has only a short cutting action in a substantially horizontal direction.

One object of the invention is to so construct a machine of this type that a boom of relatively light construction will have ample strength to handle the loads imposed thereon; and to this end it is a further object of the invention to provide means for so supporting and actuating the dipper arm that little or no strain will be imposed on the boom by the dipper arm during the digging and swinging movements of the dipper.

A further object of the invention is to provide means for so supporting and actuating the dipper arm that the dipper front may be moved more nearly into flat engagement with the ground at a point close to the foot of the boom and maintained in approximately flat engagement with the ground during a relatively long portion of its forward movement, thus materially increasing the efficiency of the machine when the dipper is operating on a substantially horizontal surface.

A further object of the invention is to provide such a machine of such simple construction that only two operating movements are required to control the digging movement of the dipper.

A further object of the invention is to provide such a machine which will be of a simple durable construction and may be manufactured and maintained at a relatively low cost.

Other objects of the invention may appear as the apparatus is described in detail.

In the accompanying drawings Fig. 1 is a side elevation of an excavating machine embodying my invention; Fig. 2 is a plan view of the boom, with the dipper arm in section; Fig. 3 is a plan view of the supporting member or lever; Fig. 4 is a plan view of the pivotal connection between the dipper arm, its supporting member and the crowding device; Fig. 5 is a side elevation of said connection, partly in section; Fig. 6 is a plan view partly in section of a modified form of said connection; Fig. 7 is a section on the line 7—7 of Fig. 6; and Fig. 8 is a side elevation of a modified form of crowding mechanism.

In these drawings I have illustrated one embodiment of the invention, together with certain minor modifications, and have shown the same as applied to a power operated shovel of a well known type. It will be understood, however, that the invention may take various forms and may be applied to excavating machines of different kinds and that the excavating element or dipper may be of any suitable type.

An excavating machine of this type comprises a platform and a normally inclined boom supported at its foot on said platform for swinging movement about a vertical axis, and the dipper is carried by a dipper arm which usually extends across the boom. The machine here shown is of the revolving type and comprises the usual portable base 10 on which is mounted a revolving platform 11 which carries the power plant and operating mechanism, including a hoisting drum 12. The boom 13 is pivotally mounted at its foot on the platform, as shown at 14, and is supported normally in a fixed inclined position by the usual cable connections 15 between the point of the boom and a gantry 16 carried by the platform 11 and, in the present instance, extending above the cab 17. The boom as here shown is of a relatively light inexpensive construction which tapers laterally from its foot to its point and is provided at its point with sheaves 18. In the particular construction illustrated the side mem-

bers of the boom are spaced one from the other to provide between them a longitudinal slot 19 which extends for the major part of the length of the boom and through which extends the dipper arm 20. The slot is of a width substantially greater than the width of the dipper arm so as to permit the latter to have a substantial lateral movement with respect to the boom without contacting therewith. It will be obvious that this arrangement may be reversed by providing a relatively narrow boom and a wide dipper arm having a longitudinal slot through which the boom extends. The dipper arm 20 carries at its lower end an excavating element, here shown as a dipper 21 of a well known type, which is connected with the hoisting drum 12 by a cable 22 extending about the sheaves 18 and then rearwardly to the hoisting drum. The upper end of the dipper arm projects above the boom and is pivotally connected at its upper end with a movable supporting member mounted on the machine and, as here shown, this supporting member is in the form of an upright lever 23 pivotally supported on the platform 11 near the foot of the boom and capable of fore and aft movement between an upright position and a position substantially parallel with and adjacent to the boom, as shown in dotted lines in Fig. 1. This lever 23 and the hoisting cable 22 constitute the supporting means for the dipper arm and dipper, the dipper arm having no connection with the boom. The supporting member 23 is preferably mounted on the foot casting which supports the boom but if desired it may be mounted on the boom itself near the foot thereof, where it will not impose any objectionable load on the boom.

As has been stated, the dipper arm is capable of lateral movement with relation to the boom and the pivotal connection between the dipper arm and the supporting lever is such as to permit the dipper arm to have pivotal movement with relation to the lever about a plurality of transverse axes, so that it can have both fore and aft movement and lateral movement and will not impose twisting strains on the supporting lever and its associated parts. The connection may be of any suitable character which will permit these movements of the dipper arm and in the construction here shown the supporting lever 23 is bifurcated at its upper end to provide the same with laterally spaced arms 24 having bearings 25. Arranged between the arms 24 is a trunnion member having at its ends pintles 26 which are journaled in the bearings 25, and having between the arms 24 an enlarged portion 27 which is provided with pintles 28 projecting from opposite sides thereof at right angles to the pintles 26. The dipper arm 20 is provided at its upper end with spaced lugs 29 having bearings 30 mounted on the pintles 28. This construction permits the dipper arm to have swinging movement both lengthwise of and transversely to the boom but it may also be desirable that the dipper arm shall have rotatory movement about a longitudinal axis and the connection shown is of such a type as to permit of this rotatory movement of the dipper arm. As shown in Fig. 5 the bearing lugs 29 of the dipper arm are carried by a connecting member 129 which is preferably tubular in form and is provided with internal bearings 130 and 131. The dipper arm 20 is provided with a shank or trunnion 132 rigidly secured thereto and extending into the tubular connecting member and journaled in the bearings therein. The trunnion 132 may be retained in the tubular member in any suitable manner, as by means of a collar 133 rigidly secured to the inner end of the trunnion in opposed relation to the bearing 131, a washer 134 being interposed between the collar and the end of the bearing.

Suitable crowding mechanism is provided for imparting fore and aft movement to the supporting member or lever 23 and thus causing the dipper arm to move transversely to its length lengthwise of the boom and to move in the direction of its length transversely to the boom. This crowding mechanism may be of any suitable character and it is mounted on the machine independently of the boom. In the present construction it comprises a rigid bar connected at its forward end with the supporting member and dipper arm and supported near its rear end on the platform 11 for both longitudinal and pivotal movement. In the arrangement shown the bar 31 is provided at its forward end with spaced bearings 32 which embrace the pintles 26 on the trunnion member between the intermediate portion 27 and the bearings 25 of the supporting lever. Its rear portion is slidably mounted in a guide or sleeve 33 which is pivotally mounted on a shaft 34 journaled in bearings 35 carried by the gantry 16, thus permitting the bar 31 to move about the axis of the shaft 34 as the supporting member 23 is moved about its axis. Preferably the bar 31 is provided with a toothed rack 36 which is in mesh with a pinion 37 secured to the shaft 34 so that the rotation of the shaft will impart longitudinal movement to the bar. Any suitable means may be provided for rotating the shaft and this rotating means may be supported in any suitable location on the platform 11. In the present construction a sprocket wheel 38 is rigidly secured to the shaft 34 and is connected by a sprocket chain 39 with a sprocket wheel 40 carried by a shaft 41 supported within the cab and driven by a motor 42, which is reversible to control the direction of movement of the dipper arm and its actuating mechanism.

However, in some cases it may be desirable that the crowding mechanism as a whole should be carried by the gantry and in Fig. 8 I have shown such an arrangement in which the driving motor 43 is mounted on the gantry 16 above the cab 17 and a pinion 44 driven by the motor meshes with a gear 45 which is rigidly secured to the shaft 34 in place of the sprocket wheel 38.

In Figs. 6 and 7 I have shown a modified form of the pivotal connection between the dipper arm, supporting lever and crowding bar which includes a universal joint. As there shown, a connecting member 46 is provided at its ends with trunnions 47 which are journaled in the bearings 25 and 32 of the supporting lever and crowding bar. The intermediate portion of this connecting member is spherical in form, as shown at 49, and cooperating with this spherical portion is a second connecting member 50 having a spherical socket which embraces the spherical portion or ball 49 of the connecting member 46. Preferably the socket is in two parts and comprises a part 51, integral with the connecting member 50, and a detachable part or cap 52. In the arrangement shown the two parts of the socket are provided with flanges 53 to receive bolts 54 by means of which the two parts of the socket are rigidly connected one to the other. The connecting member 50 is carried by the dipper arm 55 and the dipper arm is here shown as comprising two laterally spaced parts between which the end portion of the connecting member 50 is mounted and to which it is secured by bolts 56.

In Fig. 1 the dipper arm 20 is shown, in full lines, in its fully retracted position. While forward or digging movement is imparted to the dipper by the cable 22 the crowding mechanism is actuated to impart longitudinal movement to the dipper arm and thus force the dipper into the material being excavated but inasmuch as the dipper arm has no connection with the boom the thrust imposed upon the dipper arm by the crowding operation is transmitted wholly to the supporting member or lever 23 and the crowding mechanism and no part of that thrust is imposed upon the boom. When the dipper has been filled and is moving to dumping position the cable connection between the dipper and the point of the boom will not permit any substantial lateral movement of the dipper arm. Consequently the dipper arm will not engage the boom, due to the inertia of the dipper, during the starting and stopping of the movement of the boom as it swings to its dumping position and therefore no twisting strain is imposed upon the boom. When the load has been dumped and the dipper swings to its retracted position, as shown in full lines in Fig. 1, the length of the cable between the dipper and the point of the boom may permit of a lateral movement of the dipper arm sufficient to contact with the boom but this contact is close to the foot of the boom where it will impose little or no strain on the boom and, further, the dipper arm extends but a short distance below the boom so that it has but little leverage at its point of contact therewith, which further reduces the force of the contact. It will be obvious from the foregoing that substantially no strain is imposed upon the boom during the digging and swinging operations, the only load imposed upon the boom being the load imposed by the dipper on the point thereof, through the cable 22, and the boom is braced against this load by its supporting cable 15, and the load so imposed upon the point of the boom does not tend to flex or twist the boom. While the dipper arm may at times have a slight lateral movement during the digging and swinging operations this movement is not sufficient to bring the dipper arm into contact with the boom except in the retracted position of the dipper, as above explained.

The acceleration and deceleration of the rotation of the platform and boom may be speeded up due to the concentration of the weight of the dipper arm and its supporting and operating mechanism near the center of rotation of the platform, and the elimination of the twisting and flexing action of the dipper arm on the boom permits this faster acceleration and deceleration to be utilized. When the dipper is at its close-in or retracted position the greater part of the dead weight of the dipper and dipper arm is carried by the supporting lever 23 so that substantially all the energy of the crowding mechanism is used to actuate the dipper arm and not to carry weight, as in the usual construction. Further, when the dipper is lifted toward its highest elevation the connection of the dipper arm to the supporting member and crowding mechanism is such as to provide a toggle action between the dipper arm and its supporting member which gives the crowding bar a decided leverage advantage at the very place that the longitudinal thrust of the dipper arm is greatest, because the larger part of the load of the dipper and dipper arm is taken at all times by compression in the supporting member and the strain on the crowding mechanism is greatly reduced. The pivotal connection between the dipper arm, the supporting member and the crowding mechanism prevents any distortion or twist from being imparted to the crowding bar or to the supporting member.

When it is desired to operate the dipper on a substantially horizontal surface, as in street work or in cleaning up after the major excavation has been completed, the dipper may be moved downwardly from the position shown in full lines in Fig. 1 and its front 57 caused to rest upon the surface of the ground at a relatively acute angle thereto, thus placing the dipper teeth in a cutting position more nearly approaching the horizontal than is possible with the usual excavating machine. As the dipper advances the angle between the dipper front and the ground will decrease until the dipper front reaches a horizontal position and will then increase as the dipper begins its upward movement, but due to the character of the dipper supporting and operating mechanism the angular movement of the front during the bodily movement of the dipper from its initial position to its horizontal position will be relatively slow and the teeth will be maintained in substantially horizontal cutting position for a substantial portion of the forward movement of the dipper, thus adding greatly to the efficiency of the machine when operating on a substantially horizontal surface.

The machine may be operated and the excavation effected in the usual manner because both the hoisting mechanism and the crowding mechanism are controlled from the platform in the usual manner by the usual controlling devices, not here shown. The character of the operating mechanism for the dipper enables a light weight and relatively inexpensive boom to be substituted for the very heavy expensive boom required for the ordinary type of mechanism, and the elimination of all flexing and twisting strains from the boom greatly reduces the liability of distortion or other injury to the boom in the normal operation of the machine. Consequently the mechanism can be manufactured and maintained at a relatively low cost and the weight of the machine as a whole is greatly reduced because the reduction in the weight of the boom itself also reduces the amount of counterweight which must be carried by the platform.

While I have shown and described one embodiment of my invention, together with minor modifications thereof, I wish it to be understood that I do not desire to be limited to the details thereof as various modifications may occur to a person skilled in the art.

Having now fully described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. In an excavating machine, a normally inclined boom mounted for swinging movement about a vertical axis, a dipper arm supported for bodily movement both transversely to and lengthwise of said boom, a dipper carried by said arm, a movable member having supporting connection with said dipper arm, said connection being of a character to permit said dipper arm to have pivotal movement about a plurality of intersecting transverse axes, crowding mechanism for actuating said movable member to impart said bodily movement to said dipper arm, said crowding mechanism being supported by said machine independently of said boom, and means to impart digging movement to said dipper.

2. In an excavating machine, a normally inclined boom mounted for swinging movement

about a vertical axis, a dipper arm supported for bodily movement both transversely to and lengthwise of said boom, a dipper carried by said arm, a movable member having supporting connection with said dipper arm, said connection being of a character to permit said dipper arm to have pivotal movement about a plurality of intersecting transverse axes, a movable bar operatively connected with said movable member to impart movement to said dipper arm, means for actuating said bar, said bar and said actuating means being mounted on said machine independently of said boom, and means to impart digging movement to said dipper.

3. In an excavating machine, a normally inclined boom mounted for swinging movement about a vertical axis, a dipper arm extending across said boom in laterally spaced relation thereto and supported for bodily movement both transversely to and lengthwise of said boom, a dipper carried by said arm, a movable member having supporting connection with said dipper arm and adapted to move the same transversely to and lengthwise of said boom, said connection being adapted to permit the lateral movement of said dipper arm with relation to said boom, means for actuating said movable member, said actuating means being supported on said machine independently of said boom, and means for imparting digging movement to said dipper.

4. In an excavating machine, a normally inclined boom mounted for swinging movement about a vertical axis, a dipper arm extending across said boom in laterally spaced relation thereto and supported for bodily movement both transversely to and lengthwise of said boom, a dipper carried by said arm, a member mounted on said machine for fore and aft movements with relation to said boom and connected with said dipper arm above said boom to move said dipper arm lengthwise of and transversely to said boom and to permit the lateral movement of said dipper arm with relation to said boom, mechanism mounted on said machine independently of said boom to impart said fore and aft movements to said member, and means to impart digging movement to said dipper.

5. In an excavating machine, a normally inclined boom mounted for swinging movement about a vertical axis, a dipper arm extending across said boom in laterally spaced relation thereto and supported for bodily movement both transversely to and lengthwise of said boom, a dipper carried by said arm, a member mounted on said machine for fore and aft movements with relation to said boom and connected with said dipper arm above said boom to move said dipper arm lengthwise of and transversely to said boom and to permit the lateral movement of said dipper arm with relation to said boom, a rigid member mounted on said machine independently of said boom for both pivotal movement and longitudinal movement and connected with the first mentioned member to impart said fore and aft movements thereto, means for imparting longitudinal movement to said rigid member, and means for imparting digging movement to said dipper.

6. In an excavating machine, a platform, a normally inclined boom supported on said platform for swinging movement about a vertical axis, a dipper arm extending across said boom in laterally spaced relation thereto, a dipper carried by said dipper arm, a supporting member supported on said platform for fore and aft movement with relation thereto, means for pivotally connecting the upper portion of said dipper arm with said supporting member for pivotal movement about a plurality of intersecting transverse axes, means supported on said platform independently of said boom for imparting said fore and aft movement to said supporting member and thereby moving said dipper arm bodily both lengthwise of and transversely to said boom, and means for imparting digging movement to said dipper.

7. In an excavating machine, a platform, a normally inclined boom supported on said platform for swinging movement about a vertical axis, a dipper arm extending across said boom in laterally spaced relation thereto, a dipper carried by said dipper arm, a supporting member supported on said platform for fore and aft movement with relation thereto, means for pivotally connecting the upper end of said dipper arm with said supporting member for pivotal movement about a plurality of transverse axes, a rigid actuating member movably mounted on said platform and operatively connected with said supporting member to impart bodily movement to said dipper arm both lengthwise of and transversely to said boom, means for operating said actuating member, and means for imparting digging movement to said dipper.

8. In an excavating machine, a platform, a normally inclined boom supported on said platform for swinging movement about a vertical axis, a dipper arm extending across said boom in laterally spaced relation thereto, a dipper carried by said dipper arm, an upright supporting member pivotally supported at its lower end on said platform, means for connecting said dipper arm with said supporting member above said boom for pivotal movement about a plurality of transverse axes, actuating mechanism mounted on said platform independently of said boom and operatively connected with said supporting member to impart bodily movement to said dipper arm both lengthwise of and transversely to said boom, and means for imparting digging movement to said dipper.

9. In an excavating machine, a platform, a normally inclined boom supported on said platform for swinging movement about a vertical axis, a dipper arm extending across said boom in laterally spaced relation thereto, a dipper carried by said dipper arm, a supporting member mounted for fore and aft movement with relation to said boom, means for pivotally connecting the upper portion of said dipper arm with said supporting member for pivotal movement about a plurality of transverse axes, crowding mechanism mounted on said platform and including a bar operatively connected with said supporting member and means for imparting longitudinal movement to said bar, and means for imparting digging movement to said dipper.

10. In an excavating machine, a platform, a normally inclined boom supported on said platform for swinging movement about a vertical axis, a dipper arm extending across said boom in laterally spaced relation thereto, a dipper carried by said dipper arm, a supporting member mounted for fore and aft movement with relation to said boom, means for pivotally connecting the upper portion of said dipper arm with said supporting member for pivotal movement about a plurality of transverse axes, crowding mechanism mounted on said platform and including an actuating member movably supported on said platform at a substantial distance above the foot of said boom and operatively connected with said

supporting member, and means carried by said platform for imparting movement to said actuating member, and means for imparting digging movement to said dipper.

11. In an excavating machine, a platform, a boom, a dipper, a dipper arm extending across said boom in laterally spaced relation thereto and supported for bodily movement both transversely to and lengthwise of said boom, means supported by said boom for imparting digging movement to said dipper, a lever pivotally mounted on said platform near the foot of said boom and pivotally connected with said dipper arm, said connection being adapted to permit lateral movement of said dipper arm with relation to said boom, an arm pivotally connected with said lever adjacent to said dipper arm and supported on said platform above the pivotal mounting of said lever for both longitudinal and pivotal movement, and mechanism for actuating the last mentioned arm.

12. In an excavating machine, a platform, a gantry and a hoisting drum carried by said platform, a boom, a dipper, a supporting arm for said dipper extending across said boom in laterally spaced relation thereto and supported for bodily movement both transversely to and lengthwise of said boom, a sheave carried by said boom, a cable extending about said sheave and connecting said dipper with said hoisting drum, a lever mounted on said platform, said dipper arm being pivotally connected with said lever for movement with relation thereto about a plurality of transverse axes, an arm pivotally connected with said lever, means for slidably and pivotally supporting the last mentioned arm on said gantry, and mechanism carried by said platform for actuating said last mentioned arm.

13. In an excavating machine, a normally inclined boom mounted for swinging movement about a vertical axis, a dipper arm supported for bodily movement both transversely to and lengthwise of said boom, a dipper carried by said arm, a movable member having supporting connection with said dipper arm, said connection being of a character to permit said dipper arm to have pivotal movement about a plurality of transverse axes and rotatory movement about a longitudinal axis, crowding mechanism for actuating said movable member to impart said bodily movement to said dipper arm, said crowding mechanism being supported by said machine independently of said boom, and means to impart digging movement to said dipper.

14. In an excavating machine, a platform, a normally inclined boom supported on said platform for swinging movement about a vertical axis, a dipper arm extending across said boom in laterally spaced relation thereto, a dipper carried by said dipper arm, a supporting member supported on said platform for fore and aft movement with relation thereto, means comprising a universal joint for connecting said dipper arm with said supporting member, means supported on said platform independently of said boom for imparting said fore and aft movement to said supporting member and thereby moving said dipper arm bodily both lengthwise of and transversely to said boom, and means for imparting digging movement to said dipper.

15. In an excavating machine, a platform, a normally inclined boom supporting on said platform for swinging movement about a vertical axis, a dipper arm extending across said boom in laterally spaced relation thereto, a dipper carried by said dipper arm, a supporting member supported on said platform for fore and aft movement with relation thereto, means for connecting said dipper arm with said supporting member comprising a connecting member pivotally connected with said supporting member and a second connecting member carried by said dipper arm, one of said connecting members including a spherical part and the other of said connecting members including a socket embracing said spherical part, means supported on said platform independently of said boom for imparting said fore and aft movement to said supporting member and thereby moving said dipper arm bodily both lengthwise of and transversely to said boom, and means for imparting digging movement to said dipper.

16. In an excavating machine, a platform, a normally inclined boom supported on said platform for swinging movement about a vertical axis, a dipper arm extending across said boom in laterally spaced relation thereto, a dipper carried by said dipper arm, a supporting member supported on said platform for fore and aft movement with relation thereto and having laterally spaced bearings, a crowding member supported on said platform for both longitudinal and pivotal movements and having laterally spaced bearings, a connecting member having at its ends trunnions journaled in the bearings of said supporting member and said crowding member and having an intermediate spherical portion, a second connecting member carried by said dipper arm and having a socket embracing said spherical portion of the first mentioned connecting member, means for actuating said crowding member, and means for imparting digging movement to said dipper.

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