Nov. 10, 1942. S. K. TOWSON ET AL 2,301,832

INDUSTRIAL TRUCK

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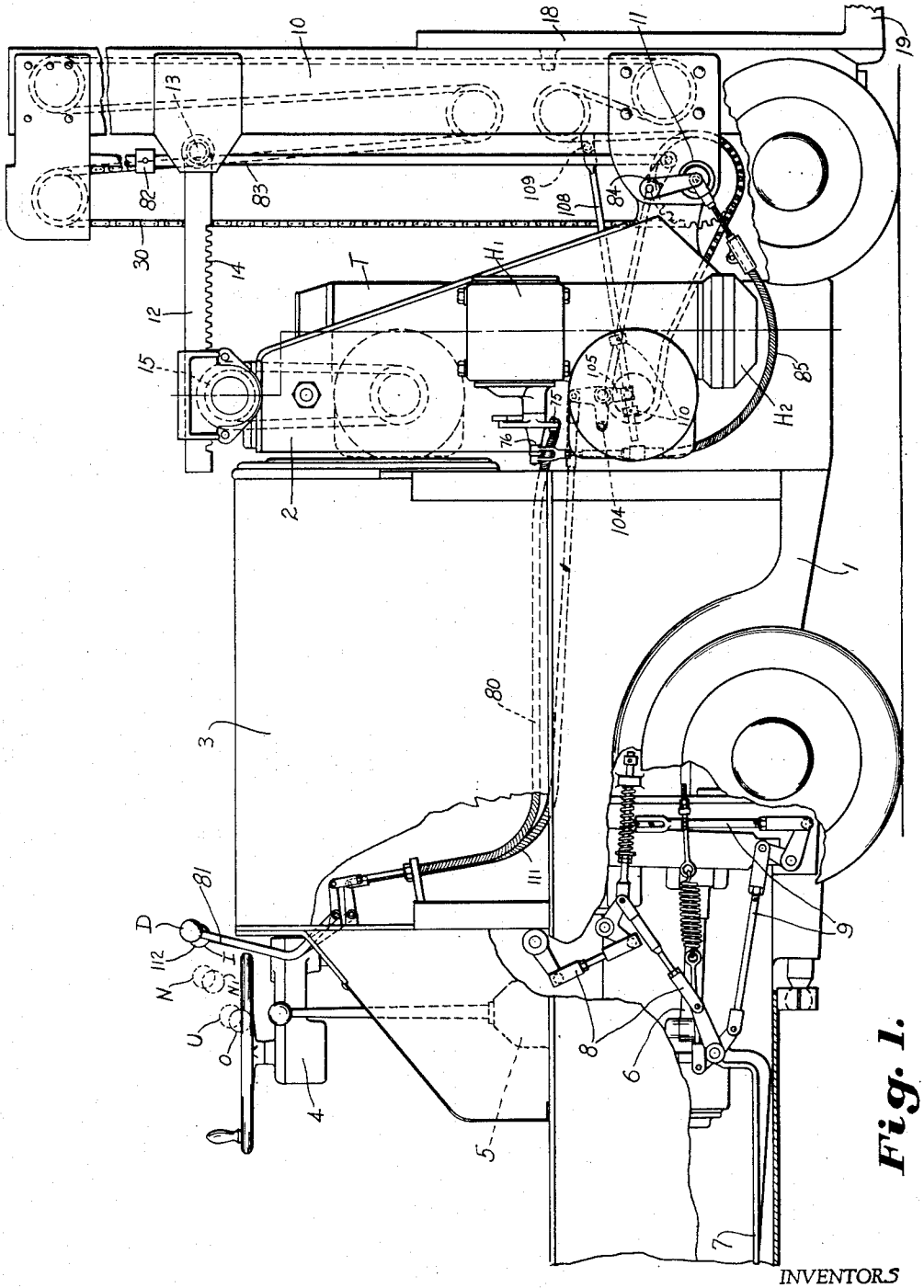

Fig. 1.

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INDUSTRIAL TRUCK

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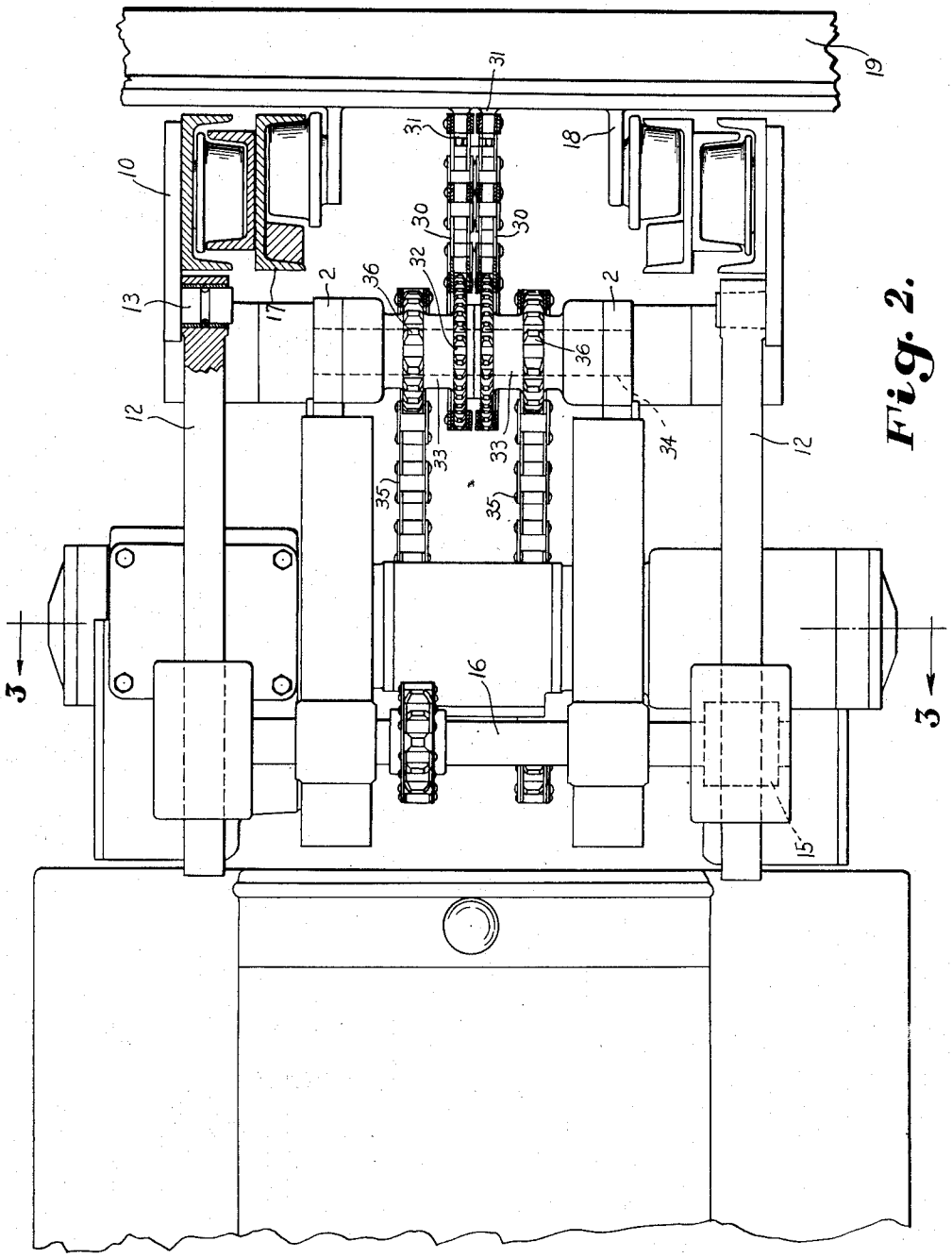

Fig. 2.

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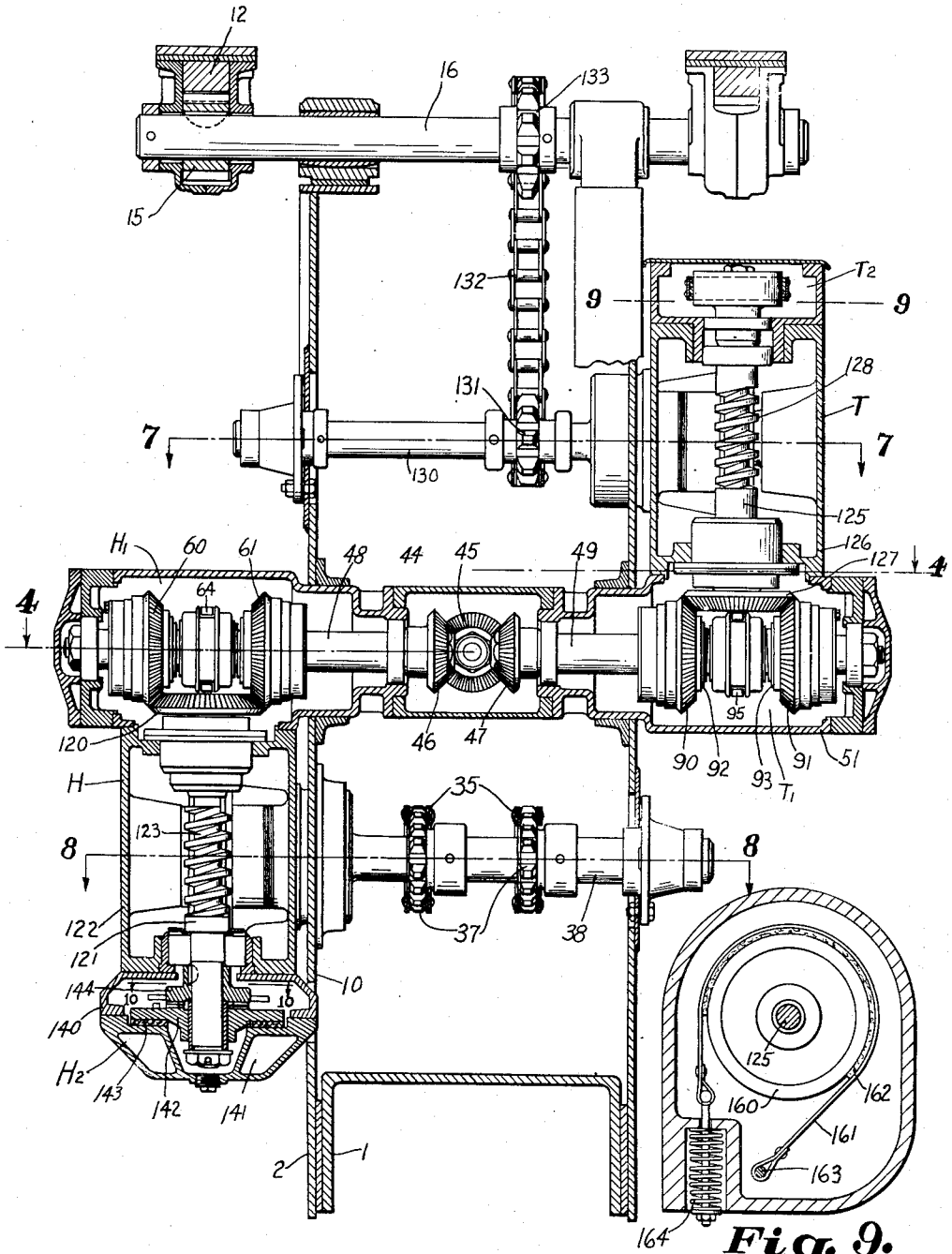

Fig. 3.

Fig. 9.

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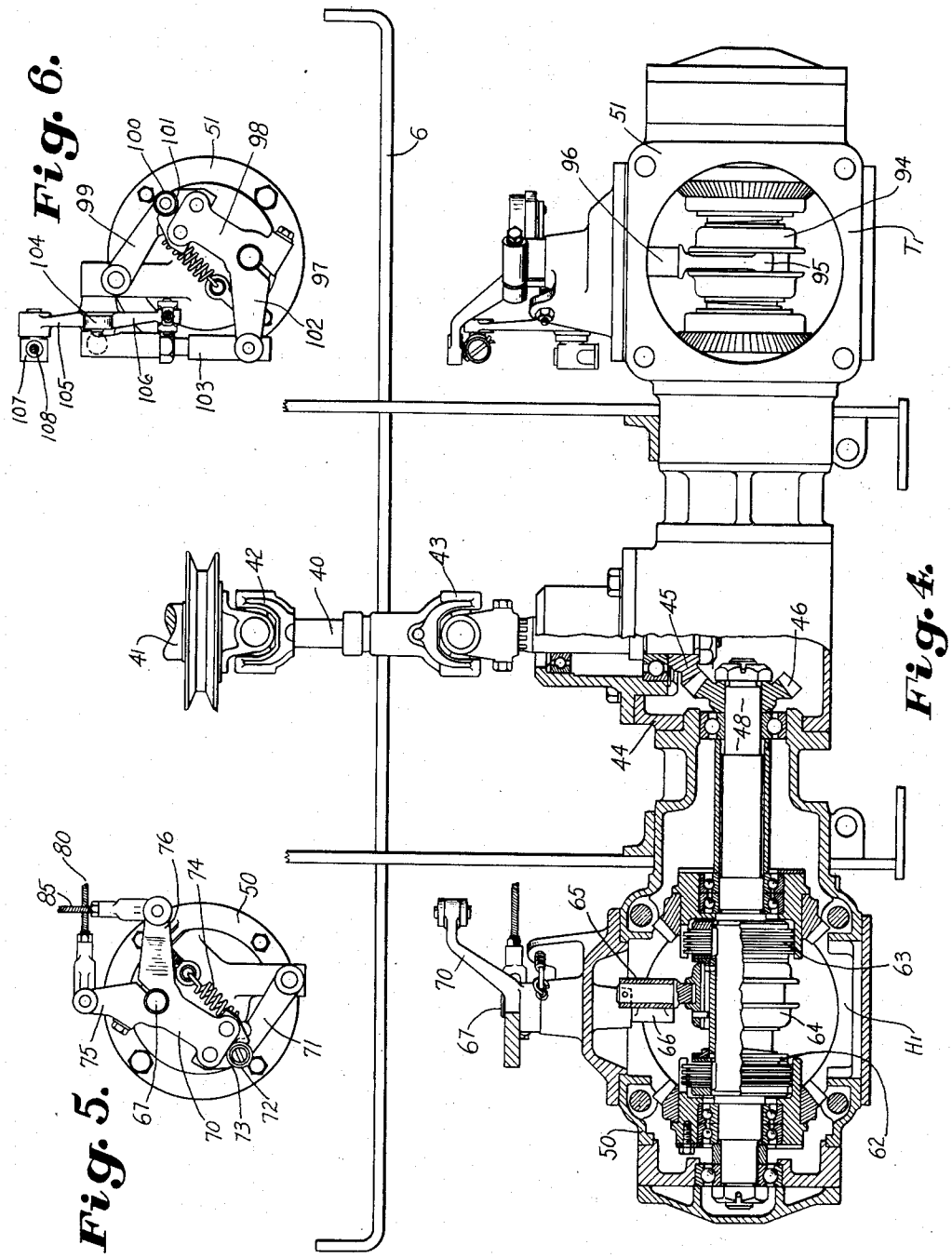

Fig. 6.

Fig. 4.

Fig. 5.

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INDUSTRIAL TRUCK

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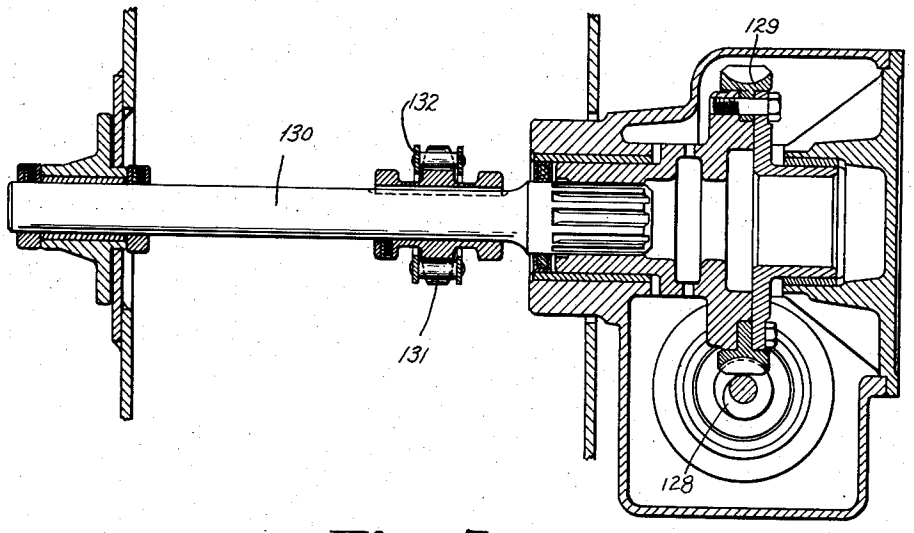

Fig. 7.

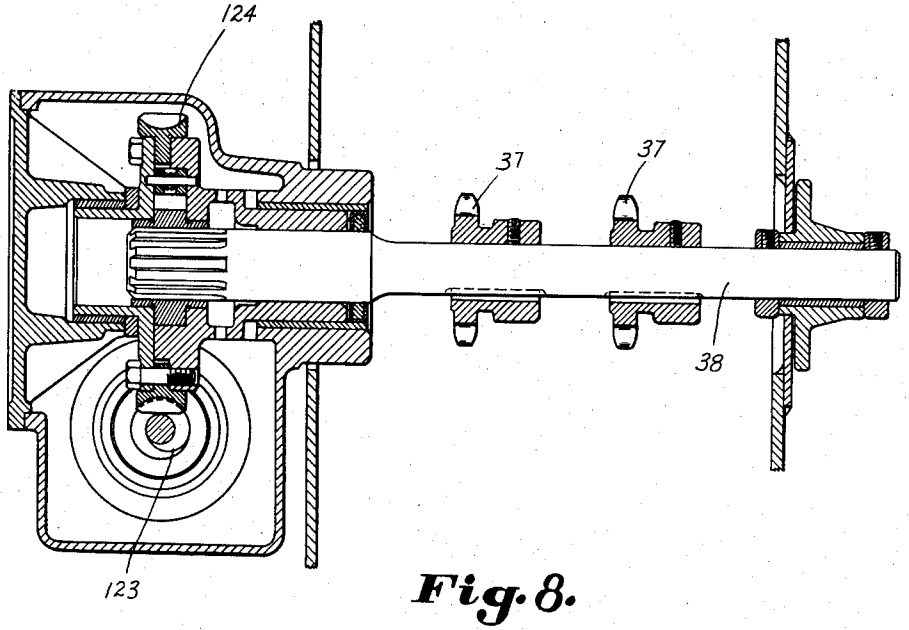

Fig. 8.

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INDUSTRIAL TRUCK

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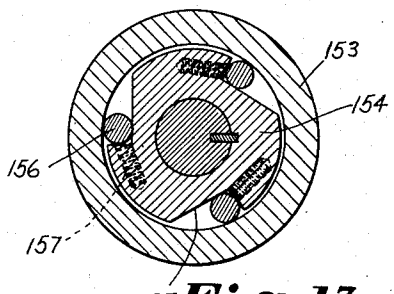

Fig. 13.

Fig. 12.

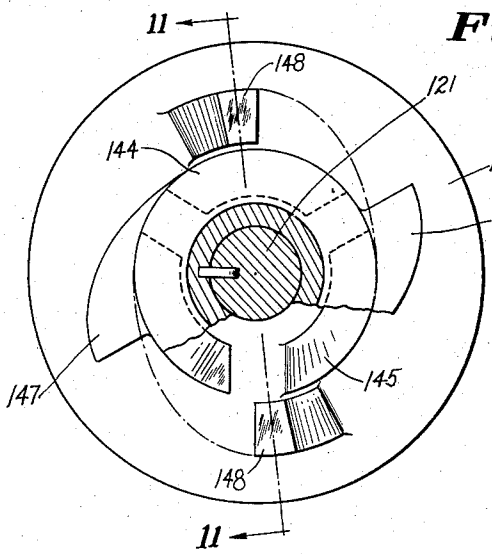

Fig. 10.

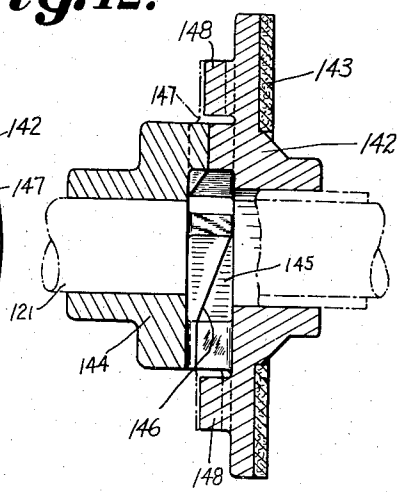

Fig. 11.

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UNITED STATES PATENT OFFICE

2,301,832

INDUSTRIAL TRUCK

Sheldon K. Towson, Cleveland Heights, and Clyde E. Cochran, Cleveland, Ohio, assignors to The Elwell-Parker Electric Company

Application October 30, 1940, Serial No. 363,520

2 Claims. (Cl. 214—113)

This invention relates to industrial trucks and more particularly to the type of truck which is better known as a tilting hoist truck.

Industrial trucks have heretofore been constructed in which different types of motive power are employed to independently operate the various functions of the truck. For example, electric motive power may be used for driving the truck, elevating the load or tilting the load as the case may be. In some instances either of the latter operations may be accomplished by a hydraulic lift or an arrangement of cables operated from an independently controlled hoisting motor.

Where it is desired however to employ a gas engine as the central motive power for the truck it has heretofore been the practice to convert the automotive power into electrical energy so that the auxiliary hoisting and tilting units could be more easily controlled. It is therefore an object of our present invention to employ a gas engine as the central source of power for an industrial truck and to provide a power transmission by which the hoisting and tilting units may be operated directly from the central source of power.

It is a further object of our invention to provide a novel transmission mechanism by which the operation of the hoisting and tilting mechanisms may be independently controlled.

A further object is to provide a novel automatic braking system to sustain the load when the power transmission is disengaged.

Further objects of our invention will become more apparent from the following description given in connection with the accompanying of which:

Fig. 1 is a side elevation of an industrial truck embodying the novel features of our invention;

Fig. 2 is an enlarged plan view of the forward portion of the truck;

Fig. 3 is a sectional view taken through the power transmission unit substantially along the line 3—3 in Fig. 2;

Fig. 4 is a transverse sectional view taken substantially along the line 4—4 in Fig. 3;

Fig. 5 is an end elevation of the clutch control mechanism for the hoisting unit in Fig. 4;

Fig. 6 is an end elevation of the clutch control mechanism for the tilting unit in Fig. 4;

Fig. 7 is a transverse sectional view taken substantially along the line 7—7 in Fig. 3;

Fig. 8 is a transverse sectional view taken substantially along the line 8—8 in Fig. 3;

Fig. 9 is a sectional view through the brake unit for the tilting mechanism taken substantially along the line 9—9 in Fig. 3;

Fig. 10 is a sectional view through the brake unit for the hoisting mechanism taken substantially along the line 10—10 in Fig. 3;

Fig. 11 is a sectional view taken substantially along the line 11—11 in Fig. 10;

Fig. 12 is a sectional view illustrating a modified form of brake construction for the hoisting mechanism; and

Fig. 13 is a sectional view taken substantially along the line 13—13 in Fig. 12.

Referring now to Fig. 1, we have illustrated a conventional type of industrial truck having a chassis comprising a main frame 1 and an upright auxiliary frame 2 for supporting a power transmission unit. The truck is provided with an automotive engine located generally at 3. Suitable steering mechanism 4 is provided to shift the dirigible wheels of the truck. The power from the engine is transmitted to the wheels of the truck through the usual automotive gear shift transmission 5 to the drive shaft 6. The engagement of the engine with the transmission is controlled by a foot treadle 7 which actuates a clutch mechanism (not shown) through suitable linkage 8. The operation of the foot treadle 7 also controls the braking mechanism for the truck which is connected thereto through suitable brake linkage 9. The arrangement is such that when the treadle 7 is released by the operator, the linkage 8 automatically disengages the clutch and the brakes are applied through the linkage 9.

The forward end of the truck is provided with the usual hoisting arrangement supported by an upright frame 10. The upright frame 10 is pivotally supported on trunnions 11 carried by the main frame 1, so that the hoist assembly may be tilted with respect to its vertical position. The tilting of the hoist is accomplished by a pair of draw bars 12 pivotally connected at 13 to the hoist frame 10. As illustrated in Figs. 1 and 2 the draw bars 12 are provided with a rack 14 which engages a pinion 15 carried on opposite ends of a cross shaft 16 journalled by suitable bearing members in the frame 2. The hoisting arrangement is also provided with a telescopic extension frame 17 and a carriage 18 is slidably mounted within the extension 17. The carriage 18 is preferably provided with suitable prongs or tines 19 for supporting a load.

The carriage 18 and the hoist extension 17 are elevated in the usual manner by a pair of heavy duty sprocket chains 30 which pass over a series of sheaves positioned on the respective members

of the hoist and are attached to the load supporting carriage at 31. Each of the chains 30 are driven from sprocket wheels 32 which are carried on individual hubs 33 rotatably mounted on a cross shaft 34 supported by the frame member 2. Each of the hubs 33 is driven independently by a pair of sprocket chains 35 passing over a sprocket wheel 36 on each of the hubs and extending over a pair of wheels 37, carried by the cross shaft 38. By this arrangement the load carriage 18 may be raised or lowered independently by each set of chains 30 and 35, in the event that failure of one of the chains should occur.

As illustrated in Fig. 3 the hoisting and tilting of the load are accomplished by a dual transmission, the hoist side of which is generally designated as H and the tilt side as T. Each of the transmission units H and T is provided with a reversing clutch mechanism generally designated as H1 and T1 respectively, and a self-acting brake unit designated as H2 and T2 for the hoist and tilt units respectively.

The dual transmission units H and T are directly connected to the source of power by a drive shaft 40, as illustrated in Fig. 4. The shaft 40 is preferably connected directly to the crankshaft of the engine 41 and suitable universal joints 42 and 43 may be interposed intermediately of the shaft to accommodate any misalignment of the same. The opposite end of the shaft 40 projects into a centrally disposed transmission housing 44 and carries a crown gear 45. The gear 45 is in constant meshing engagement with bevel gears 46 and 47 which are keyed for driving engagement to each of a pair of oppositely disposed shafts 48 and 49 respectively. The shaft 48 is suitably journalled by anti-friction bearing members within the clutch housing 50 of the hoist unit H1 and similarly the shaft 49 is journalled within the clutch housing 51 of the clutch unit T1.

The clutch reversing mechanism H1 for the hoist preferably comprises a pair of oppositely disposed bevel gears 60 and 61 rotatably mounted on the shaft 48 within the housing 50. Each of the gears 60 and 61 are provided with a multiple disc clutch 62 and 63 for independently driving either of the gears 60 or 61 from the shaft 48. A shiftable sleeve 64 is driven by the shaft 48 and is slidably mounted thereon for axial movement to engage either of the clutch members 62 or 63. The sleeve 64 is adapted to receive a shiftable yoke 65 which is carried by a crank arm 66, secured to a rotatable shaft 67 journalled in the housing 50. Thus, by rotating the shaft 67 the sleeve 64 may be brought into engagement with either of the clutch members 62 or 63 to thereby independently drive either of the reversing gears 60 or 61 from the shaft 48.

The position of the sleeve 64 with respect to either of the clutch members 62 or 63 is controlled by a star wheel 70 positioned on the shaft 67. In the position illustrated in Fig. 5 the wheel 70 is held in an intermediate neutral position by a star wheel follower 71, pivotally mounted on the housing 50. The follower 71 is preferably provided with a roller 72 for engaging a detent 73 in the wheel 70 where it is yieldably held in engagement by the provision of a spring 74.

The clutch mechanism H1 is actuated by a pair of radially extending arms 75 and 76 carried by the star wheel 70. The arm 75 is connected by suitable fastening means to a flexible cable 80 connected to a control lever 81 in the vicinity of the driver's compartment of the truck. Thus, it may be seen that when the lever 81 is pushed forwardly to the position indicated as D in Fig. 1, the wheel 70 is rotated to bring the sleeve 64 into engagement with the clutch 63 as illustrated in Fig. 4 and thereby cause the hoist to move in a downward direction, as will be hereinafter more fully described. In a similar manner as the lever 81 is pulled back to the position indicated at U in Fig. 1, the wheel 70 is rotated in the opposite direction to engage the clutch 62 and thereby raise the hoist. As the hoist extension 17 reaches the top of its travel it engages a stop lug 82 positioned on a limit rod 83 carried by the frame 10. The limit rod 83 is connected by a bell crank lever 84 to a flexible cable 85 the other extremity of which is attached by suitable fastening means to the arm 76 of the wheel 70. Thus, it may be seen that when the hoist extension 17 reaches its upper limit of elevation it trips the limit rod 83 which in turn actuates the wheel 70 to return the clutch sleeve 64 to its normal neutral position. In so doing the control lever 81 is automatically returned to the neutral position indicated by N in Fig. 1.

The clutch mechanism T1 for tilting the hoist frame 10, is operated in a similar manner. The shaft 49 is provided with a pair of oppositely disposed bevel gears 90 and 91 each of which is similarly provided with a multiple plate clutch 92 and 93 respectively. The shaft 49 similarly carries a shiftable sleve 94 which is actuated by a yoke 95 connected through a crank arm 96 and a shaft 97 to a star wheel 98. A follower 99 and a roller 100 is similarly provided to engage a recess 101 on the wheel 98 and thereby establish a neutral position for the clutch sleeve 94. The wheel 98 is provided with an arm 102 which in turn is connected by the link 103 to the central arm 104 of a bell crank lever pivotally mounted on the housing 51. As illustrated in Figs. 1 and 6 the bell crank lever is provided with a pair of radially extending arms 105 and 106. The arm 105 is provided with a suitable swivel connection 107 for sl dable movement on the limit rod 108 which is pivotally connected at 109 to the frame 10. A pair of stop lugs 110 are positioned on the rod 108 to engage the arm 105 from either direction. Thus it may be seen that when the frame 10 is tilted either inwardly or outwardly the stop blocks 110 serve to engage the arm 105 and thereby return the wheel 98 to its neutral position.

The clutch mechanism T1 for tilting the hoist is controlled in a similar manner. The arm 106 is connected by a flexible cable 111 to a tilt control lever 112 positioned adjacent the operator's compartment. In the forward position of the lever 112, as indicated by position I in Fig. 1, the clutch mechanism T1 is actuated to move the frame 10 inwardly whereas in the position indicated by O, the clutch mechanism is shifted to tilt the hoist outwardly. In a similar manner, when the hoist frame 10 is tilted inwardly or outwardly to its extremity, the limit rod 108 actuates the wheel 98 to return the clutch to its normal position. In so doing the arm 106 acting through the cable 111 returns the operating lever 112 to its normal position as indicated by the position N1 in Fig. 1. Thus, it may be seen that either either the raising of the load or the tilting of the hoist frame may be accomplished from the operator's position by the control levers 81 and 112 respectively and that the extreme position of either of these movements is automatically controlled by the limit rods 83 and 108, to thereby insure safe manipulation of the load.

To transmit power from the clutch shaft 48 to the drive shaft 38 for the hoist, a crown gear 120 is provided for meshing engagement with the reversing bevel gear 60 and 61. The gear 120 is preferably carried by a vertically disposed shaft 121 suitably journaled by bearing members in the housing 122 of the transmission unit H. As better illustrated in more detail in Fig. 8, the shaft 121 is preferably provided with a worm thread 123 adapted for engagement with a worm wheel 124 carried by the shaft 38. Thus as the clutch sleeve 64 engages either of the bevel gears 60 or 61 for rotation, the shaft 38 may be driven in either direction and thereby raise or lower the load carriage 18.

In a similar manner the tilting transmission unit T is provided with a vertically disposed shaft 125 suitably journaled in the housing 126 and having a crown gear 127 in meshing engagement with the reversing bevel gears 90 and 91. The shaft 125 is similarly provided with a worm thread 128 for driving engagement with a worm wheel 129 carried by the cross shaft 130. As illustrated in Fig. 7, the drive shaft 130 is provided with a sprocket wheel 131 for driving engagement with a sprocket chain 132 passing over a similar wheel 133 carried by the shaft 16. Thus upon actuating the clutch unit T1 for rotation in either direction the rotation of the shaft 16 will tilt the upright frame 10 of the hoist in either direction with respect to its vertical position.

In the usual operation of the truck a load is picked up by the tines 19 after which the carriage 18 is elevated and the frame 10 is tilted inwardly to stabilize the load before the truck is permitted to advance in a forward direction. In so doing the operator returns the control levers 81 and 112 to their neutral position which in turn disengages the driving connection between the clutch shafts 48 and 49 and the hoist and tilt units H and T respectively. Hence the load would be permitted to drop by slowly reversing the direction of the worms 123 and 128. To avoid this difficulty an automatic self-acting brake unit H2 is provided on the transmission H to become effective when the load is lowered and to be self-releasing when the load is raised. Similarly the transmission unit T is provided with an automatic self-acting brake unit T2 which engages when the load is tilted outwardly and is released during the reverse tilting action of the hoist.

The braking unit H2 for the hoist is preferably of the oil immersion type and comprises a casing 140, which is suitably provided with cooling jackets 141 through which the water from the cooling system for the gas engine may be circulated. The shaft 121 is provided with an extending portion having a brake disc 142 rotatably mounted thereon. The disc 142 is provided with suitable friction material 143 for engaging a flat braking surface formed in the housing 140. A spider 144 is carried by the shaft 121 for the purpose of engaging or disengaging the brake disc 142 and apply the brake when the load carriage 18 is moving in a downward direction.

As illustrated in more detail in Figs. 10 and 11 the brake disc 142 is preferably provided with a series of inclined camming surfaces 145 spaced radially of the shaft 121. The adjacent face of the spider 144 is provided with a series of oppositely disposed inclined camming surfaces 146 which are positioned in opposing relationship to the surfaces 145. Thus when the load carriage 18 is lowered and the shaft 121 is rotating in a counter-clockwise direction the cam surfaces 146 will climb upon the respective surfaces 145 to thereby force the brake clutch disc 142 away from the spider 144 and thus apply the braking material 143 to the braking surface of the housing 140. The spider 144 is provided with a pair of radially projecting dogs 147 for engaging a pair of similarly disposed lugs 148, positioned on the disc 142. As illustrated by broken lines in Fig. 10, the rotation of the spider 144 causes the dogs 147 to engage the lugs 148 and drive the disc against the braking surface on the housing. In this manner the brake is automatically applied whenever the hoist clutch H1 is released or the load is traveling in a downward direction. As previously described any heat that may be generated by the brake from this reaction is transmitted to the cooling system of the engine through the water jackets 141 provided in the housing 140.

When the load carriage 18 is raised upwardly, the direction of the shaft 121 is reversed and the inclined surfaces 46 of the spider will thereafter slide down upon the inclined surfaces 145 of the brake disc and thus relieve the axial thrust of the brake material upon the housing.

In Figs. 12 and 13 we have shown a modified form of brake construction for the hoist which may be embodied in a housing 150, similar to that described with reference to Fig. 3. A brake disc 151 is rotatably mounted upon the shaft 121 and is provided with suitable brake friction material 152. The disc 151 is preferably provided with a hollow brake drum 153 which rotatably embraces a hub 154 carried by the shaft 121. To engage the brake drum 153 the hub 154 is provided at its circumference with a series of inclined recesses 155 extending axially of the hub. These recesses are provided with a series of rollers 156 yieldably held in contact with the drum by means of recessed spring members 157. Thus when the shaft 121 is rotated in a direction to lower the carriage 18, the rollers 156 become wedged between the surfaces 155 and the drum 153 and thereby rotate the brake disc 151 to provide a self-acting brake to the downward movement of the load. On the other hand when the shaft 121 is rotated in the opposite direction the rollers 156 are free from engagement with the brake drum 153 and hence release rotation of the brake disc 151.

As illustrated in Fig. 9 the brake unit T2 for restraining the outward tilting movement of the hoist comprises a brake drum 160 carried by the shaft 125. The brake mechanism preferably comprises a flexible band 161 having suitable friction material 162 secured to its inner surface adjacent the drum. The band 161 is secured at one end to a stationary pivotal point 163, carried by the casing. The other end of the band is yieldably secured by an adjustable spring member 164 to a recessed portion of the casing. Hence it may be seen that when the drum 160 is rotated to tilt the hoist outwardly, the band 162 will wrap upon the drum 160 and apply a braking action to the shaft 125. Similarly when the rotation of the drum 160 is reversed, the yieldable action of the spring 164 will tend to unwrap the band 162 from the drum and thereby release the braking action.

It may therefore be seen that we have invented a new and novel transmission for an industrial truck which may be operated from a central source of power such as an automotive engine to either independently drive the truck, hoist or tilt

the load. It is further apparent that each of the foregoing operating units are provided with automatic self-acting brakes so that the loads may be maintained in any position and the truck abandoned by the operator without danger.

We claim:

1. A power transmission for an industrial truck comprising a power drive shaft, a pair of driven auxiliary shafts and a clutch reversing mechanism for disconnecting or reversing the direction of rotation of each of the auxiliary shafts, a power take-off for one of the auxiliary shafts including mechanism adapted to raise or lower a hoist and a power take-off for the other shaft including mechanism for tilting the hoist in either direction from its vertical position and one way self-acting braking means carried by each of the auxiliary shafts which become active to resist the turning of the respective shafts when the latter are rotated in a direction to lower the hoist or to move the same outwardly from the truck respectively.

2. In an industrial truck having mechanism for tilting and elevating a load lifting hoist, a power transmission comprising a housing, a central drive shaft and a pair of oppositely disposed auxiliary drive shafts operatively connected to the central shaft, a pair of oppositely disposed reversing gears carried by each of the auxiliary shafts and a clutch associated with each of said gears, a shiftable clutch member for actuating either of the reversing gears, a speed reduction mechanism adapted to be driven by either of the reversing gears on one of the auxiliary shafts and a second reduction unit similarly connected to the other auxiliary shaft, a power take-off for each of the speed reduction units, means for connecting one of said units to the elevating mechanism and the other unit to mechanism for tilting the hoist, control means for actuating the respective clutch members to thereby elevate or tilt the load and one way self-acting braking means carried by each of the auxiliary shafts which become active to resist the turning of the respective shafts when the latter are rotated in a direction to lower the hoist or to move the same outwardly from the truck respectively.

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