July 17, 1934. W. M. HUSTON 1,966,759

POWER SHOVEL

Filed June 4, 1931 4 Sheets-Sheet 1

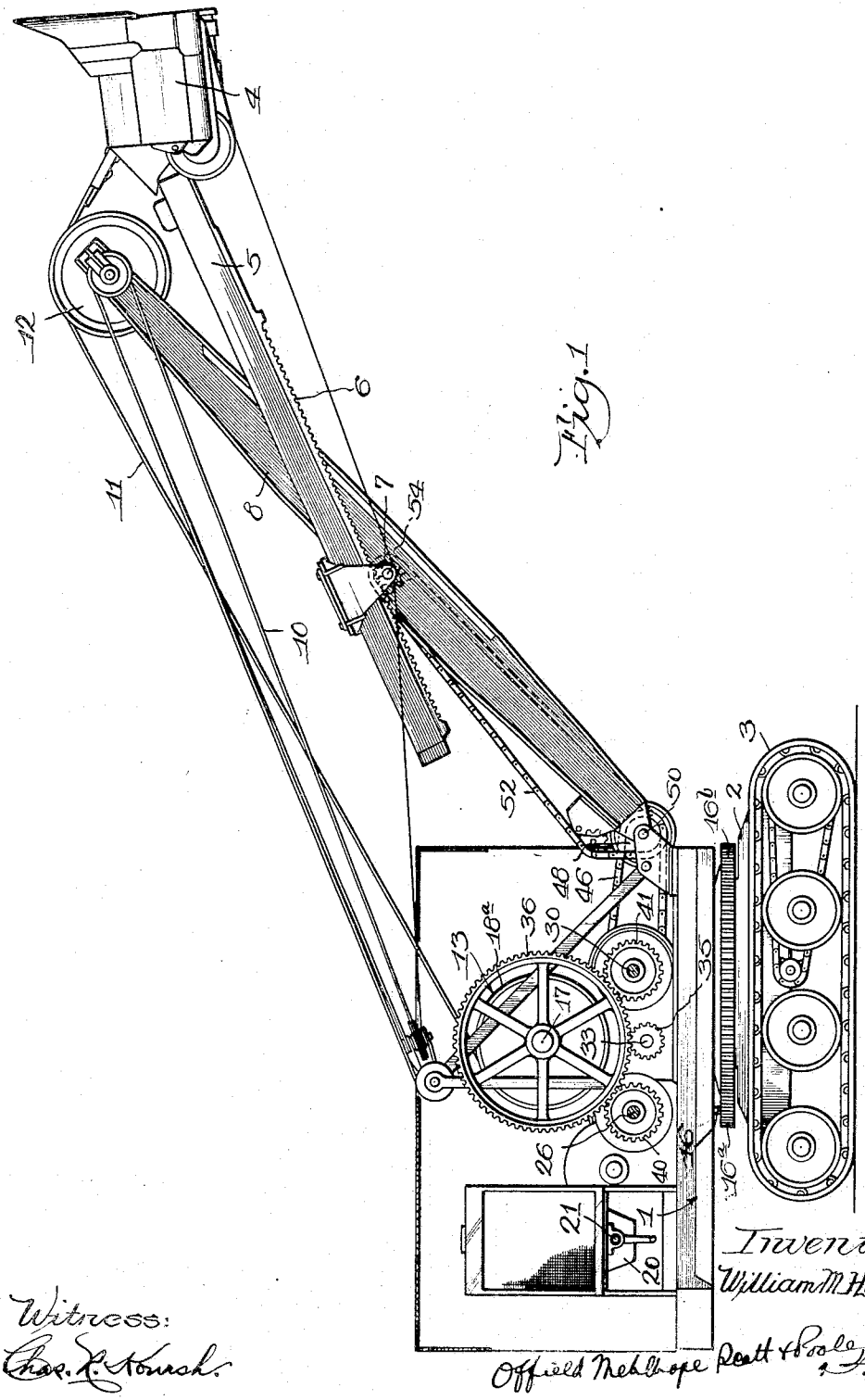


Fig. 1

Witness:
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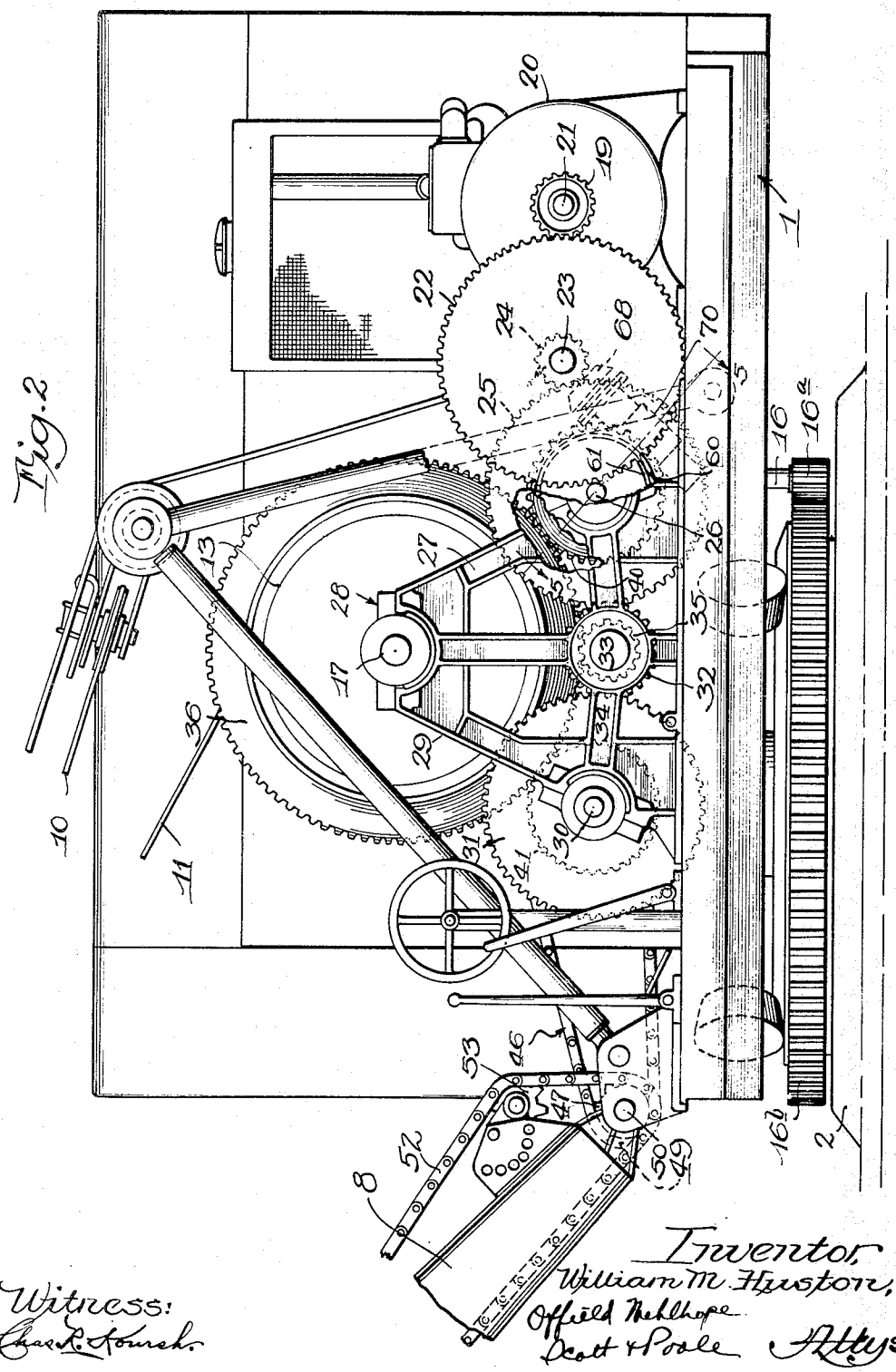
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POWER SHOVEL

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Fig. 2



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POWER SHOVEL

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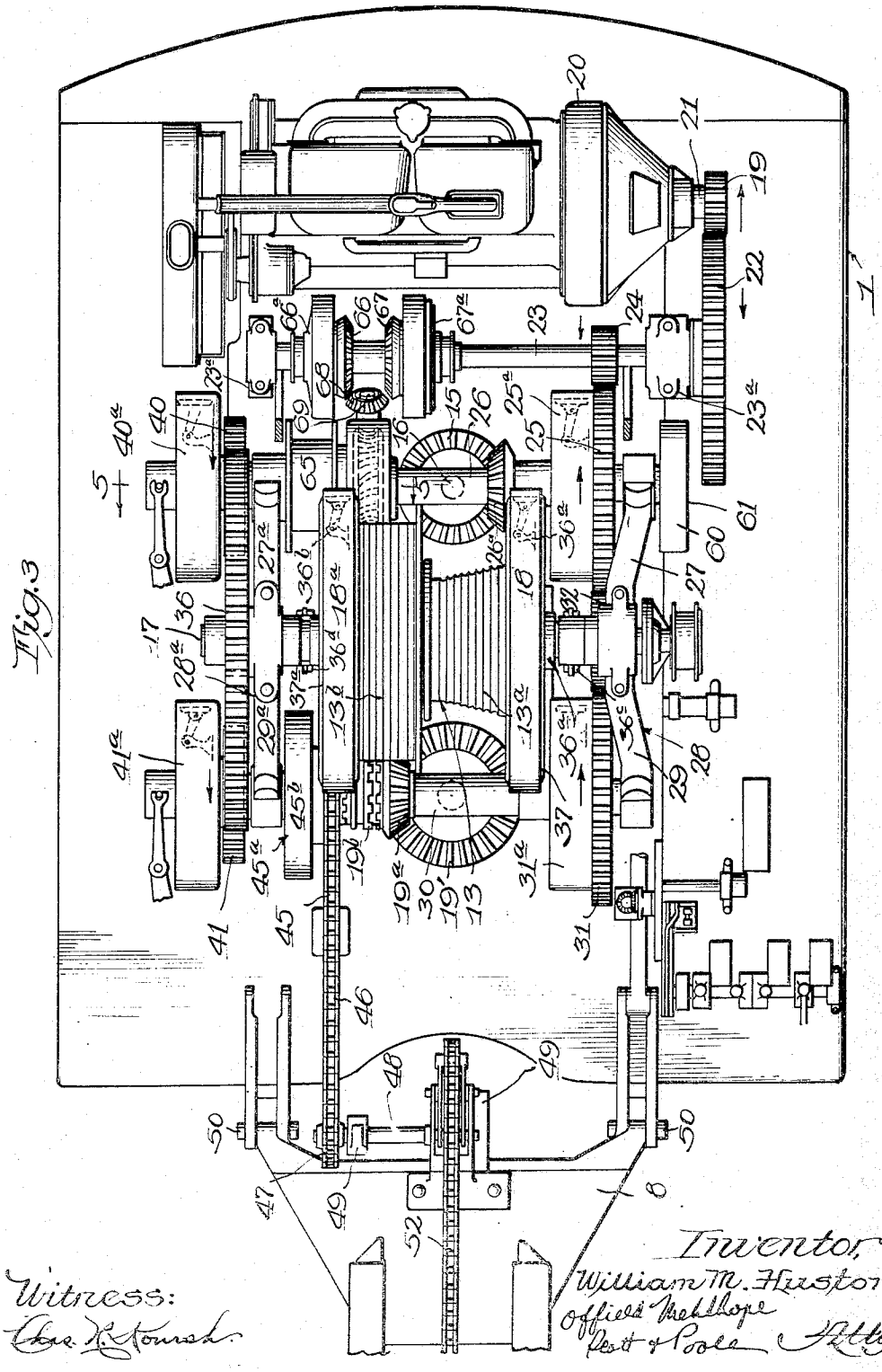


Fig. 3

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POWER SHOVEL

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Fig. 4

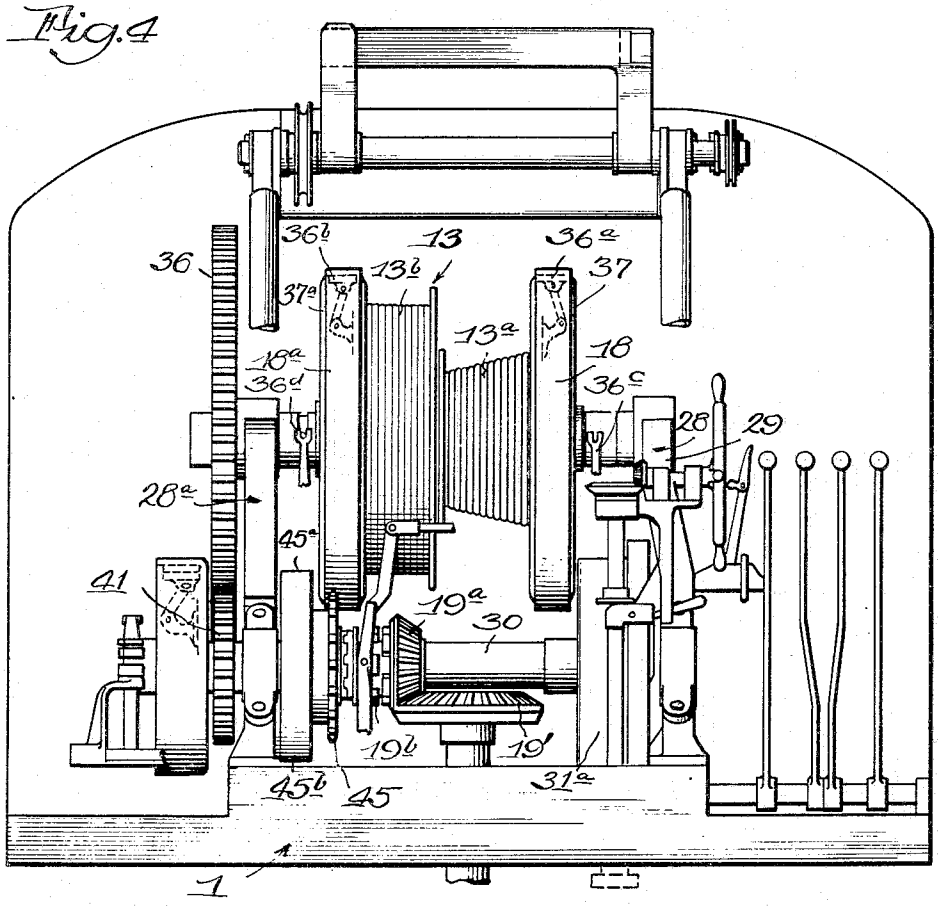
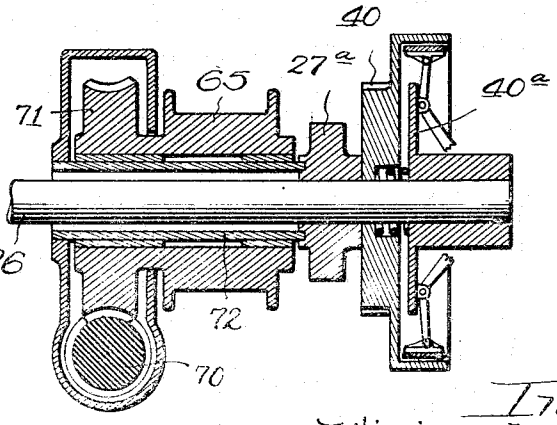


Fig. 5



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UNITED STATES PATENT OFFICE

1,966,759

POWER SHOVEL

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Application June 4, 1931, Serial No. 541,997

16 Claims. (Cl. 214—135)

This invention relates to improvements in power shovels and similar excavating devices, and has for its principal object to provide an improved construction and arrangement of drive gear connections for the hoisting, crowding, swinging and travelling operations of machines of the character described. These and other objects of invention will appear from time to time as the following description proceeds.

The invention may best be understood by reference to the accompanying drawings, in which

Figure 1 is a view in side elevation of a power shovel constructed in accordance with my invention.

Figure 2 is an enlarged fragmentary side view of the platform of the shovel, with parts omitted to show details of the gearing connections.

Figure 3 is an enlarged plan view of the platform showing the mechanism mounted thereon.

Figure 4 is an enlarged front view of the machine shown in Figure 1, but with the dipper and boom removed.

Figure 5 is a detail section of the boom hoist taken on line 5—5 of Figure 3.

Referring now to details shown in the drawings, my invention is illustrated as applied to a power shovel having the motor and main operating mechanism carried on a frame or platform 1, which frame is pivotally mounted to swing on a vertical axis upon a base 2. The base 2 is provided with propelling mechanism of any suitable form, herein consisting of endless tread mechanisms 3, 3. The shovel 4 is of the usual dipper type, having a handle 5 provided with a rack 6 engaging a pinion 7 on boom 8, the latter being pivotally mounted at the front end of the main frame so as to be raised or lowered by suitable draft means such as a cable 10 controlled from the main frame. The dipper 4 is further connected for operation by means of a single cable 11 passing over a sheave 12 on the upper end of the boom 8 and wound upon a main hoisting drum 13.

The driving motor 20 is of the usual multi-cylinder internal combustion type mounted on a transverse axis at the rear of the platform 1. Various operative connections are provided whereby power from the motor is used to drive the main hoisting drum 13, the gears for swinging the platform 1 about its vertical axis on base 2, the crowding mechanism for the dipper handle, the drive connections for the endless tread devices, and the boom elevating cable 10, which several drive connections will now be described.

The main operating drum 13 is mounted on shaft 17 arranged in a transverse axis substantially in the center of the platform 1 and supported in elevated position between two substantially A-shaped bearing structures 28 and 28a. In the form shown, the main drum 13 has two cable winding sections 13a and 13b detachably mounted thereon, arranged to provide different speeds of take-up on the dipper cable 11, or an equivalent hoisting cable, so that the machine may also be adapted for use with a clam shell bucket, crane or similar form of excavator when suitable attachments of usual form are substituted for the form of dipper and boom illustrated herein.

The transverse shaft 17 carrying the hoisting drum 13 is driven through the following gearing: The main drive shaft 21 of the motor 20 is connected through a pinion 19 to a gear 22 on a transverse shaft 23 suitably supported on bearings 23a, 23a in front of the motor. A pinion 24 is fixed on the shaft 23 and is meshed with a gear 25 loosely mounted on shaft 26 arranged parallel to and forwardly of the shaft 23. The shaft 26 has bearing on the rear legs 27 and 27a of the bearing structures 28 and 28a. The gear 25 is meshed with a pinion 32 fixed on transverse shaft 33 which has bearing on transverse members 34 which form the cross bars of the A-shaped structures referred to.

The transverse shaft 33 extends beneath the main hoist drum 13, and has a pinion 35 at the opposite end thereof which engages with a large gear 36 mounted on shaft 17. Two clutches 36a, 36b preferably of the internal expanding type, are provided for frictionally engaging clutch drum portions 37, 37a on drums 13a, 13b, respectively, when the latter are to be used as a hoist for the power shovel, or in connection with a crane, drag line or similar modified forms of excavating devices, as hereinbefore suggested. These drum clutches are shifted by arms 36c and 36d, independently controlled through suitable connections, details of which need not be described, as they form no part of the present invention. Independently operated brake bands 18 and 18a are mounted in frictional engagement with the exterior of clutch drum members 37, 37a to control the unwinding of the cable from said hoist drum members 13a and 13b.

Mechanism is also provided in connection with the driving mechanism above described for operating the swinging movement of the platform 1 with respect to the base 2. As seen in Figure 3, the platform 1 is swung about an axis common with a bevel gear 19' immediately forwardly of the main hoisting drum 13. This bevel gear 19'

forms part of the driving connection for the tread mechanism as will hereinafter more fully appear.

The swinging platform connection is provided through a bevel gear 26^a fixed on shaft 26. Bevel gear 26^a is meshed with a bevel gear 15 on an upright shaft indicated at 16, which extends downwardly through the platform and has a pinion 16^a thereon engaging an annular toothed rack 16^b on the base 2.

In order to provide means for swinging the platform in either direction, the shaft 26 is arranged for reversible drive connections, as will now be described.

The gear 25, loosely mounted on shaft 26, may be clutched thereto by a clutch member 25^a adjacent said gear. A gear 40 is also loosely mounted on the opposite end of the shaft 26, which latter gear is meshed with a large gear 36 previously described as being mounted on the main hoist shaft 17. The gear 40 has a clutch connection with the shaft 26 through a clutch member 40^a. The two clutches 25^a and 40^a are preferably interlocked for alternate engagement, in any well known manner. The arrangement is such that with the motor operating normally in one direction, as for instance in a clockwise direction as seen in Figure 2, the gear 22 and pinion 24 will be operated in a counter-clockwise direction, and the gear 25 in a clockwise direction, so as to operate the shaft 26 and its associated swing mechanism in a clockwise direction when the clutch 25^a is engaged, and the clutch 40^a is disengaged.

When the clutch 25^a is disengaged and the clutch 40^a engaged, the drive to shaft 26 then takes place in the reverse direction through gears 25 and 32, shaft 33, gear 36 and gear 40. The ratio between gears 25 and 32 is the same as the ratio between gears 35 and 40, so that the speed of rotation of shaft 26 is the same in either direction.

In connection with the shaft 26, I provide an independent brake member comprising a friction band 60 and friction drum 61 herein disposed on the end of the shaft 26 just outside of the A-shaped supporting structure 28. This friction device gives an independent control for the swing mechanism, and affords considerable saving in time by permitting the platform to be swung at relatively high speeds, yet under full control of the operator so that the swinging movement may be stopped with precision in any desired position.

The driving connection for the tread mechanism is provided through the bevel gear 19' previously mentioned, as follows: A transverse shaft 30 has bearing at opposite ends on the front legs 29 and 29^a of the A-shaped structures 28 and 28^a, respectively. A gear 31 is loosely mounted on this shaft and is meshed with the gear 32 on shaft 33 below the main drum shaft 17. The gear 31 is of the same pitch diameter as the gear 25 on shaft 26, and as seen in Figure 2 the axes of gears 31 and 25 are equi-distant from the axis of the main drum 17 and are also equi-distant from the axis of the gear 32 with which both gears 31 and 25 are engaged. Gear 31 may be clutched through clutch member 31^a to drive shaft 30 in one direction.

For driving the shaft 30 in the opposite direction, the clutch member 31^a is disengaged and connection is made through gear 32, shaft 33, pinion 35, gear 36 and a gear 41 mounted on the opposite end of the shaft 30 and clutched thereto by clutch member 41^a. It will be understood that the gear 41 is of the same pitch diameter as the gear 40 on shaft 26. Clutches 31^a and 41^a are also interlocked for simultaneous operation in the usual manner.

It will now be understood that the shafts 26 and 30 may be driven independently of each other at equal speeds and in either direction, but both of said shafts are normally idle when disengaged from their respective drive gears unless their use is required for their respective driving functions in one direction or the other.

The shaft 30 is connected by bevel gear 19^a to the bevel gear 19' which is disposed on a vertical axis concentric with the swinging axis of the platform and extends downwardly through the base where it may be connected in any well known manner for driving the tread mechanisms. These traveling connections may be disconnected through a clutch member 19^b slidable on shaft 30 and selectively engageable with the bevel gear member 19^a.

The crowd drive is provided through chain sprocket 45 loosely mounted on shaft 30, and selectively engageable therewith.

While it is obvious that separate clutch members may be provided for the traveling and crowding connections, I find it convenient in the arrangement illustrated to use the same clutch member 19^b for both connections, since the crowding and traveling operations are seldom, if ever, employed at the same time. The crowding chain sprocket 45 is connected by chain 46 to sprocket 47 on a shaft 48, which shaft is preferably mounted on brackets 49, 49 secured to the base of the boom 8 and in substantial alignment with the hinge pins 50, 50 of said boom. Another chain sprocket 51 is fixed on the shaft 48 and has a chain 52 trained thereover leading to the sprocket 53 connected to the crowding pinion 7 for the dipper through shaft 54. A brake drum 45^a is connected to the crowding chain sprocket 45, and is controlled by friction band 45^b.

Means are also provided for operating the boom hoisting cable 10 independently of the other operative functions hereinbefore described. For this purpose I provide a cable drum 65 for said cable disposed in a suitable position adjacent the shaft 23. For convenience I find it desirable to mount the drum 65 and its associated parts loosely on a bearing sleeve 72 supported on the leg 27^a and surrounding the shaft 26. Details of this construction are shown in Figure 5. Power is supplied to said drum from the shaft 23 in reverse directions by means of a pair of oppositely disposed bevel gears 66 and 67 selectively clutched to the shaft 23 by clutches 66^a and 67^a respectively, and both meshed with a bevel gear 68 on a shaft 69 disposed at an inclined angle to the platform 1 and having a worm 70 thereon engaged with a worm gear 71 connected to the drum 65.

Among the advantages of the construction above described is the simplicity of the drive gearing for the several operations, wherein, with a minimum number of gears, the two shafts 26 and 30 may be driven in reverse directions and at the same speeds, either independently or simultaneously. As a result the swinging operation may be performed in either direction from shaft 26 independently of but simultaneously with the crowding operation through shaft 30. The operation of the main hoist 13 and of the boom hoist 65 are also independent of the swinging and crowding operations.

A further advantage is the novel arrangement of gearing on the A-shaped structures 28 and 28^a wherein the large gear 36 which drives the main

hoisting drum 13 also forms a part of the reversing mechanism for shafts 26 and 30. It will be observed that the ratio between the intermediate or idler gear 32 and the two gears 25 and 31 is the same as the ratio between the gear 35 at the opposite end of shaft 33 and the two companion gears 40 and 41. Thus when the shafts 26 and 30 are driven by gears 25 and 31, respectively, said shafts are rotated in the same direction and at the same speed through gear 32 which then serves as a reach gear for this purpose, whereas when shafts 26 and 30 are rotated in the opposite direction through gears 40 and 41, their speed of rotation is substantially the same as before, but reversal and direction of rotation are afforded through the smaller pinion 35 and the large gear 36, which latter gear then serves as a reach gear between gears 40 and 41.

Furthermore, it will be especially observed that the large gear 36 and the hoist drum 13 may be made of relatively large diameter and the hoist drum 13 is disposed in a particularly convenient position above the remainder of the drive gearing, owing to the relative positions of the small gear 35 and the two gears 40 and 41 with all of which the large gear 36 is meshed. The advantages of a relatively large drum hoist are, of course, manifest to those skilled in the art. The resulting increase in speed of operation, ease in control, decrease in wear on the cable and increased cable capacity are all important factors in a machine of the character described.

Among other features of advantage are the provision of a positive brake control on the swing shaft 26 and the independent reversing control for the boom hoist drum 65.

Although I have illustrated and described one particular embodiment of my invention, it will be understood that I do not wish to be limited to the exact construction shown and described, but that various changes and modifications may be made without departing from the spirit and scope of my invention.

I claim:

1. In a power excavator, a drive gearing comprising a drive shaft having two pinions of unequal size thereon, two driven shafts, one of which is adapted for reversible power functions and the other of which is optionally connectible for driving a hoist in one direction, a large gear on said hoist shaft meshed with the smaller of said pinions, the first named driven shaft having two gears thereon and optionally connectible thereto, said gears having the same ratio to each other as the ratio between the pinions on the drive shaft, the larger of said gears being directly meshed with the larger of said pinions, and the smaller of said gears being indirectly connected with the smaller of said pinions through said large gear on the hoist shaft, whereby said reversible driven shaft may be optionally driven at equal speeds in either direction.

2. In a power excavator, a drive gearing comprising three parallel shafts, having optional driving connections respectively with a main hoist drum, a dipper crowd mechanism, and a platform swinging mechanism, a relatively large gear on said drum shaft, two pairs of similar gears respectively mounted on and optionally connectible to said crowd and swing shafts, one pair of which gears are meshed with said large gear, a fourth shaft interposed between said crowd and swing shafts having a small pinion meshed with said large gear, and a larger pinion meshed with said second pair of similar gears, the ratio between the smaller pinion and each of the first named pair of similar gears being the same as the ratio between the larger pinion and the second named pair of similar gears, and drive connections with said fourth shaft whereby said crowd and swing shafts may be selectively driven at equal speeds in reverse directions and independently of each other.

3. In a power excavator, a base having traction means therefor, a platform rotatably mounted to swing in a vertical axis thereon, a motor mounted on said platform, a boom and dipper mounted at the forward end of said platform, a hoist drum mounted centrally of said platform on a transverse axis and power connections for driving said drum and said traction means from said motor including a transverse driving shaft extending beneath said drum having two pinions of unequal size thereon, a second shaft forwardly of said driving shaft having a bevel gear thereon meshed with a bevel gear disposed concentrically with the axis of said platform and affording driving connection with said traction means in any position of rotation of said platform, a third shaft concentric with said drum and optionally connectible thereto for driving the same in one direction, a large gear on said third shaft meshed with the smaller of the two pinions on said first shaft, two gears mounted on said second shaft and optionally connectible thereto, said gears having the same ratio to each other as the ratio between the pinions on the drive shaft, the larger of said pinions being directly meshed with the larger of the gears on the second shaft and the smaller of said pinions being indirectly connected with the smaller of said gears through said large gear on the third shaft, whereby said traction driving bevel gear may be optionally driven at equal speeds in either direction.

4. In a power excavator, a base, a platform rotatably mounted to swing in a vertical axis thereon, a motor mounted on said platform, a boom and dipper mounted at the forward end of said platform, a hoist drum mounted centrally of said platform on a transverse axis and power connections for driving said drum and swinging said platform from said motor including a transverse driving shaft extending beneath said drum having two pinions of unequal size thereon, a second shaft rearwardly of said driving shaft having a bevel gear thereon meshed with a bevel gear having operative connection with said base for swinging said platform on its vertical axis, a third shaft concentric with said drum and optionally connectible thereto for driving the same in one direction, a large gear on said third shaft meshed with the smaller of the two pinions on said first shaft, two gears mounted on said second shaft and optionally connectible thereto, said gears having the same ratio to each other as the ratio between the pinions on the drive shaft, the larger of said pinions being directly meshed with the larger of the gears on the second shaft and the smaller of said pinions being indirectly connected with the smaller of said gears through said large gear on the third shaft, whereby said platform swinging mechanism may be optionally driven at equal speeds in either direction.

5. In a power excavator, a base, a platform rotatably mounted to swing on a vertical axis thereon, a motor, a hoist drum mounted on a shaft disposed on a transverse axis on said platform, a gear on said drum shaft optionally connectible with said drum for driving the latter, power con-

nections with said motor for swinging the platform on its axis including a shaft disposed parallel with said drum shaft, and reverse gear connections for said parallel swing shaft arranged to drive the latter in one direction through gearing independent of said drum shaft gear or in the other direction through other gearing including said drum shaft gear.

6. In a power excavator, a base, a platform thereon, a boom and dipper mounted at the forward end of said platform, a motor, a hoist drum mounted on a shaft disposed on a transverse axis on said platform, a gear on said drum shaft optionally connectible with said drum, crowding mechanism for said dipper having power connections with said motor including a shaft disposed parallel with said drum shaft, and reverse gear connections for said crowding shaft arranged to drive the latter in one direction through gearing independent of said drum shaft gear, or in the other direction through other gearing including said drum shaft gear.

7. In a power excavator, a base having traction devices therefor, a platform rotatably mounted on said base to swing on a vertical axis, a motor on said platform, a hoist drum mounted on a shaft disposed on a transverse axis on said platform, a gear on said drum shaft optionally connectible with said drum for driving the latter, power connections between said motor and said traction devices including a shaft concentric with the axis of said platform and a shaft on said platform disposed parallel with said drum shaft, and reverse gear connections for said parallel shaft arranged to drive the latter in one direction through gearing independent of said drum shaft gear, or in the other direction through other gearing including said drum shaft gear.

8. In a power excavator, a base, a platform rotatably mounted to swing on a vertical axis thereon, a boom and dipper mounted at the forward end of said platform, a motor, a hoist drum mounted on a shaft disposed on a transverse axis, a gear on said drum shaft optionally connectible with said drum, power connections with said motor for swinging the platform on its axis, including a parallel shaft disposed below and to the rear of said drum shaft, crowding mechanism for said dipper having power connections with said motor including a parallel shaft disposed below and to the front of said drum shaft, and independently controlled reverse gear connections for said swing shaft and said crowding shaft, respectively, arranged to drive either of said shafts in one direction through gearing independent of said drum shaft gear, or in the other direction through other gearing including said drum shaft gear.

9. In a power excavator, a base, a platform rotatably mounted to swing on a vertical axis thereon, a boom and dipper mounted at the forward end of said platform, a motor, a hoist drum mounted on a shaft disposed on a transverse axis, a gear on said drum shaft optionally connectible with said drum, power connections with said motor for swinging the platform on its axis, including a parallel shaft disposed below and to the rear of said drum shaft, crowding mechanism for said dipper having power connections with said motor including a parallel shaft disposed below and to the front of said drum shaft, and independently controlled reverse gear connections for said swing shaft and said crowding shaft, respectively, arranged to drive either in one direction through gearing independent of said drum shaft gear, or in the other direction, but at equal speeds, through other gearing including said drum shaft gear.

10. In a power excavator, a base having traction devices therefor, a platform rotatably mounted on said base to swing on a vertical axis, a boom and dipper mounted at the forward end of said platform, a motor on said platform, a hoist drum mounted on a shaft disposed on a transverse axis on said platform, a gear on said drum shaft optionally connectible with said drum for driving the latter, a shaft on said platform disposed below and to the front of said drum shaft and parallel therewith, reverse gear connections for said parallel shaft arranged to drive the latter in one direction through gearing independent of said drum shaft gear, or in the other direction through other gearing including said drum shaft gear, power connections between said parallel shaft and said traction devices including a shaft concentric with the axis of said platform, and crowding mechanism also having connection with said parallel shaft.

11. In a power excavator, a base having traction devices therefor, a platform rotatably mounted on said base to swing on a vertical axis, a boom and dipper mounted at the forward end of said platform, a motor on said platform, a hoist drum mounted on a shaft disposed on a transverse axis on said platform, a gear on said drum shaft optionally connectible with said drum for driving the latter, a shaft on said platform disposed below and to the front of said drum shaft and parallel therewith, reverse gear connections for said parallel shaft arranged to drive the latter in one direction through gearing independent of said drum shaft gear, or in the other direction through other gearing including said drum shaft gear, power connections between said parallel shaft and said traction devices including a shaft concentric with the axis of said platform, and crowding mechanism also having connection with said parallel shaft, and single clutch means for selectively connecting said parallel shaft either with said traction driving mechanism or said crowding mechanism.

12. In a power excavator, a platform, a hoist drum and hoist drum gear rotatably mounted on a transverse axis on said platform, a motor disposed rearwardly of said drum, and gearing connecting said motor and said hoist drum gear including three parallel shafts, the intermediate of which has reversible power functions independent of the operation of said hoist drum, said gearing comprising a reduction gear on the shaft nearest the motor, two intermediate shaft gears loosely mounted on the intermediate shaft and optionally connectible thereto, the first of said intermediate shaft gears being meshed with said reduction gear on the first shaft and the second of said intermediate shaft gears being meshed with said hoist drum gear, two pinions mounted on said third shaft, one of said pinions being meshed with the first intermediate shaft gear, and the other pinion being meshed with said hoist drum gear, the arrangement being such that the first intermediate shaft gear forms a part of the power connection to the hoist drum gear and also to the intermediate power shaft, whether the latter is driven directly therefrom, or indirectly in reverse direction through said third shaft, pinions and hoist drum gear.

13. In a power shovel, a base, a platform mounted for swinging action on said base and having a boom and dipper mounted at the for-

ward end thereof, a frame disposed centrally of said platform, a hoist drum supported on a transverse axis on said frame, a relatively large drive gear concentric with said hoist drum and optionally connectible therewith, two power shafts mounted parallel to and equi-distant from the axis of said hoist drum and having independently reversible power functions for operating said dipper, each of said power shafts having two gears thereon optionally connectible thereto, the first of which is meshed with said hoist drum gear, a drive shaft interposed between and parallel with said power shafts, two pinions on said last named shaft, one of which is meshed with said hoist drum gear, and the other of which is disposed between and meshed with the second gear on each of said power shafts, a motor, and drive means connecting said motor with one of said power shaft gears.

14. In a power excavator, a motor, a hoist drum and hoist drum gear, a reversible shaft having power functions independent of the operation of said hoist drum, and drive gearing connecting said motor with said hoist drum and said reversible shaft, including a drive gear loosely mounted on said reversible shaft and optionally connectible thereto, a second shaft having two pinions thereon, one of which is driven by said drive gear on said reversible shaft and the other of which is connected to drive said hoist drum gear, and a second reverse drive gear driven by said hoist drum, said reverse drive gear being loosely mounted on said reversible shaft and optionally connectible to the latter.

15. In a power excavator, a motor, a hoist drum and hoist drum gear, a reversible shaft disposed on an axis parallel with the axis of said hoist drum and having power functions independent of the operation of the latter, and drive gearing connecting said motor, said hoist drum and said reversible shaft, including a drive gear loosely mounted adjacent one end of said reversible shaft and optionally connectible thereto, a second shaft parallel with said reversible shaft and having two pinions at opposite ends thereof, one of which is driven by said drive gear on said reversible shaft, and the other of which is connected to drive said hoist drum gear, and a second reverse drive gear adjacent the opposite end of said reversible shaft driven by said hoist drum gear, said reverse drive gear being loosely mounted on said reversible shaft and optionally connectible to the latter.

16. In a power shovel, a base, a platform mounted for swinging action on said base and having a boom and dipper mounted at the forward end thereof, a pair of supporting frames disposed centrally of said platform, a hoist drum supported on a transverse axis between said frames, a relatively large drive gear concentric with said hoist drum and optionally connectible therewith, two power shafts supported between said frames parallel to and equi-distant from the axis of said hoist drum and having independently reversible power functions for operating said dipper, each of said power shafts having two gears adjacent opposite ends thereof and optionally connectible thereto, the first of which is meshed with said hoist drum gear, a drive shaft supported by said frames and interposed between and parallel with said power shafts, two pinions adjacent opposite ends of said last-named shaft, one of which is meshed with said hoist drum gear, and the other of which is disposed between and meshed with the second gear on each of said power shafts, a motor, and drive means connecting said motor with one of said power shaft gears.

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