R. JANNEY.

DRIVING MECHANISM.

APPLICATION FILED FEB. 3, 1917.

1,307,819.

Patented June 24, 1919.

4 SHEETS—SHEET 1.

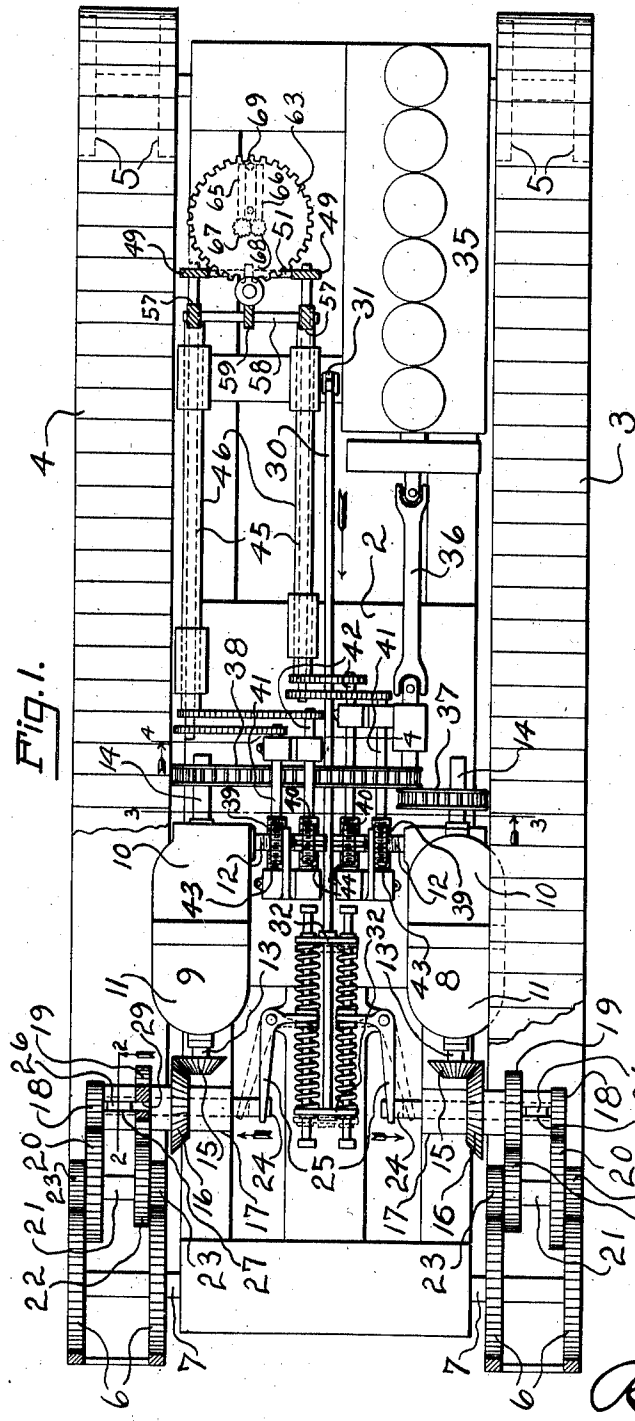


Fig. 1.

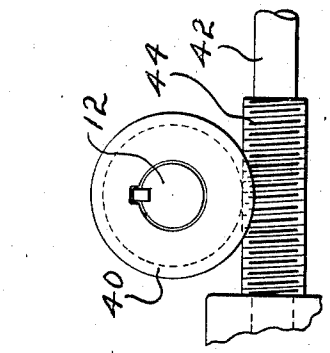


Fig. 5.

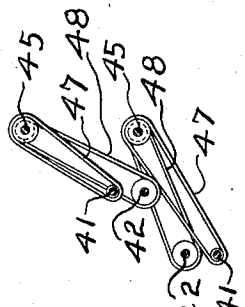


Fig. 4.

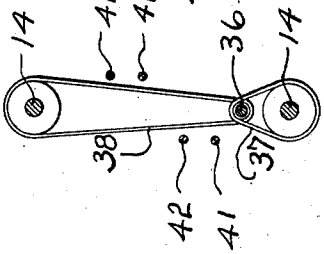


Fig. 3.

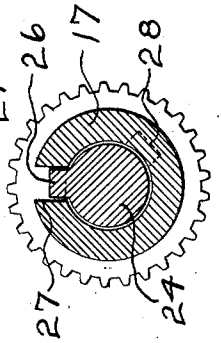


Fig. 2.

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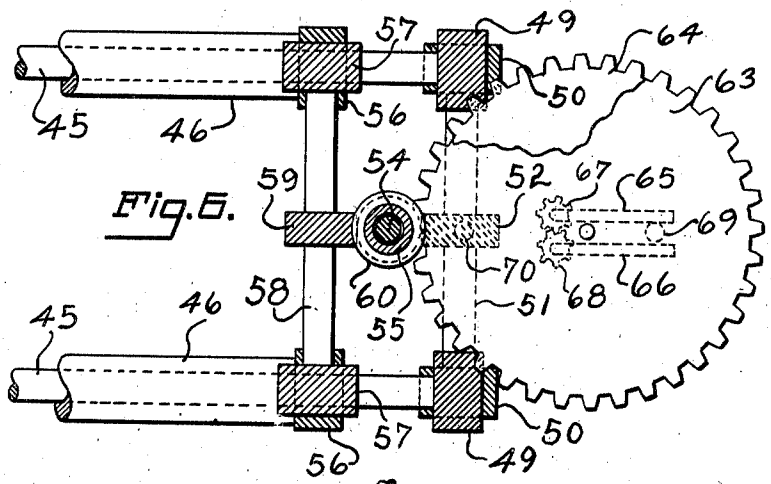


Fig. 6.

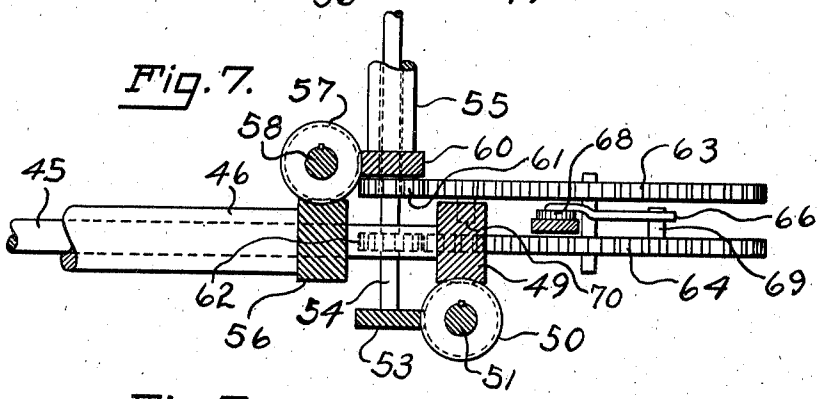


Fig. 7.

Fig. 8.

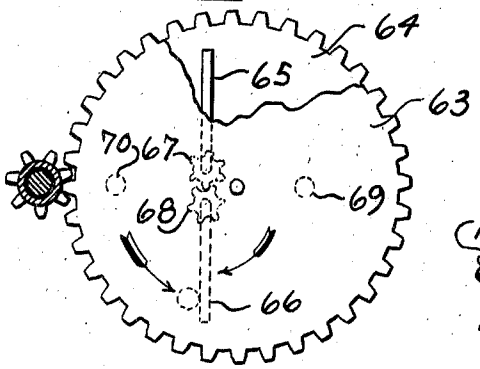
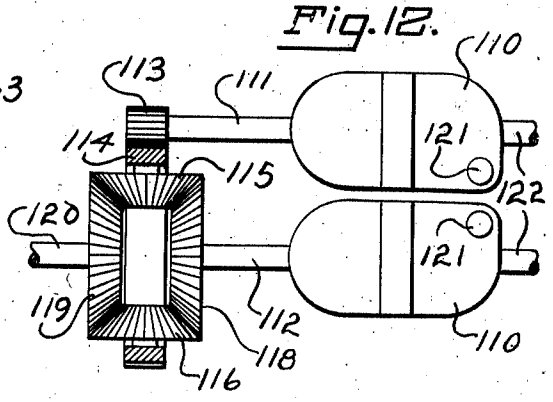


Fig. 12.



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4 SHEETS—SHEET 3.

Fig. 10.

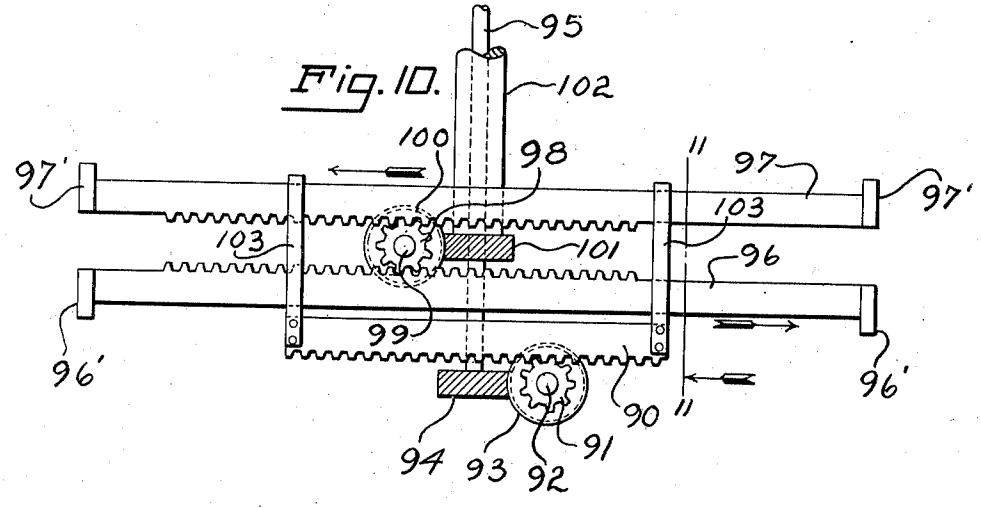


Fig. 9.

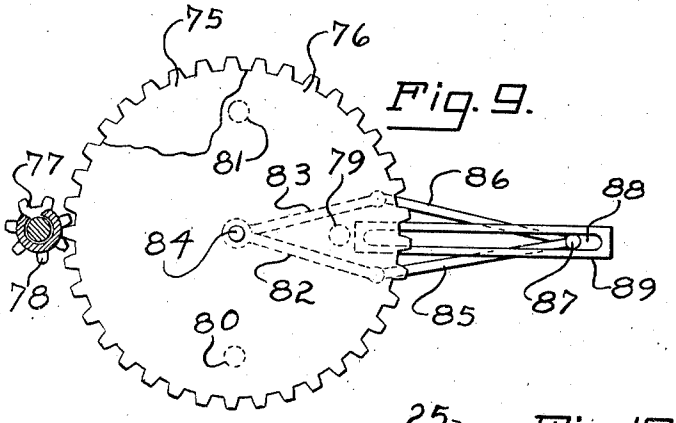


Fig. 11.

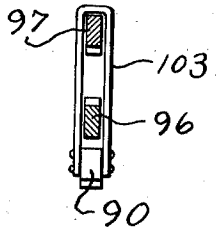
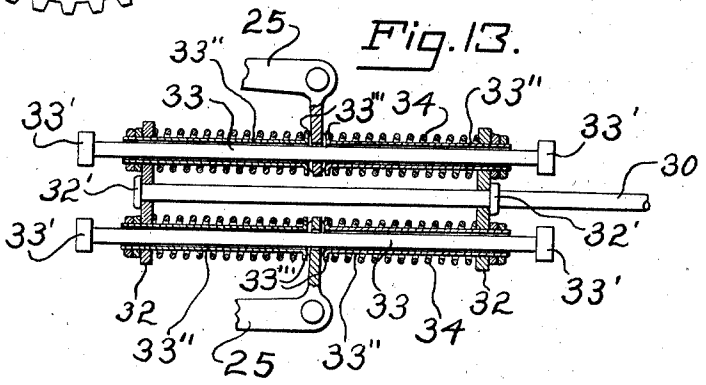


Fig. 13.



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4 SHEETS—SHEET 4.

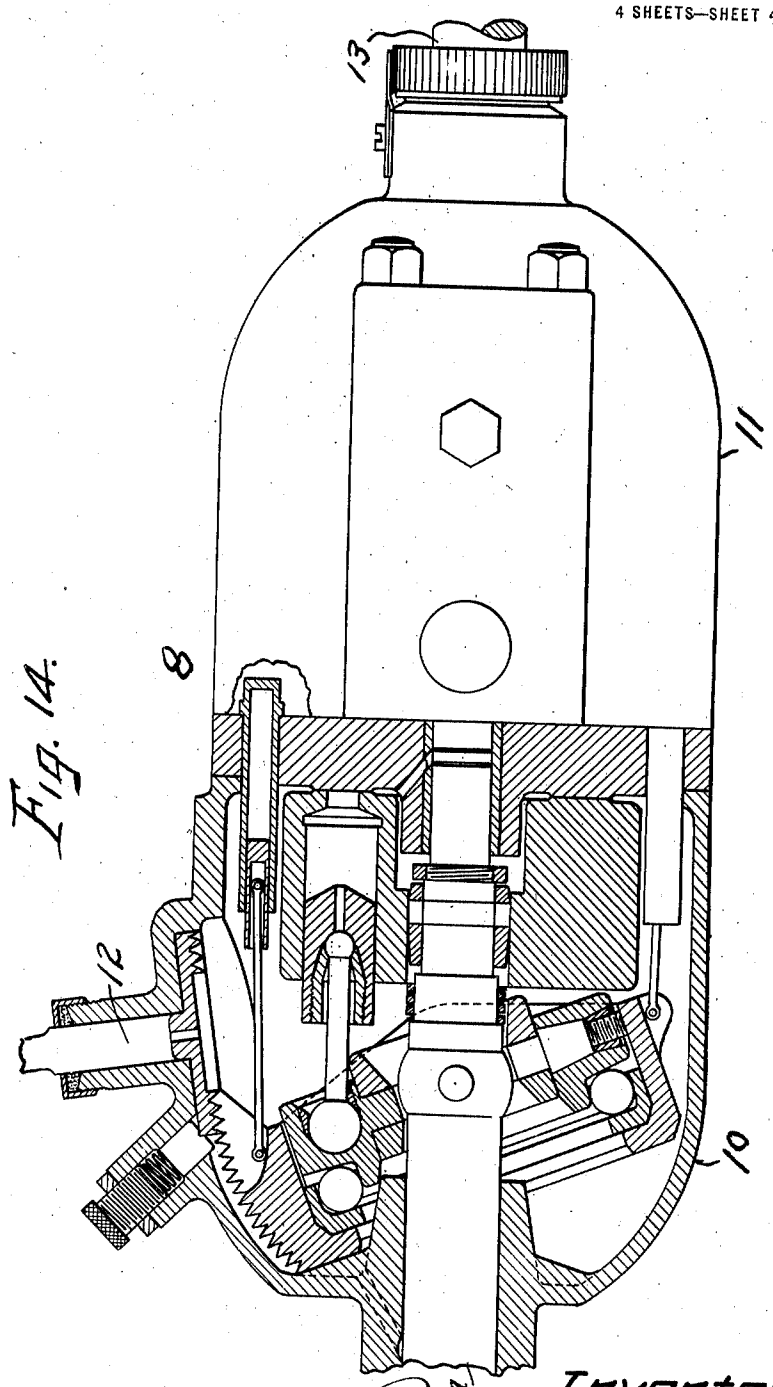


Fig. 14.

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UNITED STATES PATENT OFFICE.

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DRIVING MECHANISM.

1,307,819. Specification of Letters Patent. Patented June 24, 1919.

Application filed February 3, 1917. Serial No. 146,503.

To all whom it may concern:

Be it known that I, REYNOLD JANNEY, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Driving Mechanism, of which the following is a specification.

This invention relates to driving mechanism. Driving mechanism involving the invention can be incorporated in apparatus or appliances of widely different character.

In the drawings accompanying and forming part of the present specification I have shown in detail one of the several convenient forms of embodiment of the invention which I will set forth fully in the following description. In no sense do I restrict myself to this disclosure; I may depart therefrom in several respects within the scope of the invention defined by the claims following said description. In this particular form of embodiment of the invention it is shown incorporated in what is known as a "caterpillar traction vehicle". One of the primary purposes of the invention is the provision of means capable of effective control, by which two drivers or "propellers" as they may also be considered, can be driven either forwardly or backwardly together or independently and at varying speeds. I have mentioned a caterpillar traction vehicle as one of the many appliances in which the driving mechanism can be embodied. As will be evident from what I have already noted, it can be used in many other different connections; for instance it can be utilized as the propelling means of a vessel or of a wheeled vehicle, these being merely two of many other illustrations.

Referring to said drawings:

Figure 1 is a top plan view partly in section of a vehicle provided with driving mechanism involving the invention.

Fig. 2 is a vertical section on the line 2—2 of Fig. 1, looking in the direction of the arrow.

Figs. 3 and 4 are vertical sections on the lines 3—3 and 4—4 respectively of Fig. 1, looking in the direction of the arrows applied thereto.

Fig. 5 is a detail view of worm gearing hereinafter more particularly described.

Fig. 6 is a sectional top plan view, and

Fig. 7 a vertical sectional side elevation of controlling mechanism.

Fig. 8 is a sectional plan view of certain of the parts shown in Fig. 6.

Fig. 9 is a plan view somewhat similar to Fig. 8 but showing a modified arrangement.

Fig. 10 is a like view of a further form of controlling mechanism.

Fig. 11 is a transverse section on the line 11—11 of Fig. 10, looking in the direction of the arrow.

Fig. 12 is a top plan view of a modified form of driving mechanism.

Fig. 13 is a horizontal sectional plan view of the double spring controlling mechanism shown in Fig. 1.

Fig. 14 is a sectional elevation of a hydraulic variable speed gear.

Like characters refer to like parts throughout the several figures.

In Fig. 1 I have shown driving mechanism comprehending the invention, as mounted upon and forming part of a caterpillar traction vehicle which may be equipped as is usual with running gear or other suitable framework of which the deck or platform 2 constitutes a part. This framework including the deck, constitutes suitable supporting means for the various parts of the driving mechanism and certain coacting elements. At opposite sides of the vehicle are endless chains as 3 and 4 of sprocket type. The front ends of these chains pass around sprocket wheels as 5, the shafts of which are supported by the framing of the machine. At the rear the chains pass around sprocket wheels as 6 which as shown are disposed in pairs, the shafts 7 having the rear sprocket wheels 6, rigidly connected therewith and being like the shafts of the front sprocket wheels 5 suitably supported for rotation by the framing of the machine. These chains 3 and 4 constitute suitable drivers for the vehicle, their under runs being adapted to engage the ground so as to drive or propel the vehicle. This as a matter of fact is a brief description of some of the principal parts of a caterpillar-tractor. In the present case the chains 3 and 4 can be driven simultaneously in the same direction to effect either forward or backward movement; they are capable of being operated at different speeds not only while traveling in the same direction but while moving in different di-

rections. It will be clear, therefore, that the driving members or propellers of which the parts 3 and 4 are merely illustrations do not act in an equalizing manner but independently so far as speed is concerned. The speeds of these two drivers or propellers as well as the direction of movement thereof are controlled relatively by interacting controlling devices as will hereinafter more particularly appear.

In conjunction with the drivers or propellers are transmission devices, there being one transmission device coöperative directly with each driver. These transmission devices may be of any suitable nature, those denoted by 8 and 9 and supported by the framework of the machine between the parallel drivers or chains 3 and 4 answering satisfactorily in this connection. The transmission devices whether of the kind shown preferably should be of such nature as to obtain through proper instrumentalities the necessary speed changes of the two drivers or chains and also the necessary changes in direction of movement. These transmission devices 8 and 9 are as shown of hydraulic type and are known as hydraulic variable speed gears. They have been the subject of descriptions and discussions in many scientific and engineering papers, not only in the United States but in many other countries and are fully described in a text book on gunnery used in the regular course of instruction in the United States, and I might add have been known to the world commercially for over ten years past. As a matter of fact I have obtained Patent No. 924,787 on June 15, 1909, which illustrates such a transmission device. They are alike in construction, so that a concise description of one will apply to the other. Said transmission device or hydraulic variable speed gear includes an A-end or hydraulic variable stroke pump 10 and a B-end or hydraulic motor 11. As part of the A-end is a tilting box to which is connected a control shaft 12. When this controlling member or shaft 12 and the tilting box are in the neutral position, the pistons in the pump or A-end will deliver no fluid. By moving the tilting box in either direction through the agency of the control member operatively connected therewith, the pistons will commence to reciprocate, their stroke increasing in proportion to the movement of the tilting box from the neutral. If the tilting box be moved in one direction from the neutral, the pistons of the motor or B-end will be driven in one direction, whereas on movement of the tilting box in the opposite direction, the pistons of the motor will be driven in the opposite direction, the greater the angle of the tilting box, the greater the movement of the two sets of pistons and hence the greater amount of speed of the shaft 13 extending from the B-end, which shaft may be considered the outgoing shaft or driven member of the transmission device. The incoming shaft of the transmission device is designated by 14, and it may be considered also as the driving shaft of the said transmission device.

It will, therefore, be clear that the outgoing shafts can be driven in opposite directions at various speeds from practically zero up to the range of the device. The outgoing shafts 13 of the respective transmission devices are connected operatively to the drivers 3 and 4 for actuating the same either forwardly or backwardly and at different speeds or the same speed in the opposite or the same direction. The effect of the transmission devices 8 and 9 can be transferred to the drivers 3 and 4 by any suitable mechanism, although that shown and now to be described answers satisfactorily in this connection. The outgoing shafts 13 are shown as furnished with bevel gears 15 in mesh with bevel gears 16 on the independently supported yet co-axial transversely disposed shafts 17. The shafts 17 loosely carry near their outer ends spur gears as 18 and also carry loosely between these spur gears and the bevel gears 16 the spur gears 19. The spur gears 18 mesh respectively with spur gears 20 rigid with the shafts 21 which also have rigid with them spur gears 22 in mesh with the spur gears 19. It will be noted that the spur gears 18 are smaller in diameter than the spur gears 19 and the reason for this will hereinafter appear. Rigid with the shaft 21 are pinions 23 in mesh respectively with the sprocket wheels 6. By clutching the spur gears 18 and 19, assumed to be in motion, in alternation to the shafts 17 I can, as will be clear, effect changes in speed of the drivers 3 and 4 independently of the transmitting devices 8 and 9, which as will be understood is merely one way of accomplishing this result. I will describe clutch means suitable for the purpose. The shafts 17 as shown are hollow and support within them for sliding movement the clutch rods 24 connected at their inner ends to the long arms of the angle levers 25 supported pivotally at their elbows upon the framework of the machine. The rods 24 are provided with keys 26 which extend through longitudinal slots 27 in the respective hollow shafts 17 and are adapted to coöperate with keyways as 28 and 29 in the spur gears 18 and 19. It will be understood that when the keys of the clutch members 24 are in their middle positions they are spaced at their ends from the keyways or slots 28 and 29 in the adjacent spur gears 18 and 19.

The means for operating the clutch members to which allusion has been made involves the longitudinally extending rod 30 connected at its forward end to the lever 31 within convenient reach of the operator

of the machine. This rod at its rear end extends through the longitudinally separated crossheads 32 and has stops 32′ bearing against the outer faces of said crossheads. Through said crossheads freely extend the floating rods 33 disposed in parallelism with each other longitudinally of the machine and provided at their ends with stop collars 33′. Each floating rod 33 carries a pair of sleeves 3″, the sleeves being surrounded by springs 34 abutting at their outer ends against the crossheads 32 and at their inner ends against the collars 33‴ of said sleeves 33″. The inner ends of the two pairs of sleeves 33″ are spaced or separated to receive between their collars 33‴ the inner or short arms of the angle levers 25. The four springs 34 are assembled under independent compression, and owing to this fact they act in effect as rigid bodies for moving the clutch members or rods 24, unless the keys 26 should not happen to register with the corresponding key slots or ways 28 and 29 in the pinions 18 and 19 respectively. Should this be the case the springs permit throwing the lever 31 forward or backward to its extreme position by the further compression of the necessary spring or springs 34 and under the further compressed spring the key or keys will slip into the proper slot or keyway when they are brought against each other by the rotation of the gear or gears 18 and 19. This provision relieves the operator from giving any consideration to the clutch mechanism after he has thrown the lever 31 to obtain the necessary speed change.

It is, of course, necessary to operate the transmission devices 8 and 9 by suitable power, and this is accomplished in the present case through the rotation of what I have called the incoming shafts of said transmission devices. The driving of these shafts may be accomplished in any desirable way either by a constant or variable speed motor, the former being preferred. In the construction shown the hydrocarbon engine 35 mounted on the deck near the front is provided for this purpose, the shaft 36 of said motor or engine being operatively connected by suitable means, one form of which will be hereinafter described, to the respective incoming shafts 14 of said two transmission devices. Said shaft 36 as represented, is shown connected at its rear end with sprocket gearings denoted in a general way respectively by 37 and 38 with the incoming shafts 14 of said transmission devices 8 and 9. Therefore, so long as the motor or engine 35 is in action, said incoming shafts 14 will be driven. The speed and direction changes of the two drivers 3 and 4, however, are accomplished irrespective of any changes in speed of the motor.

When the control shafts 12 of the transmission devices 8 and 9 are in position to maintain the tilting boxes of said transmission devices in the neutral positions thereof, the outgoing shafts 13 will not turn even though the motor or engine 35 be in action and act to drive through the intermediate connections the incoming shafts 14 of said transmission devices. To effect the operation of the outgoing shafts 13 it will be necessary to move the tilting boxes from the neutral positions thereof. If a tilting box is moved in a predetermined direction the outgoing shaft 13 associated therewith will be rotated, the speed being progressively increased as the tilting box moves from the neutral and being in correspondence with the amount of movement of the tilting box from the neutral. The opposite function takes place when the tilting box is moved in the opposite direction and the action of the tilting boxes, as I have already observed, is effected through the control members or shafts 12 connected respectively in an operative manner with said tilting boxes. In the present case variations in speed therefore, of the outgoing shafts and changes in direction of movement thereof are secured by the inward or outward movement of said control members or shafts 12, and I will now describe a means by which these respective in and out movements can be secured. In connection with each control shaft is a pair of worm wheels 39 and 40 both immovable laterally. The two outer worm wheels 39 as shown are interiorly threaded to register with corresponding threads on the respective control shafts 12. The two inner worm wheels, however, have sliding key connections with their respective control shafts. It will, therefore, be clear that turning the worm wheel 39 will cause the respective control shafts to move in and out in accordance with the direction of the thread and the direction of rotation of said worm wheels. By turning the worm wheels 40, the control shafts will also be fed in and out, by reason of their threaded connection with the worm wheels 39 which act in this case as feed nuts. Clearly it will be evident that the effects of the worm wheels on the respective control shafts are similar but are produced in different ways. The worm wheels 39 do not rotate the respective control shafts 12 but push them in and out by reason of the threaded connection therewith, while the worm wheels 30 rotate the shafts and thus move the same in or out by reason of their threaded connection with the respective worm wheels 39. If, therefore, an outer worm wheel 39 has been turned so as to move its coöperating control shaft in, the companion wheels 40 may be turned without interfering with the position of the said worm wheel 39 to move the shaft out again. It

is evident, therefore, that the wheels 39 and 40 of the respective pairs may be so turned as to counteract or neutralize each other or on the other hand they may be moved together to double the movement of the respective control shafts, and means whereby these actions can be obtained will be hereinafter described. At each side of the clutch-operating element or rod 30 are two pairs of shafts 41 and 42, the outer shafts being designated by 41 and the inner by 42. These shafts like the other moving parts are carried by suitable bearings and as shown extend longitudinally of the machine. The outer shafts 41 are provided at their rear ends with worms 43 rigid therewith and in mesh with the worm wheels 39 respectively. The inner shafts are equipped with similar worms 44 also rigid therewith and in mesh with the two inner worm gears or wheels 40. Extending longitudinally of the machine and practically in parallelism therewith are the two shafts 45 inclosed respectively by the hollow shafts 46. Each inclosed shaft 45 and tubular shaft 46 constitutes what I consider a double shaft, the ends of the inclosed shafts extending from the opposite ends of the tubular shafts. The rear projecting ends of the inclosed shafts are connected as by sprocket gearing denoted in a general way by 47 with the outer shafts 41, while the rear portions of the hollow or tubular shafts 46 are connected by sprocket gearing denoted in a general way by 48 with the inner shafts 42. Either of the pairs of shafts 45 and 46 when operated can, therefore, effect through the agency of the intermediate parts, the action of a transmission device to either stop or start or reverse or vary the movement of the outgoing shaft 13 thereof. The reason for the doubling of the shafts in the manner set forth is to reduce the number of parts which extend forward from the transmission devices to the controlling position of the operator. At the forward ends of the inclosed or inner shafts 45 are spiral gears 49 in mesh with spiral gears as 50 shown as being located near the ends of and rigid with the transverse shaft 51. Said transverse shaft as shown is provided between its ends with a spiral gear 52 in mesh with the spiral gear 53 rigid with the upright shaft 54 which in the present case is upright and which acts as a suitable speed control member as will hereinafter appear, being provided in practice with a wheel or other suitable means by which it can be easily operated. This shaft 54 extends through and beyond the ends of the tubular shaft 55 which in the organization illustrated comprises a steering control member and like the inner shaft is provided with a wheel or equivalent to facilitate its manipulation. The inner or speed control shaft 54, it will be noted, extends below the steering control shaft 55 and it is to the lower end that the spiral gear 53 to which I have already referred is connected.

To the forward ends of the tubular shafts 46 are rigidly connected respectively spiral gears 56 in mesh with spiral gears 57 respectively carried by the transverse shaft 58 practically a counterpart of the shaft 51. To the intermediate portion of the shaft 58 is rigidly connected a spiral gear 59 in mesh with a like gear 60 rotative with the outer or steering control member or shaft 55 at or near the lower end thereof. The two shafts 54 and 55 as shown are vertically disposed, although this is not an essential matter and they present collectively a suitable column, the elements or sections of which can be independently manipulated to effect the necessary speed changes or steering of the vehicle or equivalent apparatus, of which a ship, as I have already mentioned, is an example. The connections from the speed controlling shaft 54 are such that if said shaft be turned to the right or the left, the worm wheels or gears 39 through the intermediate described parts are rotated to effect movement simultaneously of the control shafts 12 inwardly or outwardly in accordance with the direction in which said shaft 54 is turned to increase or decrease alike the speeds of the outgoing shafts 13 of the two transmission devices 8 and 9. The consequence of turning the member 54 is to increase or decrease the speed of the vehicle or it might be anything of an equivalent nature by increasing alike the speeds of the caterpillar chains 3 and 4 on both sides of the vehicle. The described connections, with the tubular or steering control member 55 to the control shafts 12, however, are such that on the movement of said part 55 in a predetermined direction, the control shafts 12 will be oppositely rotated so as to produce exactly opposite effects on the outgoing shafts 13. Therefore, through the action of the part 55 one of the drivers (the chains 3 and 4 as shown) will be caused to increase in speed while at the same time the other is correspondingly decreased in speed or one may be caused to move in one direction and the other in the opposite direction. The consequence of this will be the turning of the vehicle or analogous apparatus to the right or left in accordance as one of the drivers goes faster than the other or in an opposite direction thereto.

It will be understood by considering the peculiar construction and mode of operation of the control shafts 12 and their connection with the worm wheels 39 and 40 that the rotations of the shafts 54 and 55 do not necessarily interfere with each other; for instance the vehicle or other traveling or

movable body may be moving forward at a moderate speed and at the same time may be turned to the right or left without materially changing its speed as a whole. There is, however, a condition possible under which there would be an interference as if the vehicle or its equivalent be moving forward at full speed at which time both control shafts 12 are thrust into their cases to the full depth. In this event, it will not be possible to turn the steering member 54, because it is not possible when the condition pointed out is present, to move either of the shafts 12 any farther inward and since the rotation of the shaft 54 always forces one control shaft in while it forces the other out, through the described connections, it will be impossible to rotate the shaft 55 unless the speed of the vehicle as a whole be first reduced by retracting or bringing out the two control shafts 12, at least sufficiently to permit the movement of one of them in while the other is being turned out by the rotation of the shaft 55. It is, therefore, necessary to provide means of some suitable character to meet this possible extreme condition, so that whether the vehicle or other movable body be going full speed ahead or full speed back, there will be no interference with changing the general direction of the vehicle 45. As I say this condition can be brought out in any suitable way, and I show three of the means by which it can be accomplished. On the lower end of the hollow shaft 55 is shown a pinion 61 rigid therewith, the inner shaft 44 having a rigid pinion 62. These two pinions mesh with spur gears as 63 and 64 respectively. The gears 63 and 64 are made relatively large with respect to the pinions 61 and 62, so that the gears 63 and 64 respectively will never make quite a half turn even when the members 43 and 44 are turned to either of their extreme positions. Between the gears 63 and 64 are mounted arms 65 and 66 respectively which are geared together by pinions 67 and 68 respectively, so that if one of the arms be moved in one direction, the other is forced to move in the opposite direction, by reason of the geared connection between the arms. It will be noted that the supports for the pinions 67 and 68 are independent of the gears 63 and 64. On the wheel 64 is a pin or stud 69, while the wheel 63 is provided with a practically similar pin or stud 70 extending downward far enough to come in contact with the arms 65 and 66 when swung around to meet it.

It will be seen that if the shaft 54 is turned the wheel 64 will be turned and thus cause the arms 65 and 66 to be spread apart and moved toward the pin 70 on the gear 63. When these arms have been forced to their extreme, they come in contact with the pin 70 on each side of said pin. If under this condition the shaft 55 is turned the gear 63 will be turned carrying with it the pin 70 and forcing one or the other and thereby both of the arms 65 and 66 back toward their original positions; but if these arms are forced back, one or the other of them will by reason of its engagement with the pin 69 cause the gear 64 to be moved back correspondingly and this gear will cause through the pinion 62 the shaft 54 to be rotated back toward its original positions. Consequently as the shaft 54 is the speed control member, rotating it backward will cause a general reduction of the speed of the vehicle which is secured by moving the control shafts 12 in or out as the case may require. This will permit of the rotation of the shaft 55 and through the intermediate parts already described the steering of the vehicle or other movable body. It is, therefore, clear that if the rotation of one of the shafts 54 and 55 has been carried to the extreme in either direction, the other member will be permitted to rotate in either direction by forcing the previously rotated member back by reason of the operative connection therebetween.

In Fig 9 I show a further arrangement for securing the condition noted. In this construction are superposed gears or support wheels 75 and 76 in mesh with pinions 77 and 78 respectively. The lower gear 75 is provided with the pin 79 while the upper gear is provided with diametrically opposite pins 80 and 81. The pin 79 is disposed between the members 82 and 83 respectively loosely connected with the pivot 84 and pivoted to companion links as 85 and 86 respectively, the companion links being jointed together as at 87 guided in the channel 88 of the part of the bar or equivalent member 89.

In Figs. 10 and 11 I show a further modification of this organization, wherein a rack 90 is driven forward or backward by the pinion 91 on the cross shaft 92, said cross shaft having a worm 93 driven by the worm gear 94 on the upright shaft 95. Shown as located above the rack 90 are racks 96 and 97, the teeth of which face inwardly and mesh with the pinion 98 on the shaft 99, the worm gear 100 of which meshes with the worm 101 of the outside shaft 102, through which the shaft 95 extends. Fixed to the rack bar 90 are loops 103 through which the rack bars 96 and 97 extend, said racks terminating in limit stops 96′ and 97′ respectively. The counteracting or counter-driving effect of this combination of elements is exactly the same in practice as the organization shown and described in detail in connection with Figs. 6, 7 and 8.

In Fig. 12 I have shown two transmission devices 110 counterparts of the transmission devices already described. These

transmission devices are provided with the outgoing shafts 111 and 112 respectively. The outgoing shaft 111 has fixed to it a pinion 113 meshing with the gear 114 provided on its inner side with the bevel gears 115 and 116 respectively at diametrically opposite points. The outgoing shaft 112 is provided with the bevel pinion 118 in mesh with the diametrically opposite bevel gears 115 and 116. In mesh in turn with the diametrically opposite bevel gears 115 and 116 is the bevel gear 119 coaxial as shown with the gear 118. Fixed to the bevel gear 119 is the shaft 120 coaxial as shown with the shaft 112 and which is adapted to be driven forward or backward at varying speeds by controlling the speeds of the control shafts 121. The variable speed gears 110 are equipped with the incoming shafts 122.

What I claim is:

1. The combination of a plurality of hydraulic motors, a variable-stroke multiple-cylinder pump in communication with, and for effecting the action of, each motor, a controlling member for each pump to secure opposite motions of the pistons thereof and to also vary the strokes of said pistons in opposite directions, means for acting on both controlling members to vary the strokes of the pumps together, and means for acting on both controlling members to vary the strokes of the pumps in opposite directions.

2. The combination of a plurality of hydraulic motors, a variable-stroke multiple-cylinder pump in communication with, and for effecting the action of, each motor, rotary members driven by the respective motors, a controlling member for each pump, to secure opposite motions thereof and to also vary the strokes of the pistons in opposite directions, means for acting on both controlling members to vary the strokes of the pumps together, and means acting on both controlling members to vary the strokes of the pumps in opposite directions.

3. The combination of a plurality of hydraulic motors, a variable-stroke multiple-cylinder pump in communication with, and for effecting the action of, each motor, a controlling member for each pump, to secure opposite motions of the pistons thereof and to also vary the strokes of said pistons in opposite directions, manually-operable means for effecting the action of both controlling members to vary the strokes of the pumps together, and manually-operable means for acting on both controlling members to vary the strokes of the pumps in opposite directions.

4. The combination of a plurality of hydraulic motors, a variable-stroke multiple-cylinder pump in communication with, and for effecting the action of, each motor, a controlling member for each pump, to secure opposite motions of the pistons thereof and to also vary the strokes of said pistons in opposite directions, manually-operable means for effecting the action of both controlling members to vary the strokes of the pumps together, and manually-operable means for acting on both controlling members to vary the strokes of the pumps in opposite directions, both of said manually-operable means being accessible from the same station by the operator.

5. The combination of a plurality of hydraulic motors, a variable-stroke multiple-cylinder pump in communication with, and for effecting the action of, each motor, a controlling member for each pump, to secure opposite motions of the pistons thereof and to also vary the strokes of said pistons in opposite directions, manually-operable means for effecting the motion of both controlling members to vary the strokes of the pumps together, and manually-operable means for acting on both controlling members to vary the strokes of the pumps in opposite directions the two manually-operable means being rotative about the same axis.

6. The combination of a plurality of hydraulic motors, a variable stroke multiple cylinder pump in communication with, and for effecting the action of, each motor, a controlling member for each pump, to secure opposite motions of the pistons thereof and to also vary the strokes of said pistons in opposite directions, means for effecting the action of both controlling members to vary the strokes of the pumps together, independent means for acting on both controlling member to vary the strokes of the pumps in opposite directions, and propelling members driven by the respective motors.

7. The combination of a plurality of hydraulic motors, a variable stroke multiple cylinder pump in communication with, and for effecting the action of, each motor, a controlling member for each pump, to secure opposite motions of the pistons thereof, and to also vary the strokes of said pistons in opposite directions to each other, and mechanism connecting the two controlling members to vary the strokes of the pumps together through said controlling members and also through said controlling members to vary the strokes of the pumps in opposite directions.

8. The combination of a speed controlling member and a direction controlling member, and means for automatically moving the speed controlling member upon the movement of the direction controlling member.

9. The combination of a speed controlling member, a direction controlling member and means for automatically moving the speed controlling member so as to reduce the speed when the position of the speed controlling member would otherwise interfere with the

movement of the direction controlling member.

10. The combination of a speed controlling member, a direction controlling member and means for automatically moving the direction controlling member by a movement of the speed controlling member, when otherwise the position of the direction controlling member would interfere with the movement of the speed controlling member.

In testimony whereof I affix my signature in the presence of two witnesses.

REYNOLD JANNEY.

Witnesses:

L. L. MARKEL,

HEATH SUTHERLAND.