Jan. 29, 1929. 1,700,181

L. A. RUSSELL

INTERCHANGEABLE SHOVEL CRANE

Filed April 16, 1926 4 Sheets-Sheet 1

Fig. 1.

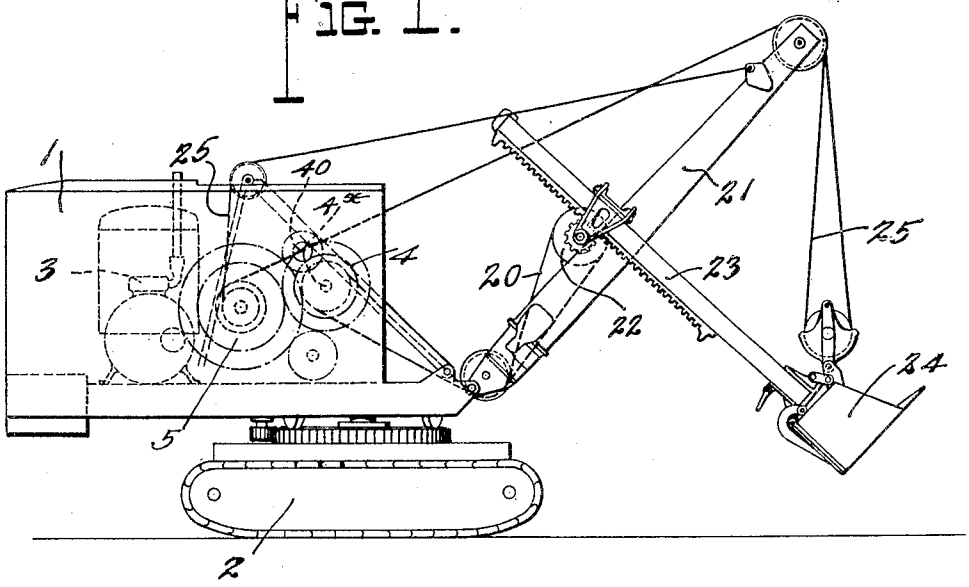
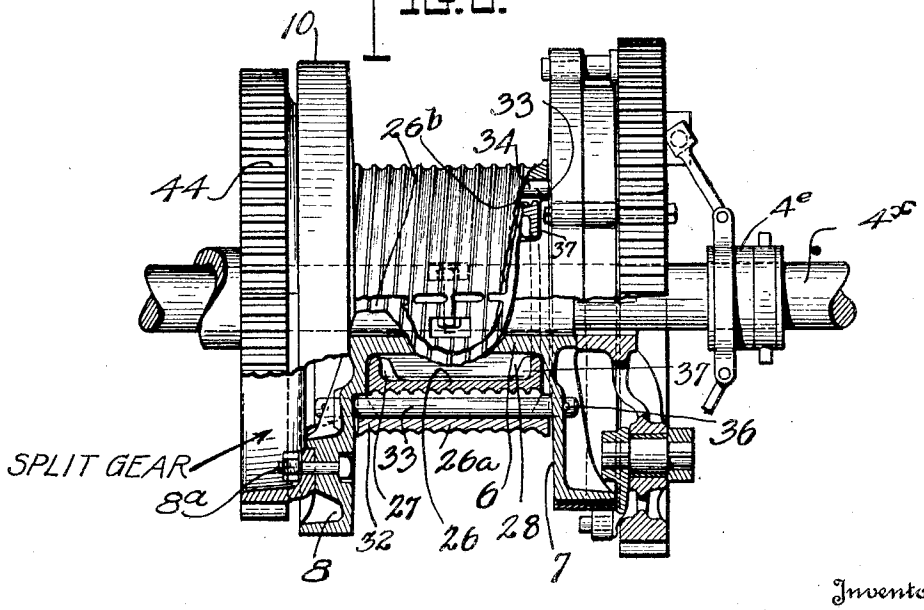


Fig. 6.



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INTERCHANGEABLE SHOVEL CRANE

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Fig. 2.

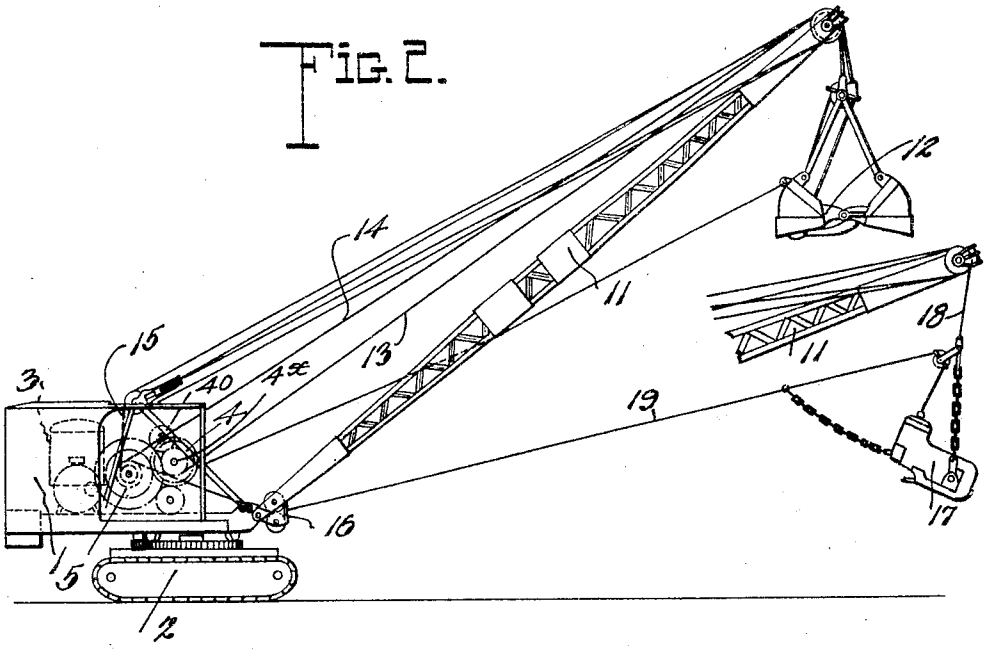
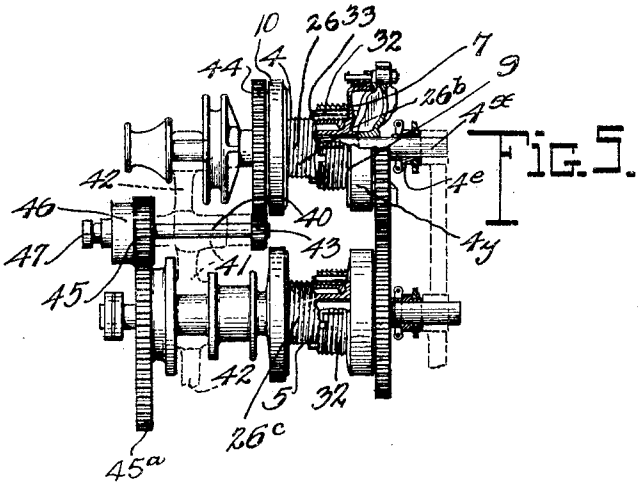


Fig. 5.



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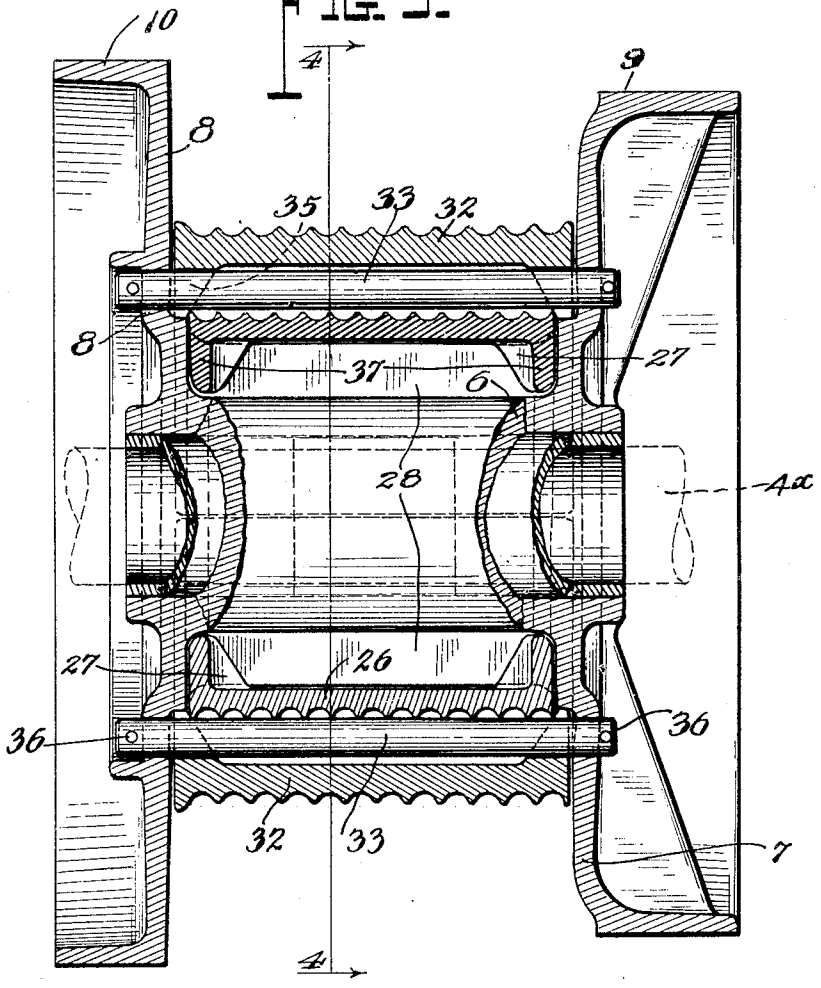
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INTERCHANGEABLE SHOVEL CRANE

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Fig. 3.



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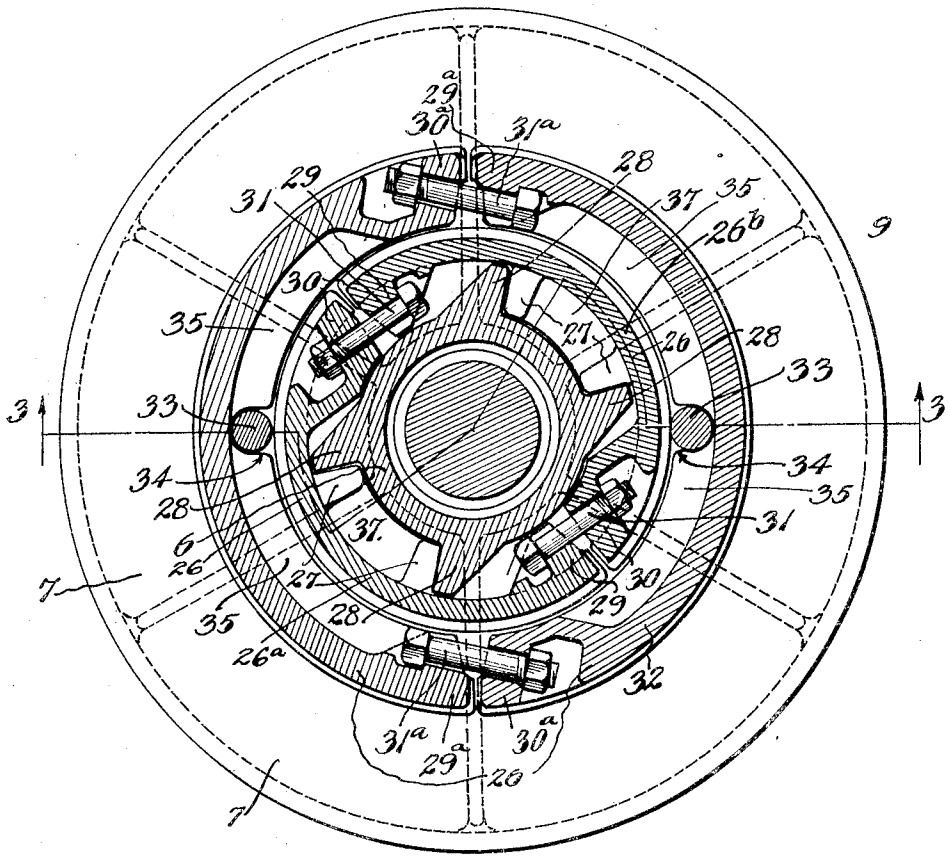
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INTERCHANGEABLE SHOVEL CRANE

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Fig. 4.



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UNITED STATES PATENT OFFICE.

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INTERCHANGEABLE SHOVEL CRANE.

Application filed April 16, 1926. Serial No. 102,535.

This invention, in one aspect thereof, improves upon the convertible types of shovel cranes, which are disclosed in the Letters Patent of Holcomb and Russell Patent No. 1,509,295, issued September 23rd, 1924, and Patent No. 1,506,906, issued September 2nd, 1924. By convertible shovel crane, I refer to a construction of portable cranes such as may be used for what is known as crane work, including hoisting operations and excavating by means of orange peel, or clam shell, or like types of buckets, the said cranes being susceptible of use as power shovels by interchanging the boom and bucket mechanisms thereof for the boom and dipper type shovel means employed ordinarily for shovel purposes.

In the building of cranes of the above types, I have found that a simplification of the mechanism for operating the different kinds of excavating and dipper shovel equipments may be made that will do away with somewhat complicated change speed gears such as are contemplated in the patents previously referred to. I accomplish the desired result by the employment of a special arrangement of detachable laggings or members adapted to be applied to cable drum devices that form a part of the general crane operating mechanism.

Another feature of the invention hereof resides in the provision of the detachable cable operating laggings or members to the drum frames for the purpose of obtaining a convertibility result in respect to using the drum driving means for actuation of crane type excavators such as clam shell and orange peel buckets or interchanging with such excavating means a dipper shovel boom mechanism. The convertibility referred to involves a variation in driving speeds. For instance, a line speed of 160 feet per minute is desirable for the operation of clam shell and orange peel boom and bucket mechanisms or an interchanged dipper shovel mechanism, whereas an approximate relative line speed of 120 feet per minute is usual for dragline bucket operation. I find that by the use of special drum frame structures, equipped with different diameter laggings or cable operating members I may achieve desired variation in driving speeds for the cable means employed for the different excavating equipments including clam shell, orange peel, dragline and dipper shovel types, by the mere removal or replacement of a lagging or cable driving member or members on the operating drum of the crane.

A third aspect and feature of this invention necessitates reference to another problem which is dealt with in the development of the means hereinafter described. My interchangeable crane and shovel type machine employs driving cables for the boom and bucket apparatus of any particular type which is applied to the body of the crane by way of convertibility or interchangeability.

It is found that a very considerable wear takes place on the cable driving drum or drums which are used in these cranes or shovels, due to the traction of the cables upon the surface of the drum about which the cable winds. Renewal of the said cable winding surface therefore is necessitated and up to the time of this invention, so far as I am aware, such renewal has necessitated a replacement of the entire drum because the cable winding surface has usually been made integral with the drum. However, in my present invention, I have designed a special construction of drum frame wherein what may be characterized as the hub of the drum, mounted upon its driving shaft, is so formed as to receive a renewable driving element which upon excessive wear sufficient to reduce its efficiency to the point where it is desired to be discontinued from use, may be detached from the drum frame entirely and replaced by a fresh driving element, about which the cable may wind and which in time may itself become worn and necessitate replacement. This is a special feature of the invention of considerable advantage under practical conditions of service to which crane drums are subjected.

As a final and more limited phase of the present invention, I have devised a drum construction possessing the features hereinafter referred to, and which comprises a combination renewable driving element for the purpose just above described, and associated removable and replaceable cable driving lagging, which have a sort of nested relation in that they are adapted to be concentrically mounted relatively to one another so that the renewable driving element is enclosed or housed by the lagging. When so enclosed or housed, the renewable cable drive element will be out

of use and the lagging will be employed for the cable drive purpose. A removal of the lagging, however, admits of rendering available the driving element cable winding surface when the line speed of the particular cable to be used is to be less than that which is obtained by the employment of the lagging. Under the conditions just stated, therefore, I am enabled to employ a drum frame unit structure adapted to receive the renewable driving element and the enclosing larger diameter lagging, the last two parts affording convenient means by which to secure different line speeds for the operating cables, something necessary and important where a low line speed cable equipment is employed for an excavator of one type and a higher speed is required for the cable equipment of an excavator of another type.

In the accompanying drawings:—

Figure 1 is a side view showing somewhat diagrammatically a shovel crane of the class wherein a dipper shovel boom and dipper stick mechanism is used and illustrating one adaptation of the invention.

Figure 2 is a view somewhat similar to Figure 1 but showing the same crane body as employed for the operation for clam shell, or in the alternative a dragline boom and bucket equipment, the dragline boom and bucket equipment being shown fragmentarily and the clam shell equipment in full.

Figure 3 is a vertical sectional view of an operating drum mechanism embodying the novel parts of my invention.

Figure 4 is a sectional view of the means shown in Figure 3 but taken at a right angle thereto.

Figure 5 is a plan view of the general arrangement of front and rear main drums of a crane of the convertible type of the invention, or if the convertible features are ignored, the view illustrates the feature of the renewable cable driving elements with which the said drums are equipped.

Figure 6 is a sectional elevation of the front drum frame and driving mechanism by which the same may be driven in reverse directions.

I shall refer generally to my crane mechanism in reference to the interchangeable operating features because these are largely well known so far as the particular kinds of equipments that may be interchanged are concerned. The crane includes a rotary body of car 1, mounted in the usual rotative manner upon a traction base 2, the car containing a gas engine or motor 3 utilized as a prime mover for the operation of the drum mechanism contained within said car or body 1. The said drum mechanism comprehends suitable independently driven front and rear drums which are designated as 4 and 5 but which mainly comprise drum frames in that each consists of a hub 6 and terminal drums or end flanges 7 and 8. Each end flange 7 is provided with a clutch flange or element 9 and each end flange 8 is provided with a brake flange or element 10, seen best in Figure 3.

Before describing the drum devices in detail, I note that when the crane is to be used for clam shell work, it will be equipped with the boom 11, the clam shell bucket 12, the closing line cable means 13, the bucket hoisting cable means 14 and the boom hoisting cable means 15. The so-called front and rear drums 4 and 5 for clam shell work will be driven say at high relative speed which may approximate 160 feet per minute for the cable line speed. An orange peel type of bucket may be interchanged at any time with the clam shell type using the same line driving speed.

To adapt the machine for dragline work, the clam shell and its cable operating means will be removed, the boom 11 will be equipped with the fairlead casting 16 unless the latter is already attached thereto and the dragline bucket 17 will be operated by the hoist cable 18 and by the drag cable 19, the drag cable 19 leading to one of the drums 4 and 5, namely the drum 5, and the hoisting cable 18 extending to the other of said drums, namely the drum 4, after the well known manner. Since for dragline work a relatively lower line speed for the cables is desired, say approximately 120 feet per minute, provision must be made for obtaining this variation in speed. The variation in the line speeds is obtained, as between the clam shell or orange peel, and dragline work by removing the cable drive laggings employed for the clam shell work and applying the cables of the dragline to the renewable driving elements on the drum frames of the drums 4 and 5 as will be later described herein.

If it be desired to use a dipper shovel excavating equipment instead of any of those previously referred to, it is only necessary to remove the boom and bucket equipments, such as shown in Figure 2, in lieu thereof, to mount on the rotary body 1, a shovel boom and dipper stick mechanism as shown in Figure 1. The general scheme of operation of the shovel dipper stick mechanism of Figure 1 may be described on special reference to Figure 5 of the drawings as comprising the front drum mechanism 4 of a reversible driven type and operating the cable means 20 which winds about the drum means in opposite directions, passes down from the front drum means 4 around suitable guiding pulleys, extends upwardly through the hollow portion of the boom 21 and is wound in opposite directions about a shipper shaft drum 22. The shipper shaft mechanism operates the dipper stick 23 carrying the dipper 24 and the dipper 24 will be hoisted by means of the dipper hoisting cable means 25 operable by a drum carried on the same axis as that

which carries the rear drum means 5. Various kinds of mechanism might be employed to drive the front drum means 4 in opposite directions. It will be understood that such driving in reverse directions of the front drum means 4 is only necessary when a dipper shovel equipment is employed as in Figure 1. Reverse driving is not necessary when the orange peel, clam shell, dragline or pile driving, or general hoisting operations are being performed by the front and rear drum means 4 and 5.

For shovel operation the forward drum means will be actuated by being driven from the forward shaft 4^x seen in Figure 5, by means of the friction band clutch 4^y, said band clutch being operable by hand lever controlling mechanism, not shown, though the shift collar thereof is designated at 4^c. By the use of the clutch means 4^y the crowding out drive of the forward drum means 4 is effected for crowding out the dipper stick and dipper. For racking in of the dipper the reverse action of the forward drum means must be effected, and for this purpose is used the reversing gearing illustrated at the left hand of Figure 5, said gearing including a counter shaft 40 supported by a bearing bracket 41 detachably mounted upon the adjacent frame part shown at 42, said shaft 40 having at its inner end a spur gear or pinion 43 meshing with a large split gear 44 which is bolted at 8^a to the drum frame flange 8 just inside of the brake flange 10, as seen best in Figure 6. The gear 44, therefore, is adapted to drive the forward drum means 4; in fact, it will drive the forward drum for the racking in action thereof on the cable 20.

On the other end of the shaft 40 is keyed a spur gear 45 which is loose on the shaft but adapted to be connected therewith by a friction clutch 46, the driving member of which is keyed or otherwise attached to the shaft 40 so that the clutch may be used for the purpose stated, namely, to connect the gear 45 to said shaft 40 in driving relation. The actuating part for the clutch 46 is designated 47. The parts 40, 41, 43, 44, 45, 46, 47 form an attachable unit susceptible of ready removal as such from the frame member 42. This removable unit is advantageous because it enables installation of the unit on any machine of the type of my construction whether at the factory, or in the field, but primarily in the field.

It is to be understood, therefore, that when the drum means 4 is performing its crowding function, the band clutch 4^y is employed to drive the drum means 4 in one direction; by connecting said means directly to the shaft 4^x; and when the said drum means is operated to rack in the dipper the clutch 46, the reversing gearing above described will drive the drum means 4 in the opposite direction, corresponding movements being imparted to the cable 20.

When the machine is being used for clam shell, or all purposes other than shovel work the clutch 46 is inactive and the reversing gearing unit of which it forms a part idles. In fact, said unit might be removed from the machine, if desired, but this is not necessary. Moreover, installation of the removable reverse gearing, see Figure 5, as above described, may be made without interfering with or requiring adjustments, or detachment of any other part of the machine.

Reference is made now to Figures 3 and 4 for a complete understanding of the construction of the front drum means 4 or the rear drum means 5. The two drum means so far as the drum frame constructions are concerned are alike, except for the provision of the gear 44 on the front drum means, the rear drum means 5 not being reversibly driven, as is the front drum means 4. The detailed construction of the drums 4 and 5 will now be set forth and will be seen to include a renewable grooved cable winding surface or driving element 26 which is made in two sections, 26^a and 26^b, see Figure 4. The sections 26^a and 26^b are substantially counterparts of one another and therefore interchangeable. Each of said sections is formed with inwardly projecting lugs or projections 27 adapted to be seated between, engaging with, and thereby establishing an interlocking connection with certain outwardly extending lugs or longitudinal fins 28 that project from the hub portion 6 of the drum frame. The sections 26^a and 26^b of the renewable cable driving element 26 preferably have their outer surfaces grooved and at the ends of the section are the inwardly extending lugs 29 and the outwardly extending lugs 30, a lug 29 being disposed at one end of each section and a lug 30 at the relatively opposite end thereof. The inwardly extending lug of section 26^a matches or is arranged opposite the outwardly extending lug of section 26^b, and vice versa, the two adjacent lugs 29 and 30 in each instance having registering openings through which a fastening bolt 31 extends, the same being equipped with a nut as shown. The two sections of the renewable driving element 26 are thus secured together in such a manner that they are positively clamped around the hub of the drum frame and they are so interlocked with the hub by means of the projections 27 and 28 that there is no possibility of rotative slippage between the parts. Suitable means for attachment of cable ends to the renewable driving element 26 will be employed. The element or member 26 is a low speed cable line driving member.

Surrounding the driving element 26 and housing the same for each drum 4 and 5, I provide a renewable lagging member 32 and

this lagging member from a structural viewpoint is very much the same formation as the element 26 so far as being formed of separable sections and the provision of fastening projections 29^a and 30^a and the bolts 31^a are concerned. To render the lagging 32 stationary on the drum frame, however, I utilize cross rods 33 which pass through the end flanges 7 and 8 of the drum frame and through notches or recesses 34 in the inturned end flanges 35 of said lagging. The ends of the rods 33 may have openings through which cotter pins 36 may be passed to prevent endwise displacement of said rods. The outer periphery of the lagging 32 is preferably grooved for cable winding purposes. It may also be noted that the renewable wear element 26 is slightly shorter than the lagging 32 and is also formed with inwardly projecting end flanges 37.

With the foregoing construction of drum frames in mind, I will briefly recite the manner in which the various objects of the invention are achieved thereby.

If my crane is used for clam shell purposes or orange peel operations, or for hoisting or pile driving actions with the necessary usual boom and cable equipments, the lagging 32 on the drums 4 and 5 will be in use.

Should it be desired to convert the crane into a power shovel of the dipper shovel type, it is only necessary to mount in place of the boom cable and excavating parts, a shovel boom and dipper equipment. The high speed cable driving operation of the drum laggings 32 is still availed of for shovel work, but in addition, the reverse driving of the front drum 4 by suitable manually control means referred to is utilized in order to get the required movements of the dipper of the shovel, usually termed crowding out and racking in actions.

Obviously should the laggings 32 become worn to the extent of incapacitating them, they may be replaced at any time at will.

Should it be desired now to use the crane for dragline purposes, a lower line speed on the cable equipment is desirable and accommodated by this invention by resorting to a simple expedient. This expedient is to remove the laggings 32 and render available for use the previously enclosed renewable cable driving surfaces or elements 26 by connecting up the cables of the dragline boom and bucket equipment with the renewable surfaces 26, the latter may be availed of for the slower cable driving operation appropriate to the dragline work. On easy digging in drag-line work, the laggings 32 might be used.

Under the foregoing conditions, there is no need for removing the drum frames or drums 4 and 5 because they are equipped with the parts 32 and 26 susceptible of being put into interchangeable use at any time in the manner set forth.

By my invention, I obtain special interchangeability or convertibility of crane operation as between clam shell, orange peel or like excavating boom and bucket equipments, and dipper shovel boom and bucket equipment my single crane mechanism being adapted for all of these. Moreover, as to the dipper shovel operation where boom hoisting is required to be employed at times, I may utilize with my invention, the convertible operating mechanism of my pending application, Serial No. 72,925, filed December 3rd, 1925; indeed such combination is actually employed. Additional scope of interchangeability is obtained by reason of the adaptability of use of my mechanism for the purposes of dragline work by the mere detachment of the laggings 32 without substitution of any parts for the same. By this I mean that I may simply take off the laggings 32 in order to change a dragline bucket type machine into a shovel or other class of crane mentioned, the necessary boom and bucket equipment being placed in position, of course. I may use a single handle lever controlling means to operate the clutch devices 46 and 4^y alternately in order to obtain the necessary opposite driving actions on the front drum means for the shovel operation.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States, is:—

1. A convertible crane, comprising, in combination, excavator operating mechanism including a crane body, a boom, and drum means embodying a drum frame for operating cable and bucket equipments that in operation are associated with the boom, necessitating relatively high and low speed driving actions, and interchangeably usable high and low speed driving elements carried by said frame, and means to transmit driving forces to the drum frame and thereby to said elements whichever is used.

2. A convertible crane, comprising, in combination, excavator operating mechanism including drum means embodying a crane body, a boom, and a drum frame for operating cable and bucket equipments necessitating relatively high and low speed driving actions, and interchangeably usable high and low speed driving elements adapted to be connected with the drum frame and coaxial respecting one another, and means removably attaching said elements to the drum frame.

3. A convertible crane, comprising, in combination, excavator operating mechanism including drum means embodying a crane body, a boom, and a drum frame for operating cable and bucket equipments necessitating relatively high and low speed driving actions, and interchangeably usable high and low

speed driving elements adapted to be connected with the drum frame, and means to reversibly operate the drum frame.

4. A convertible crane, comprising, in combination, excavator operating mechanism including drum means embodying a crane body, a boom, and a drum frame for operating cable and bucket equipments necessitating relatively high and low speed driving actions, and interchangeably usable high and low speed driving elements adapted to be connected with the drum frame, and means to reversibly operate the drum frame, the driving elements being of different operative diameters for imparting different driving speeds to excavating devices connected up therewith.

5. A convertible crane, comprising, in combination, excavator operating mechanism including a crane body, a boom and drum means embodying a drum frame for operating cable and bucket equipments necessitating relatively high and low speed driving actions, and interchangeably usable high and low speed driving elements cooperative with said frame, and separate means for attaching the elements to the drum frame.

6. An operating drum assembly unit for cranes comprising a hub portion having end flanges and adapted to receive a supporting axis means, a removable driving element carried by said hub portion and interlocked therewith, and a coaxial secondary driving element mounted on said hub portion and having interlocking means cooperating therewith, the said hub portion having end flanges at substantially right angles thereto, and the said driving elements extending around the hub portion from one end flange to the other.

7. A drum assembly unit for cranes comprising a hub portion to receive a supporting axis means and having off-standing radial projections, and a removable driving element extending around said hub portion and having projections interlocking with those of the hub portion to prevent rotative slippage thereon.

8. A drum assembly unit for cranes comprising a hub portion to receive a supporting axis means and having off-standing radial projections, and a removable driving element extending around said hub portion and having projections interlocking with those of the hub portion to prevent rotative slippage thereon, and a removable lagging surrounding the said removable driving element, with means to prevent rotative movement of the lagging relatively to the said driving element.

9. A drum assembly unit for cranes comprising a hub portion to receive a supporting axis means and having off-standing radial projections, and a removable driving element extending around said hub portion and having projections interlocking with those of the hub portion to prevent rotative slippage thereon, the said driving element being made in separable sections of interchangeable construction.

10. A drum assembly unit for cranes comprising a hub portion to receive a supporting axis means and having off-standing radial projections, and a removable driving element extending around said hub portion and having projections interlocking with those of the hub portion to prevent rotative slippage thereon, and a removable lagging surrounding the said removable driving element, with means to prevent rotative movement of the lagging relatively to the said driving element, the driving element and the lagging being made in sections, the sections of each adapted to receive fastening members, and fastening members applied to the sections of each to hold them together and permit their removal.

11. An operating drum assembly unit for cranes, comprising a drum frame having a hub portion provided with end flanges, a renewable cable driving element applied to the hub portion, and a removable lagging concentric with and housing said driving element, the element and lagging being arranged between the said end flanges, means interlocking the cable driving element with the hub portion and means interlocking the lagging with the flanges of the hub portion.

12. A convertible crane operating mechanism comprising, in combination, a plurality of drum frames, high and low speed driving elements interchangeably connectible to a drum frame for alternative action thereon, means to transmit driving forces to the drum frames and their driving elements, detachable means for transmitting reverse driving force to the frame with which the interchangeable driving elements are connectible, and means to connect up excavating boom and bucket equipments of different types for cooperation with the drum frames, one for use with the high speed driving element, and the other with the low speed driving element.

13. A crane as claimed in claim 10, and excavating boom and bucket equipments of different types, one to cooperate with the high speed driving element, and the other with the low speed driving element, and means to reversibly actuate one of the drum operating mechanism drum frames when coacting excavating equipment is that of the shovel dipper type.

14. In combination, shovel crane mechanism comprising front and rear drum means adapted to operate hoisting and shipper mechanism for a shovel dipper, means for reversibly driving the front drum means to operate the shipper mechanism of the shovel in opposite directions, the front and rear drum means comprising detachable members enabling said drum means to operate the hoisting and shipper mechanism with different driving speeds for different boom and bucket equipments and means for holding

said detachable members in position on said drum means permitting their ready removal when it is desired to use them for operating other boom and bucket equipments at a different speed from the shovel boom and bucket equipment, and detachable shovel boom and bucket equipment associated with said crane mechanism.

15. In combination, shovel crane mechanism comprising front and rear drum means adapted to operate hoisting and shipper mechanism for a shovel dipper, means for reversibly driving the front drum means to operate the shipper mechanism of the shovel in opposite directions, the front and rear drum means comprising detachable members enabling said drum means to operate the hoisting and shipper mechanism with different driving speeds for different boom and bucket equipments and means for holding said detachable members in position on said drum means permitting their ready removal when it is desired to use them for operating other boom and bucket equipments at a different speed from the shovel boom and bucket equipments, and detachable shovel boom and bucket equipment associated with said crane mechanism, and means for incapacitating the reverse driving means aforesaid when other boom and bucket equipment is substituted for the above mentioned shovel boom and bucket equipment.

16. Convertible crane operating mechanism, comprising a crane body, a boom and a drum frame for operating cable and bucket equipments necessitating relatively high and low speed actions, interchangeably usable high and low speed driving elements on the drum frame, means for driving the drum frame, and means usable in alternation with said driving means for reversibly driving the drum frame.

17. An operating drum assembly unit for cranes, comprising, a hub, and a removable driving element carried by and directly interlocked with said hub.

18. An excavating mechanism operating drum for a convertible crane comprising a hub, terminal flanges thereon, rods connecting the flanges and spaced from the hub, radially applicable and removable lagging sections adapted to be applied between the flanges and in engagement with the rods, and means detachably connecting the lagging sections to lock them in operative relation to each other and in driving engagement with the rods.

19. An excavating mechanism operating drum for a convertible crane comprising a hub, terminal flanges thereon, rods connecting the flanges and spaced from the hub, radially applicable and removable lagging sections adapted to be applied between the flanges and in engagement with the rods, and means detachably connecting the lagging sections to lock them in operative relation to each other and in driving engagement with the rods, the lagging sections being formed with inturned flanges notched to accommodate the rods.

20. An excavating mechanism operating drum for a convertible crane comprising a hub, terminal flanges thereon, the hub being formed with a radial extension, rods spaced from the hub and connecting the flanges, an inner lagging of detachable sections surrounding the hub, means for detachably connecting said sections together for retaining the same in driving engagement with the extension of the hub, an outer lagging of detachable sections surrounding the inner lagging, and means detachably connecting the sections of the outer lagging between the hub flanges and in driving engagement with said rods.

In testimony whereof I affix my signature.

LESLIE A. RUSSELL.