

Dec. 27, 1955

R. A. BECKWITH
COMBINED TRUCK AND CRANE

2,728,463

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3 Sheets-Sheet 1

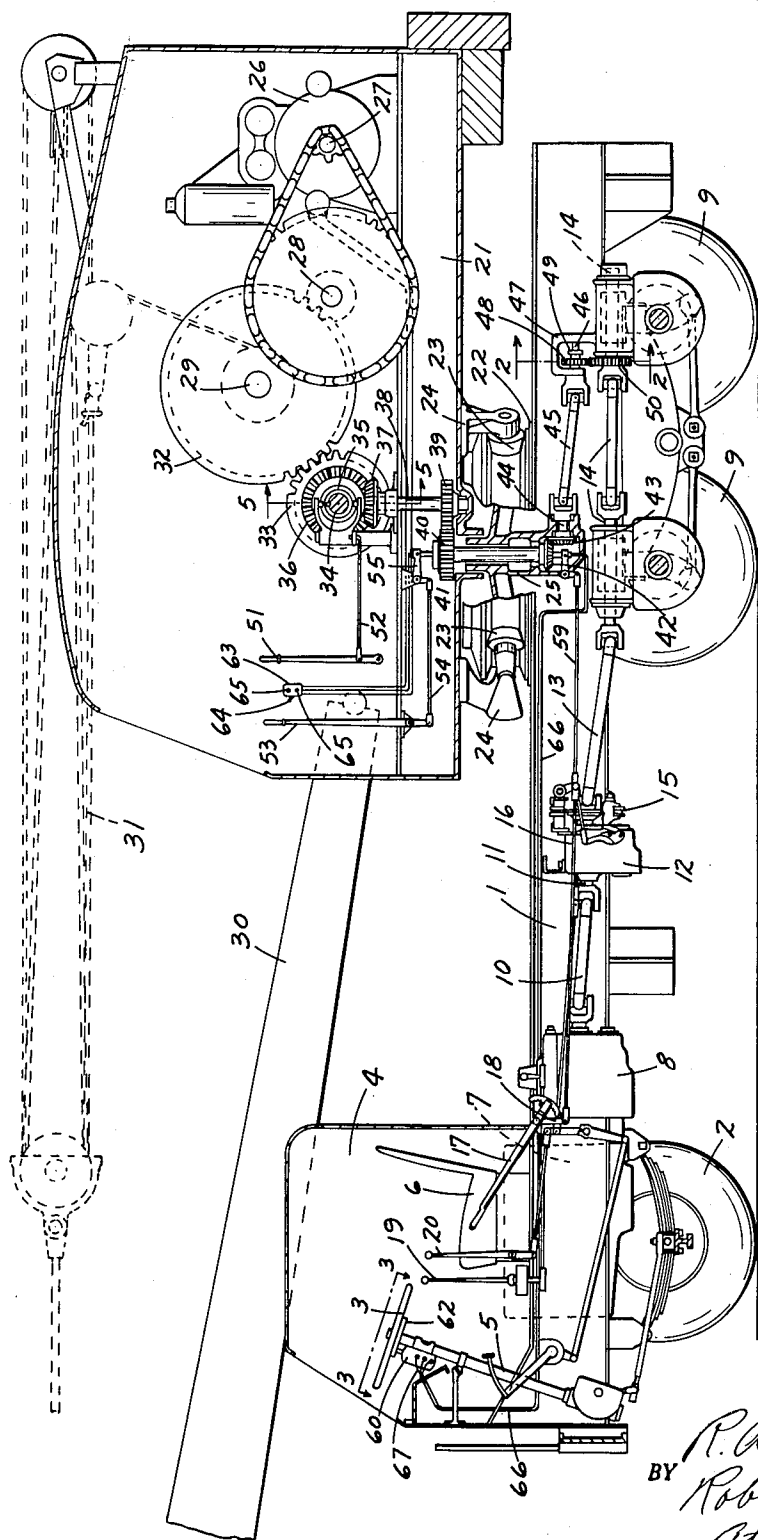


FIG. 1.

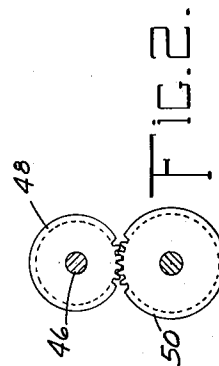


FIG. 2.

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3 Sheets-Sheet 2

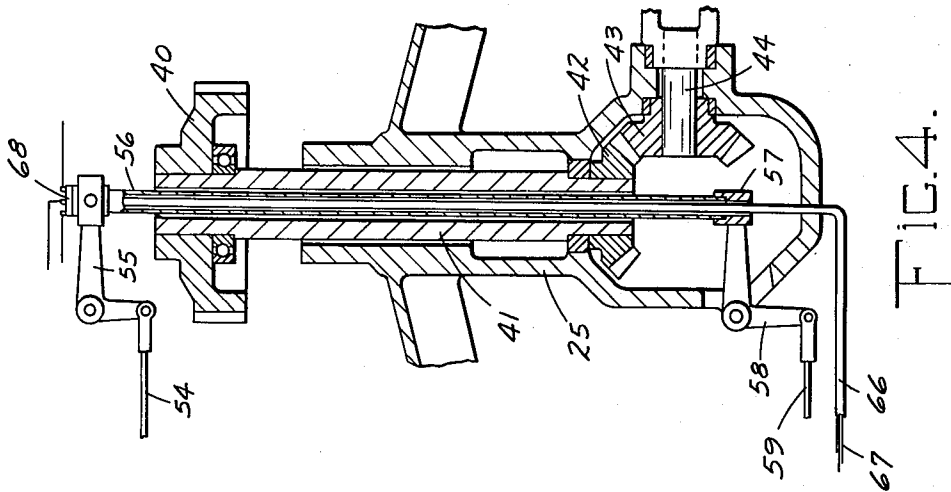


FIG. 4.

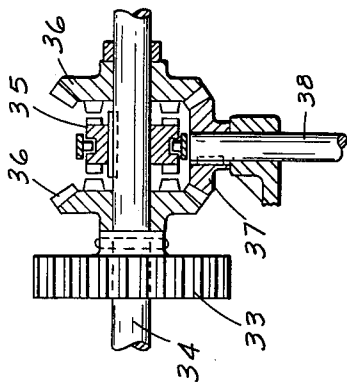


FIG. 5.

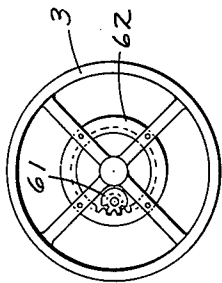


FIG. 3.

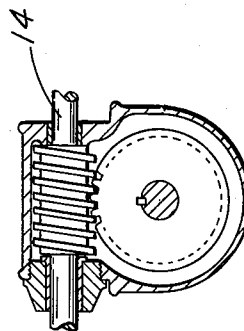


FIG. 6.

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3 Sheets-Sheet 3

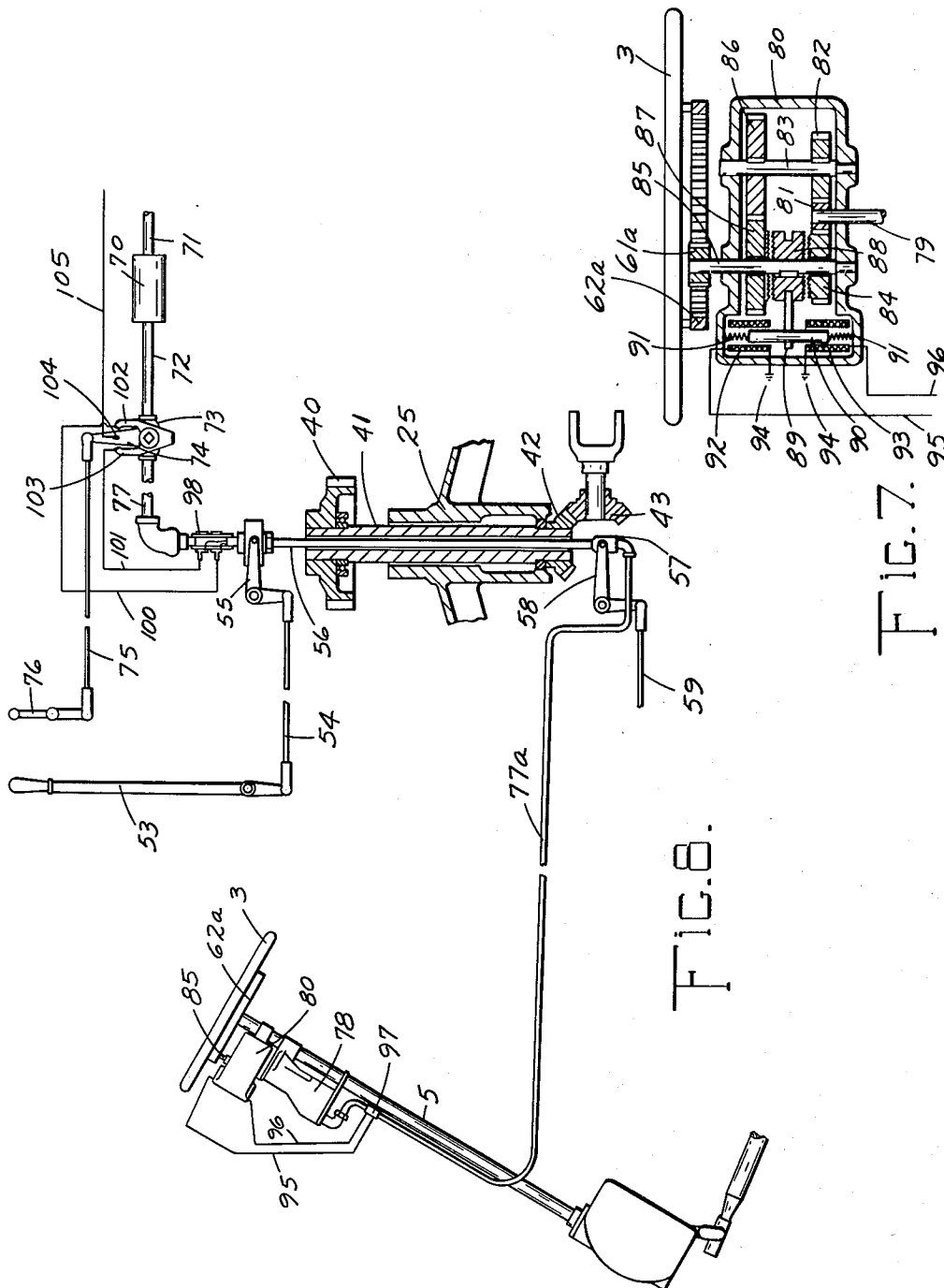


FIG. 8.

FIG. 7.

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2,728,463

COMBINED TRUCK AND CRANE

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6 Claims. (Cl. 212—38)

This invention involves improvements in excavating machines of the class in which a crane (shovel, drag-line or other type) is mounted on a truck capable of being driven at relatively high speeds to and from the site of excavation by an engine forming the regular equipment or power plant of the truck, the crane of this invention embodying its own engine or power plant operable from the crane cab when the excavating machine is doing excavating work.

The present invention comprises mechanism for connecting the crane motor to the driving wheels of the truck for operating said wheels, while the truck engine is idle during excavating operations.

The present invention further includes operating features whereby the truck may be moved in opposite directions and steered by an operator in the crane cab, to handle excavating operations, without necessity for employing any operator at the driving position in the truck cab.

This invention additionally comprises means for disconnecting the crane motor drive to the ground wheels of the truck when the truck is to be driven by its own engine at highly mobile speeds which are not employed during excavating operations.

My construction of combined machine of the type referred to is especially advantageous because I am enabled to mount upon a truck a complete crane unit of any one of many known types, and adapt the crane for combined operation with the running gear and control means of a truck by connecting up the standard crane mechanism with the truck wheels by mere addition of auxiliary driving connections to such wheels, and utilizing special controls for the conventional steering means of the truck, operable by the operator in the crane cab, said operator being thus able to handle both the crane and truck when the latter is driven from its cab, or the crane and vehicle are operated from the crane cab.

This invention also embodies novel specific instrumentalities to combine certain conventional power driven devices, usually parts of an ordinary crane, with special auxiliary driving shaft means for the ground wheels of the vehicle for actuation of the latter.

Other detail and new features of the construction of my combined truck and crane will appear more fully hereinafter on referring to the following detail description and to the accompanying drawings, and in the latter the figures shown are described as follows;

Figure 1 is a view, certain parts in section, and certain parts in side elevation, illustrating a combination truck and crane embodying the essential features of my invention.

Figure 2 is a detail view showing certain gearing, the view taken about on the line 2—2 of Figure 1.

Figure 3 is a plan view showing more particularly a detail feature of the steering wheel driving gear which is operable from the cab of the crane body, the view being taken about on the line 3—3 looking in the direction of the arrows.

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Figure 4 is a vertical sectional view, parts broken away, taken about on the vertical line of the center pin assembly by which the crane body is mounted upon the truck body, and bringing out the arrangement of certain of the controlling and operating instrumentalities located at this point of the combination vehicle.

Figure 5 is a detail view, a section taken about on the line 5—5 of Figure 1, bringing out the reversible clutch means by which the horizontal swing shaft is enabled to drive the rear traction wheels of the vehicle from the power plant or engine located in the cab or crane body.

Figure 6 is a detail sectional view showing one of the drive connections between the driving shafts leading from the crane and the truck engine to a pair of the rear ground wheels of a tandem axle unit at the rear end of the truck.

Figure 7 is a detail sectional view showing certain of the electrical and gear control means for the steering wheel of the truck, according to the modified apparatus or mechanism illustrated in Figure 8.

Figure 8 is a general view showing a modified or alternative arrangement of steering wheel control mechanism which is operable from the crane body by an operator located therein who is able to steer the crane and truck, therefore, employing the truck steering means for such purpose.

First referring to Figure 1 of the drawings, there will be described now the truck unit employed in conjunction with my invention, the same being largely made up of conventional construction known to the art, with which construction I combine the frame unit features to be more fully later set forth.

The truck above referred to includes the chassis 1 made up of the customary side channels and equipped at its front end with the front wheels 2 adapted to be steered after the conventional manner of operation, by means of the steering wheel 3 in the cab 4 of the truck. The steering wheel 3 is mounted upon the usual steering column 5, and the steering shaft in said column is operably connected with the front wheels for steering in any well known manner. Mounted on the front end of the chassis or frame 1 below the seat 6 for the driver of the truck when he is located in the cab 4, is the truck engine 7 shown by dotted lines in Figure 1, the shaft of this engine being connected by suitable transmission gear mechanism included in the unit 8, to the rear wheels 9 of the truck, the latter mounted upon a tandem axle unit of conventional type, very largely.

The transmission gear unit 8 is connected by a shaft section 10 to a short shaft section 11 entering the auxiliary transmission unit 12, the gearing of which is connected by another shaft section 13 with universally jointed line shaft sections 14 arranged on the tandem gear unit at the rear of the truck and connected for driving the wheels 9 of said unit after conventional practice, as by means of worms on the shaft section 14 engaging with worm wheels on the axles of the tandem unit.

Located at the auxiliary transmission unit 12 is a common type of emergency brake designated 15, and an emergency brake rod 16 connects said brake with the emergency brake lever 17 in the cab at a side of the driver's seat 6, the rod 16 at its forward end connecting directly to the arm 18 operated by said lever 17. In the cab 4 there is provided the usual main transmission operating lever 19 and the auxiliary transmission operating lever 20 connected by suitable rod connections back to the gear shifting means for the two units 8 and 12 respectively. The operating connections may be conventional and do not form any special or material part of my invention other than that they are employed in the usual manner when put into use.

The foregoing generally sets forth the features of the

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truck with which my crane unit now to be described is combined by making certain provision between the truck unit and the crane unit whereby the operator of the truck may get out of the cab 4 and take his place in the crane unit cab or body and thereafter operate the crane and truck as a combination organized machine from the crane station.

Referring now to the crane unit as seen in Figure 1 primarily, I note that this unit comprises generally the swing body 21 which is mounted on the turntable 22 supported on the chassis 1 of the truck in largely the conventional and well known manner, the turntable means utilizing the customary turntable rollers 23 carried by brackets 24 attached to the base portion of the swing body 21.

As usual, the turntable 22 is provided with a hollow centerpin, or revolving axis portion, through which, in ordinary types of cranes, drive shafts and other control means for the operation of the crane for moving and steering the same, ordinarily pass. All of such means are not illustrated in the drawings, but those which are necessary for the purposes of my invention and form a part thereof are to be seen on reference to the various views of the drawings.

Referring now to Figure 1 and to the crane body 21 which is rotative upon the chassis 1 of the truck, about the axis of the centerpin or trunnion 25, I note that I equip the crane body with the customary power plant consisting of an explosive or diesel type engine generally, designated 26. The shaft 27 of the engine 26 is drivingly connected to a shaft 28 parallel thereto and spaced therefrom, which shaft 28 is in turn geared to a drum shaft 29 shown in dotted lines in Figure 1, which carries the drum known as the hoist drum for the boom of the crane, said boom being designated 30 in Figure 1 and being broken away at its outer portion for lack of space for full illustration. The boom 30 is customarily adapted to be raised and lowered and held at a desired pitch or angle in relation to the crane body 21 by cable means 31 illustrated partly in dotted lines in Figure 1. The A frame with which this cable means is usually connected is disclosed in the drawings in collapsed condition. The gear 32 on the drum shaft 29 meshes with a spur gear 33 which is carried by what is commonly known as the horizontal swing shaft supported on the body of the crane in the customary way, the spur gear 33 being shown in Figure 5 as well as the said horizontal swing shaft designated 34.

For the purposes of the present invention I provide on the swing shaft 34 a reversible clutch member 35 engageable with either one of reversing bevel gears 36 and located intermediate the gears which latter are equipped with clutch parts to engage with the clutch member 35. The gears 36 are loose on the shaft 34 and are normally engaged with the bevel gear 37 on a vertical wheel driving shaft 38 which is supported in suitable bearings in the base of the swing body 21 of the crane and leads through said base downwardly to a point at which the shaft 38 supports the spur gear 39 meshing with another spur gear 40, see Figure 1, the gear 40 being mounted on a hollow driving shaft 41 see Figure 4, which leads through the centerpin 25 of the turntable and swing body 21. On the lower end of the hollow shaft 41 is a bevel gear 42 keyed to the shaft 41 and meshing with a second bevel gear 43 on a short shaft 44 which is connected by a universal joint with the shaft section 45. The shaft section 45 in turn is universal joint-connected with a drive gear shaft 46 disposed in a bearing bracket 47 on the tandem wheel unit frame at the rear end of the truck chassis 1. The shaft 46 carries the driving gear 48 of the spur gear type, said driving gear being equipped with a grooved throw collar 49 and being slidable a short distance longitudinally of the shaft 46. The gear 48 of the shaft 46 is adapted to mesh and unmesh in respect to a corresponding spur gear 50, which latter gear is keyed to the rearmost section 14 of the line shafting which is employed to drive the rear wheels of the tandem wheel unit before referred to, from the engine 7 at the

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front end of the truck chassis 1. By operating a suitable lever or other member connected with the shifting collar 49 of the gear 48, said gear may be thrown from the position of Figure 1, in which it is meshed with the gear 50 to a position in which it is disengaged from said gear, by slight rearward movement.

From the foregoing it will be observed that by the driving means provided intermediate the crane engine or motor 26 and the driving gear 48 I can operate the wheels 9 of the tandem wheel unit at the rear of the chassis 1, from said crane motor 26, or I can incapacitate the driving of the gear 50 by means of the gear 48, at will. A lever 51 in the crane cab adjacent to the operator's station has a rod connection 52 leading to the clutch member 35 for shifting said clutch member to engage it with one or the other of the bevel gears 36, and when the member 35 is clutched to one of the gears 36 the drive of the motor 26 may be transmitted to the rear wheels 9 in a forward direction, or by shifting the members 35 to engage the other of the gears 36, a rearward drive of the wheels 9 may be produced. When the clutch member 35 is in neutral position, the driving of the parts 36, 37, 38, 41, 42, 43 and 40 will be discontinued in respect to the driving forces transmitted from the engine 26. Likewise, when the gear 48 is disengaged from the gear 50 it is obvious that the gear and shaft parts leading to the crane unit operated by the gear 48 will remain idle notwithstanding that the line shafting 14 leading to the rear tandem wheel unit and operated by the engine 7 at the cab of the truck is operated to propel the truck for high speed movement.

It is obvious that it is desirable for the operator of the truck crane of this invention, when stationed in the cab or body of the crane, to control the excavating operation of the latter, to be able to apply braking means for holding the crane and truck stationary against bodily movement. For this purpose I provide a lever 53 in the cab of the crane body, accessible to the operator while stationed therein, said lever 53 being connected by a rod 54 to a bell crank 55, one arm of which terminates just above the center of the turntable centerpin 25. This arm of the bell crank 55, see Figure 4, is connected by a hollow rod 56 which leads downwardly through the hollow drive shaft 41 of the centerpin 25, through said shaft 41. The lower end of the rod 56 is equipped with a sleeve 57 having a suitable connection with the rear end or arm of another bell crank 58 supported on the chassis 1, with which member 58 a brake rod 59 connects and leads to the emergency brake 15. Under these conditions it is obvious that the emergency brake 15 is controlled by the lever 17 at the cab 4 of the truck when the operator is located in said cab, and is likewise controllable from the lever 53 in the cab of the swing body of the crane when the operator is stationed in the latter for controlling the excavating operations of the crane.

Now it is further required that means be supplied in the swing body of the crane at the operator's station for controlling the steering of the crane and truck when the combined machine is being used for excavating purposes. To this end I mount upon the steering column 5 in the cab 4 of the truck a reversible electric motor designated 60 in Figure 1 of the drawings, the shaft of this motor indicated at 61, see Figure 3, having a pinion which is normally engaged with a ring gear 62 affixed to the spokes of the steering wheel 3. In the cab of the crane body 21 I provide a control panel 63 which is equipped with a cut-out switch 64 and with circuit closing buttons or switch members 65, the switch panel 63 being connected by circuit wires in a conductor cable 66, see Figures 1 and 4, the wires designated at 67, which cable leads from the platform of the swing body 21 of the crane through the hollow shifting rod 56 previously referred to as used to operate the emergency brake from the lever 53. After passing through the rod 56 the cable 66 leads forwardly of the chassis 1 to the motor 68 on the

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steering wheel column 5 and the wires 67 are connected up with the motor 60 so that the reverse operation of the motor will be effected in accordance with ordinary electric operations of this type, through the control actuation of the buttons or switches 65 on the panel 63 in the crane cab. The wires or conductors 67 may be attached to a collector ring which is mounted at the top of the shiftable tubular rod 56 previously referred to and which is designated at 68. Thus it will be seen that when the operator of the combined truck and crane of this invention is stationed in the cab of the swing body 21 he will be able to operate the steering wheel 3 of the truck through the control members 65, in an electrical manner, the usual storage battery of the truck supplying the necessary current to the conductors or wires 67 in the complete electric circuit which includes said battery, said conductors, the motor 60, and the members on the panel 63 in the crane cab. Steering of the crane while it is being operated for excavating purposes by the operator stationed in the cab of the swing body 21 is thus readily controlled, as well as the operation of braking the combined machine to hold the machine stationary.

Summarizing the operation of my machine, it is notable that when the truck and crane is being driven from a place for excavating work, or to such place, relatively high speed movement of the truck is desirable to save time. Under these conditions the operator will of course drive the truck from the seat 6 in the cab 4 and attend to all steering and braking operations by recourse to the various control instrumentalities in the cab. At such time also the crane motor 26 will be idle or out of operation and the swing body 21 will be preferably adjusted so that the boom 30 lies longitudinally of the truck and extends over the cab 4 where it is held in a suitable position by means of the hoist lines 31 connected with the drum of the drum shaft 29. When the truck has reached the place of excavation or any other place a long distance therefrom, the operator will stop the truck with the emergency brake unset. He will also place the transmission unit 12 in neutral. He can then assume the operator's station in the crane cab at the controls of the latter, start the motor 26, and do the usual excavating work which is performed by the type of crane used. At the latter station the operator may throw in the operating connections from the motor 26 to wheels 9 and move the machine forwardly and rearwardly, as well as brake and steer while excavating.

In Figures 7 and 8 of my drawings I have illustrated an alternative modified type of means for operating the steering wheel of the truck from the operator's station in the cab of the crane body, such means including an air motor employed in lieu of the electric motor 60 previously referred to. Describing the modified construction in conjunction with Figures 7 and 8, I note that there will be located on the swing body 21 of the crane a reservoir for motive fluid designated 70, said reservoir being supplied from a conduit 71 leading to a suitable compressor. From the reservoir 70 the motive fluid is supplied through a conduit 72 to a valve casing 73 in the cab of the crane, a valve lever 74 operating the valve in said casing 73 and being in turn operated by a rod 75 leading to the hand lever 76 located adjacent the operator's station. From the valve casing 73 a fluid pressure conduit 77 leads downwardly through the hollow shifting rod 56 previously described as operated by the brake lever 53, the conduit 77 coming out of the bottom of the rod 56 at the continuation portion of the conduit designated 77a. The conduit 77a leads forwardly along the chassis 1 of the truck to the steering column 5 and thence upwardly along said column to the air motor 78 to supply air to the rotor of said motor, not shown, to drive the said rotor in one direction. The rotor shaft of the motor 78, designated 79, see Figures 7 and 8, leads upwardly into a combined solenoid and gear casing 80 and carries at its upper end, in said casing 80, a pinion 81. The pinion 81 is in mesh with a gear 82 on

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a vertical shaft 83 in the casing 80, to which shaft the gear is keyed. The pinion 81 is also in mesh with a gear 84 on a countershaft 85 mounted in the casing 80, gear 84 being loose on the shaft 85. On the shaft 83 there is also carried another keyed gear 86 which gear, in turn, is meshed with another loose gear 87 on the countershaft 85 mentioned above. Gears 82, 84, 86, and 87 are in the casing 80, and on the shaft 85 and splined to the latter intermediate the gears 84 and 87 is a reversing clutch member 88 having clutch teeth on its upper and lower side to engage, respectively, teeth on the under side of the gear 87 and on the upper side of the gear 84.

The clutch member 88 is solenoid operated by an actuating arm 89 fixed to the core 90 of a solenoid, the member 90 being normally centered in non-operating position by means of springs 91 engaging the end portions thereof.

By energizing the solenoid the member 90 may be caused to move upwardly or downwardly thereby to shift the clutch member 88 to engagement with the gear 87 with clutched relation, and with the gear 84, respectively. The windings of the solenoid designated 92 and 93 may be grounded to the chassis 1 at the points shown at 94. Said windings are also included in an electric circuit comprising the conductors 95 and 96 for the respective windings 92 and 93, these conductors controlling the steering operation of the mechanism shown in Figure 7, the conductor 95 for steering the truck to the left, and the conductor 96 for controlling the steering of the vehicle by turning the steering wheel to the right.

The shaft 85 which carries the gears 87 and 84 loosely thereon is also provided with the pinion 61a that meshes with the ring gear 62a attached to the steering wheel 3 of the truck.

The conductors 95 and 96 of the electric circuit, including the solenoid above described, lead at their lower ends through a union 97 through which the fluid conduit section 77a passes and said conductors 95 and 96 thus enter the conduit and pass through the conduit 77a and the portion 77 of said conduit to electric contacts at the collector ring assembly 98 located adjacent to and above the lever 65 near the base of the swing body 21 of the crane. From the collector ring 98 the conductors 95 and 96 are connected by secondary conductor leads comprising wires 100 and 101 which are respectively finally connected to contact members 102 and 103 at opposite sides of the air valve lever 74 of the casing 73.

The electric connections above described may be conventional and such as commonly used in the art for the purposes thereof. Under operating conditions when the operator of my machine is stationed at the operator's station in the cab of the crane body 21 he is enabled to operate the lever 76 to move the valve lever 74 in one direction for supplying fluid under pressure from the reservoir 70 to the fluid motor 78 to operate the rotor of said motor. If the direction of the movement of the lever 71 effects contact of the electric contact on the lever 74 with the contact 102, the electric circuit, including the several conductors at the solenoid, will be closed so as to operate the armature or core of the solenoid in one direction. This action, while simultaneous with the driving of the gears in the casing 80 by the motor 78 will cause clutching of the clutch member 88 through one of the gears 87 and 84, whereby to turn the pinion 61a and the steering wheel 3 in one direction. If the movement of the valve lever 74 is in the opposite direction to that previously referred to, the circuit will be closed at the contact member 103 and simultaneously there will be supplied fluid under pressure to the motor 78 again, and the solenoid unit will be operated to cause clutching of the clutch member 88 to the other of the gears 87 and 84, whereby to operate the pinion 61a in a direction opposite to that last previously described, thereby to turn the steering wheel 3 in an opposite direction to that mentioned above in this particular part of this specification.

The electric circuit, including the conductors or leads just described in reference to Figures 7 and 8 may have for its source of current the storage battery of the vehicle which correspondingly supplies the current to the power plants or engines in the truck cab and in the crane body cab, as previously described. The lever 74 controlling the passage of pressure fluid from the reservoir 70 to the motor casing of motor 78 will have a contact 104 common to the contact members 103 and 102 for engagement with either one of the latter, dependent upon the direction of shifting of the valve lever. The contact 104 is connected to the storage battery last mentioned, not shown, and its generator, by the lead 105, the battery being grounded to the chassis in the conventional manner.

When the combined machine of the invention is operated as a crane for excavating purposes, the operator being then stationed in the cab of the crane, it is contemplated that the gears 48 and 50 shall be maintained in mesh so that during driving of the rear wheels 9 by the crane motor, through horizontal swing shaft 34, the drive shaft parts 13 and 14 will be operated forward to the brake 15. The propelling movement of the truck and crane by the motor 26 can therefore be braked by operation of the lever 53. Preferably when the truck is being driven longer travel distances by the operator at the cab 4, however, gear 48 will be unmeshed from gear 50 under which conditions the drive from the truck engine 7 will not be carried up by shafts 45, 41 and 38 to the bevel gears 36 on the horizontal swing shaft, such parts thus being idle.

A lever may be used to mesh and unmesh gear 48.

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

1. A combined truck and crane, comprising, in combination, a truck including a chassis having steering wheels, and driving wheels for propelling the truck, also an operator's station having control means for driving the truck, an engine on said chassis, an excavating crane unit mounted on the chassis comprising crane machinery, and a separate motor for the crane machinery, and two sets of driving connections, one connecting the truck motor to the driving wheels and the other connecting the crane motor to said driving wheels, a single brake means for controlling both said driving connections and directly coacting with the driving connections connecting the truck motor to the driving wheels, control means for the brake means located at the truck operator's station and separate control means on the crane unit for said brake means, and connections for both said control means with the brake means aforesaid.

2. A combined truck and crane as claimed in claim 1, in which the sets of driving connections include operating shaft instrumentalities leading from the truck motor to the driving wheels, and like shaft instrumentalities leading from the crane motor to the driving wheels and connected to the first shaft instrumentalities, the stated brake means being operable to control said shaft instrumentalities.

3. A combined truck and crane as claimed in claim 1, in which the sets of driving connections include operating shaft instrumentalities leading from the truck motor to the driving wheels, and like shaft instrumentalities leading from the crane motor to the driving wheels and connected to the first shaft instrumentalities, the stated brake means being operable to control said shaft instrumentalities,

ties, together with manually operable devices mounted on the crane unit to control connection and disconnection of the crane motor with the shaft instrumentalities leading to the driving wheels, and manually shiftable means to connect or disconnect the shaft instrumentalities leading from the truck motor with those leading from the crane motor.

4. A combined truck and crane as claimed in claim 1, in which the sets of driving connections include operating shaft instrumentalities leading from the truck motor to the driving wheels and like shaft instrumentalities leading from the crane motor to the driving wheels and connected to the first shaft instrumentalities, the stated brake means being mounted on the shaft instrumentalities leading from the truck motor, control means for said last instrumentalities mounted on the crane unit and connected with the brake means, and an axis member supporting the crane unit on the chassis and comprising a tubular structure through which said last mentioned control means passes.

5. In a combined truck and crane, in combination, a truck chassis, driving and steering wheels for said chassis mounted thereon, a truck motor on the truck chassis, connections between the truck motor and the driving wheels of the chassis for driving the latter, an excavating crane unit mounted on the truck chassis and comprising excavating device operating machinery, including a motor on the crane unit, connections from said motor leading to the driving wheels of the chassis for operating the latter from the motor, an operator's station on the truck chassis, an operator's station on the crane unit, a brake coacting with the driving connections leading from the said truck motor to the driving wheels, operating means for said brake located at the driver's station on the truck chassis, and operating means on the crane unit connected to said brake for operating the latter from the crane unit, said last operating means being located at the operator's station on the crane unit.

6. A combined truck and crane comprising the combination set forth in claim 5 wherein the brake recited comprises an emergency brake directly coacting with the driving connections leading from the engine on the truck chassis to the driving wheels.

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