

July 8, 1924.

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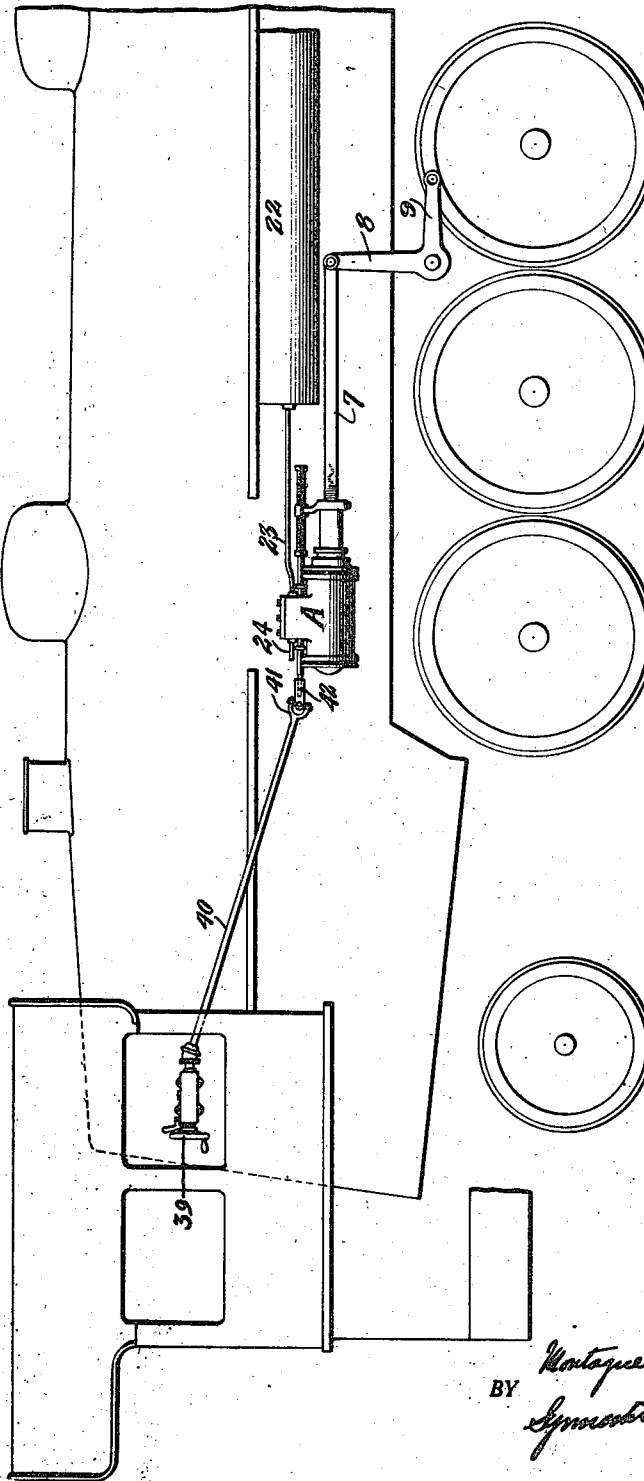
M. H. ROBERTS

POWER REVERSE GEAR

Filed Feb. 26 1921

7 Sheets-Sheet 1

Fig. 1.



WITNESS.
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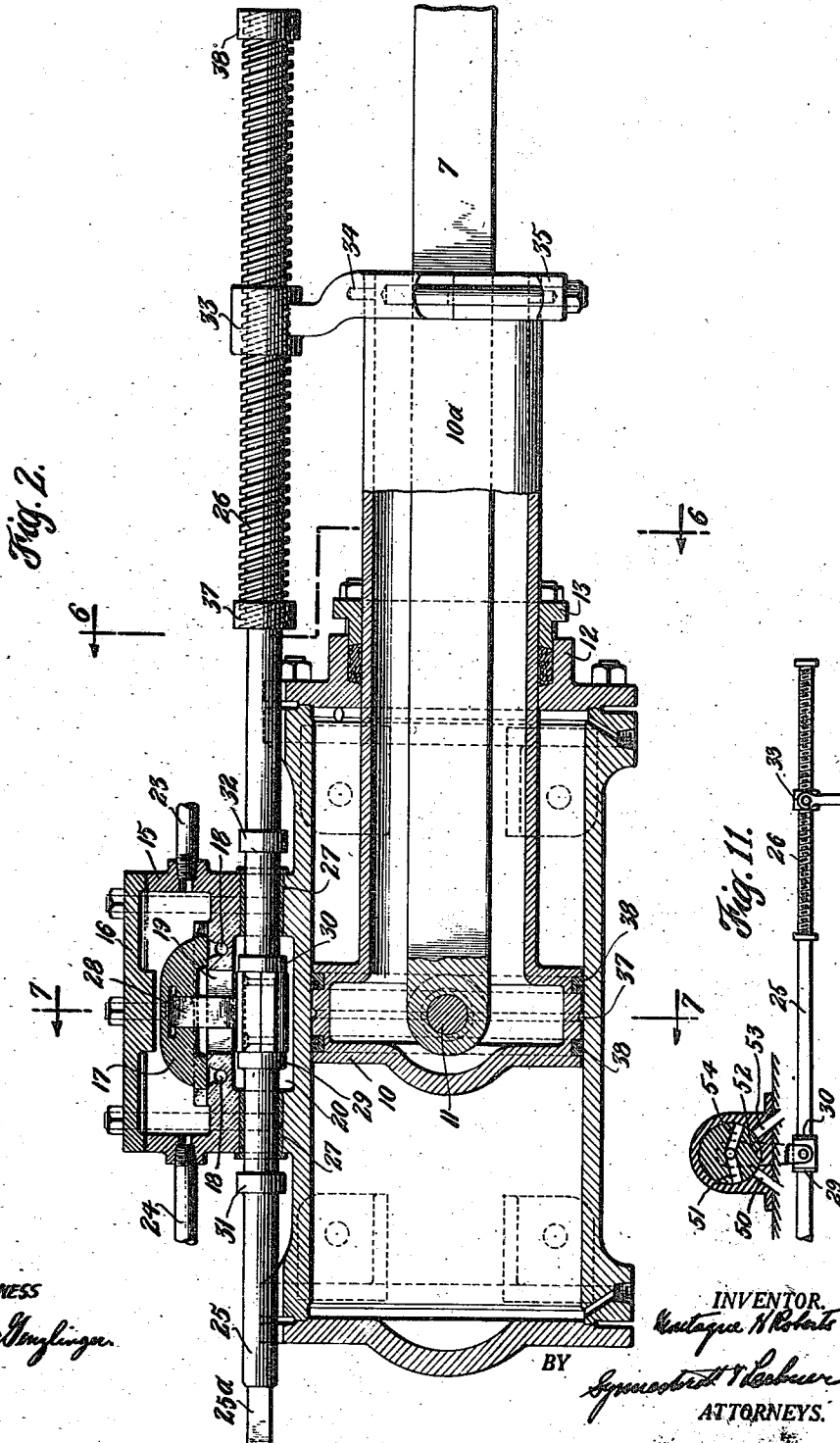
July 8, 1924.

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POWER REVERSE GEAR

Filed Feb. 26, 1921

7 Sheets-Sheet 2



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July 8, 1924.

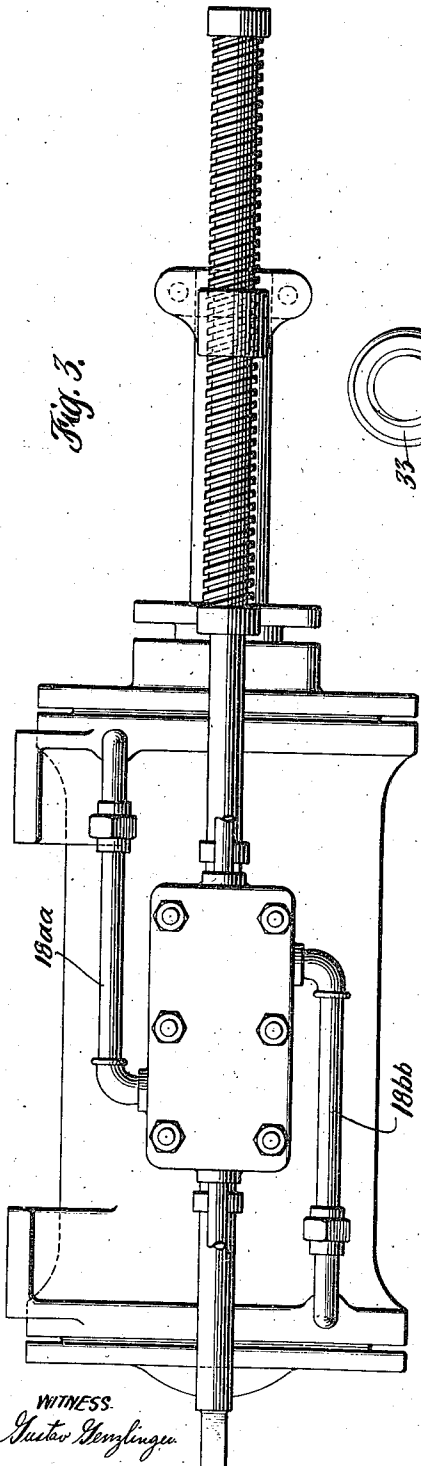
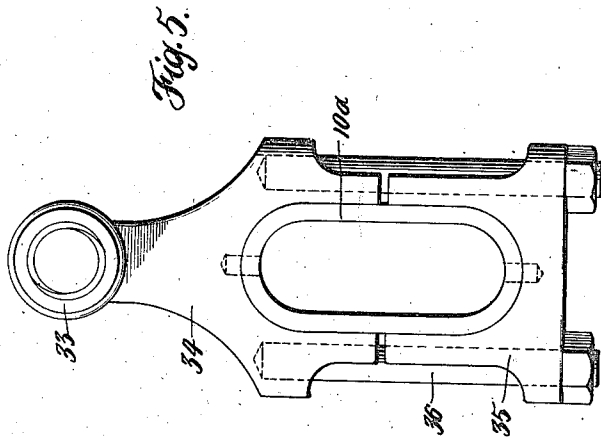
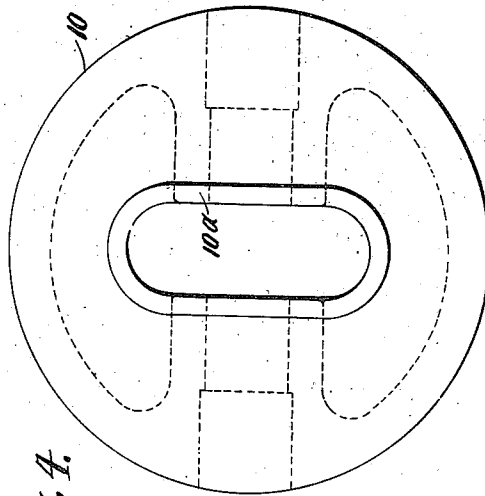
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POWER REVERSE GEAR

Filed Feb. 26, 1921

7 Sheets-Sheet 3



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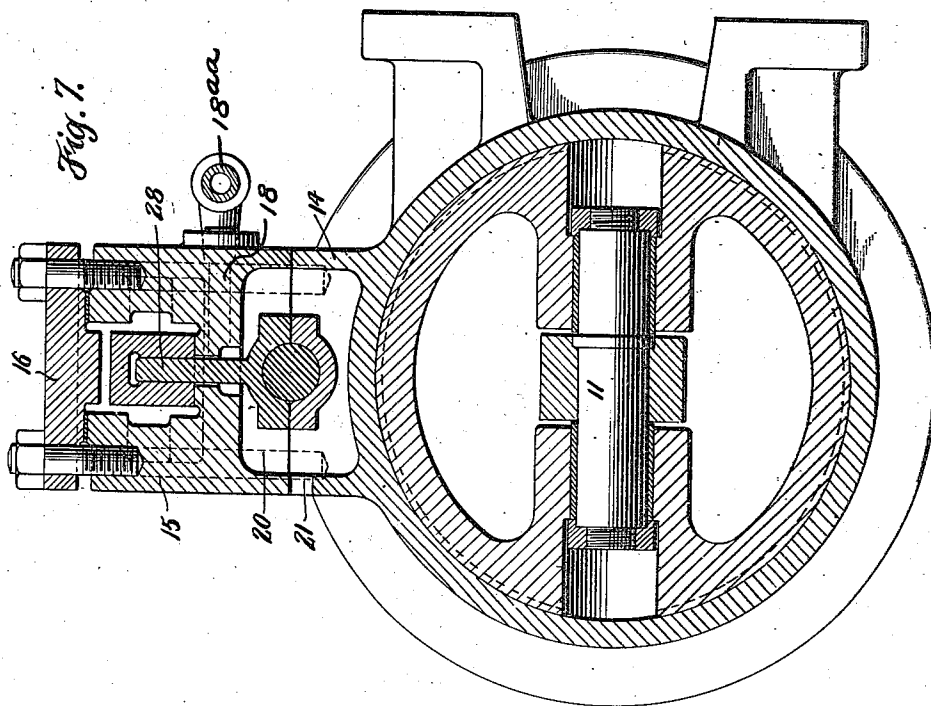
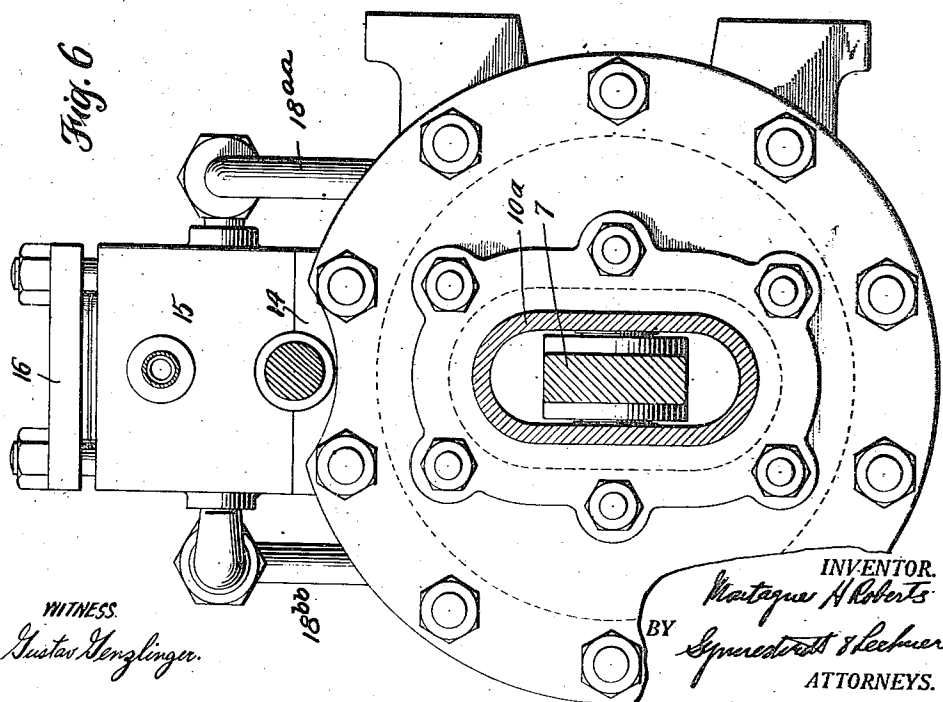
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POWER REVERSE GEAR

Filed Feb. 26 1921

7 Sheets-Sheet 4.



WITNESS.
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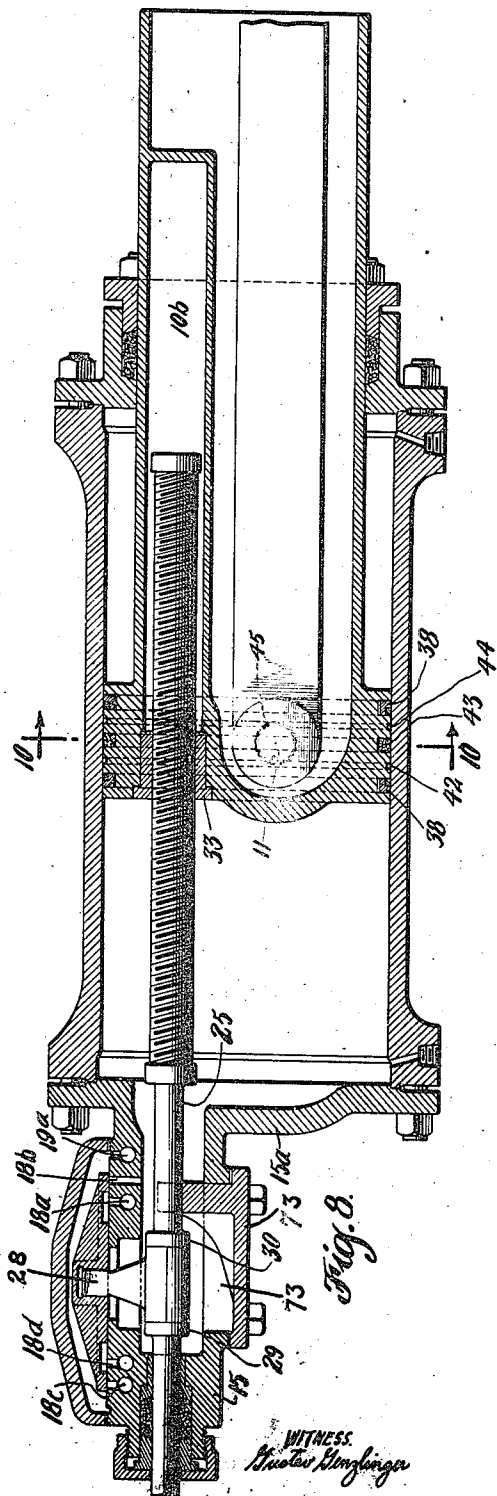
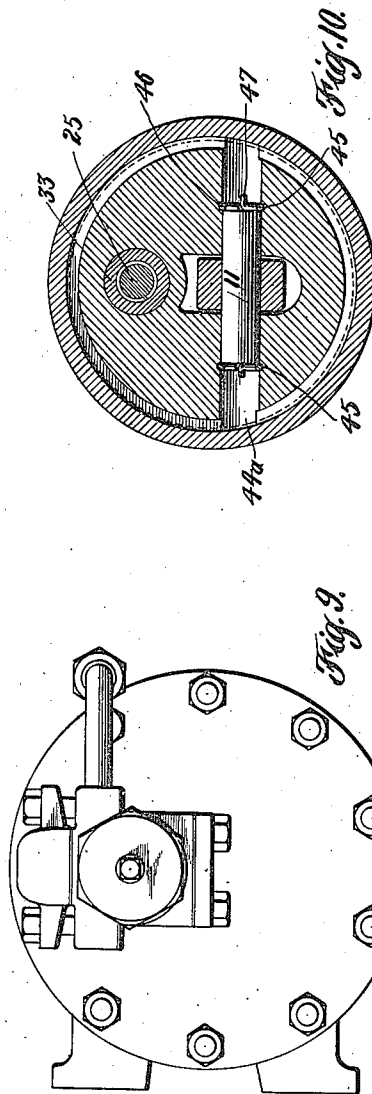
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POWER REVERSE GEAR

Filed Feb. 26, 1921

7 Sheets-Sheet 5.



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1,500,685

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POWER REVERSE GEAR

Filed Feb. 26, 1921

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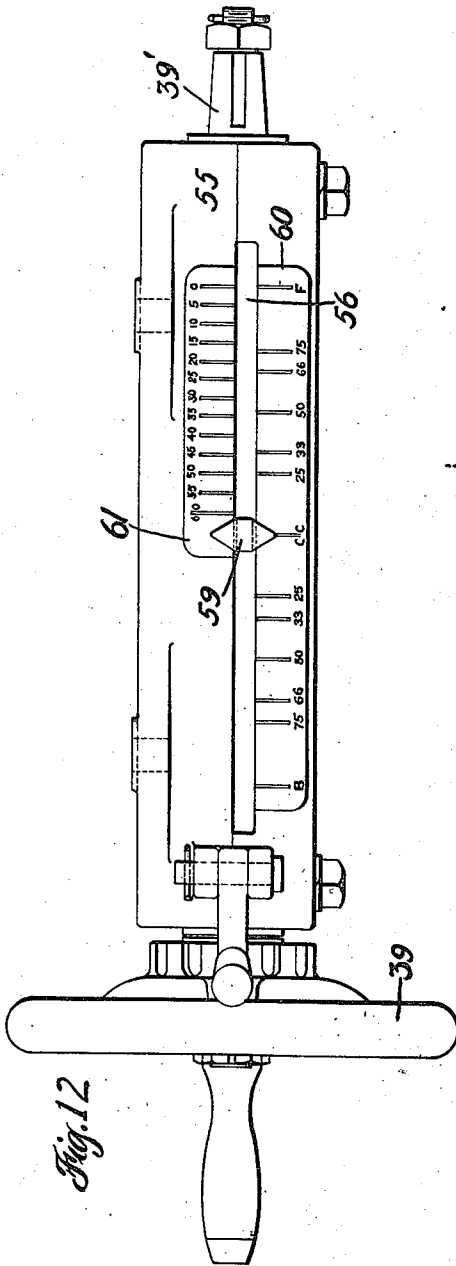


Fig. 12

WITNESS.

Gustav Heminger

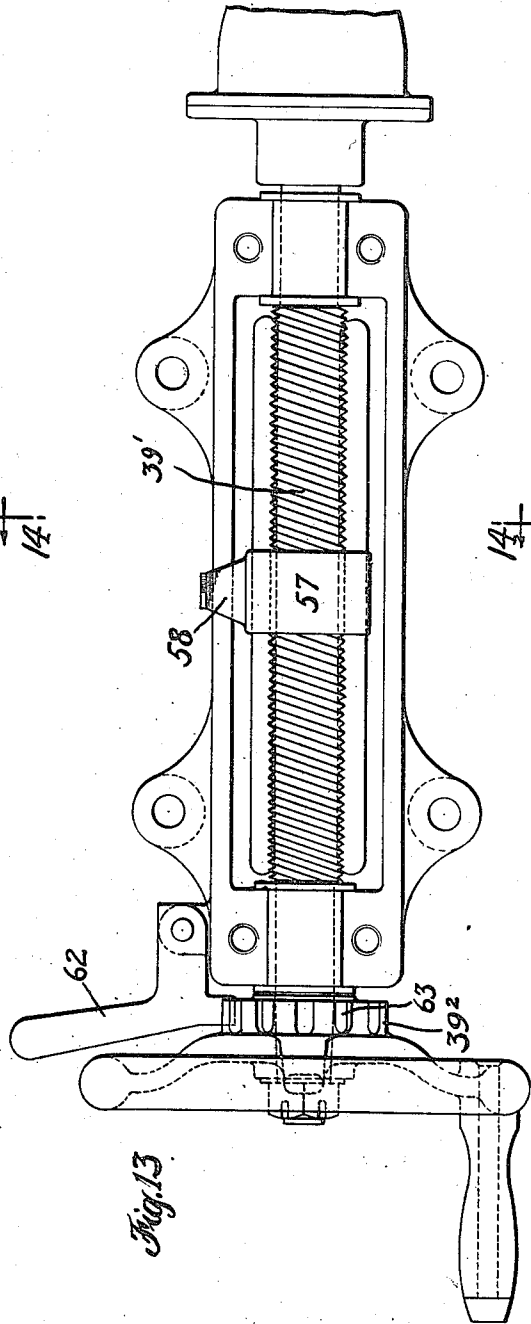


Fig. 13

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July 8, 1924.

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M. H. ROBERTS

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Filed Feb. 26, 1921

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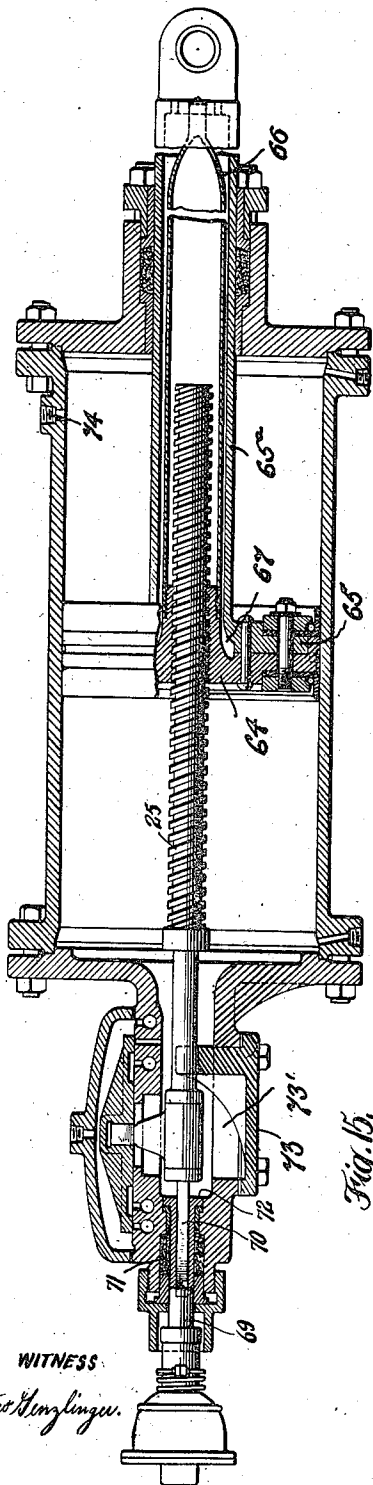


Fig. 15.

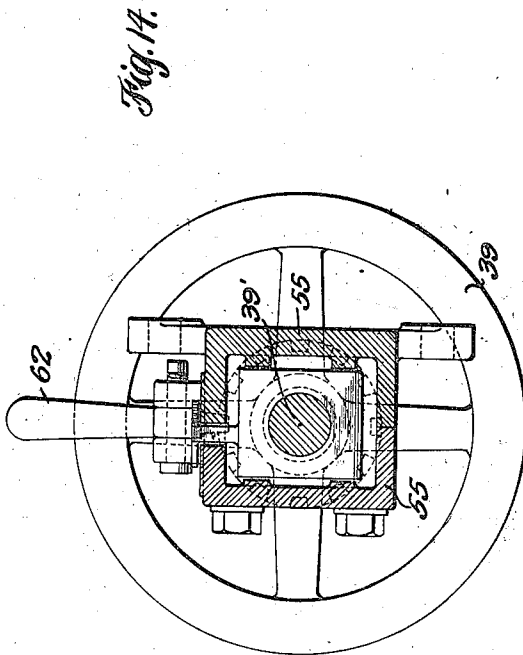


Fig. 17.

WITNESS
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UNITED STATES PATENT OFFICE.

MONTAGUE H. ROBERTS, OF ENGLEWOOD, NEW JERSEY, ASSIGNOR TO FRANKLIN RAILWAY SUPPLY COMPANY, A CORPORATION OF DELAWARE.

POWER REVERSE GEAR.

Application filed February 26, 1921. Serial No. 448,044.

To all whom it may concern:

Be it known that I, MONTAGUE H. ROBERTS, a citizen of the United States, residing at Englewood, in the county of Bergen and State of New Jersey, have invented certain new and useful Improvements in Power Reverse Gears, of which the following is a specification.

This invention relates to power reverse gears such, for example, as those for locomotives and it has for one of its primary objects the provision of a simple reverse gear which combines the advantages of the hand operated screw reverse gear and the power reverse gears heretofore employed in standard practice, while at the same time it avoids the disadvantages incident to such prior types.

Another object of the invention is the provision of a gear in which no load or movement is transmitted through the gear to the manual operating means in the cab or corresponding place. In another aspect, my invention contemplates a gear having the connection between the controlling valve and piston or other moving part variable whereby advantages hereinafter pointed out may be obtained.

Still another object of the invention is to provide a rotary means for operating the valve; and also a means for apprising the engineman of the point of cut-off, as well as a means for locking the gear at any selected position without, however, transmitting load through the gear on the lock device.

My invention also contemplates the provision of an improved power reverse gear in which "creeping" is eliminated; in which reverse may be obtained more quickly than heretofore and with much less physical effort; in which the usual ratio of movement between the power reverse piston and the controlling valve may, if desired, be avoided and the piston and valve caused to travel in unison whereby many complications in operation and structure may be avoided, while at the same time greatly increased sensitiveness in operation is obtained; in which there are no pins or pin bearings or other part which necessarily involve lost motion increasing as wear takes place; in which the parts will stay "put" within one notch without air and also be maintained substantially at any selected position of cut

off under all service conditions; and in which but a minimum amount of fluid pressure is required for operation.

In addition, I propose to provide a power reverse gear in which the pressure is automatically altered to the degree required to maintain the reverse piston in predetermined position; and in which the hand control is not used as a fulcrum.

In general, I propose to provide a power reverse gear in which not only the number of parts but also the wearing surfaces are reduced to a minimum.

The foregoing, together with such other objects as may hereinafter appear, or are incident to my invention, I obtain by means of a construction which I have illustrated in the preferred form in the accompanying drawings, wherein:

Fig. 1 is a diagrammatic side elevation of a locomotive equipped with my improvements; Fig. 2 is a longitudinal section through the power reverse cylinder, drawn on an enlarged scale; Fig. 3 is a plan view of Fig. 2; Fig. 4 is an end elevation drawn on an enlarged scale of the trunk piston illustrated in Fig. 2; Fig. 5 is an end elevation illustrating the manner in which a portion of the valve operating mechanism is mounted on the trunk of the piston; Fig. 6 is a section taken on the line 6—6 of Fig. 2, drawn on an enlarged scale; Fig. 7 is a section taken on the line 7—7 of Fig. 2, also on an enlarged scale; Fig. 8 is a longitudinal section through a modification of my invention; Fig. 9 is an end elevation of Fig. 8; Fig. 10 is a section taken on the line 10—10 of Fig. 8; Fig. 11 illustrates another modification in diagrammatic form; Fig. 12 is a plan view, on an enlarged scale, of the hand operating and cut off indicating means; Fig. 13 is a side elevation of Fig. 12 with a half of the housing removed to expose the inner parts; Fig. 14 is a section on the line 14—14 of Fig. 13; and Fig. 15 is a longitudinal section through a modified form of gear.

Referring now to Fig. 1, only those portions of the locomotive and its valve motion are shown as are necessary to the understanding of the invention. The reference letter A indicates the power reverse cylinder and its associated parts, the reference number 7 indicates the power reverse reach rod,

and the reference number 8 indicates the reverse shaft bell crank.

The rear end of the reach rod 7 extends within the trunk of the trunk piston 10 (see Fig. 2) and is connected to the piston proper by the wrist pin 11. The trunk is vertically elongated in cross section and is preferably of the shape and construction shown, described and claimed in my copending application Serial No. 444,508, filed February 12, 1921. The trunk passes through the stuffing box 12 and gland 13, the stuffing box being packed with any preferred type of packing, although metal packing is particularly suitable as it has longer life, dampens the movement of the piston and may be superior where steam is used or is liable to be used instead of compressed air, as the operating medium.

On the top, the power reverse cylinder is provided with a seat 14 (see Figs. 6 and 7) for the valve chest 15, which is open at the top and provided with a cover plate 16 for ready access to the interior. Any suitable valve mechanism may be employed but in the present instance I have illustrated a D-valve 17. The valve 17 controls the admission ports 18 and the exhaust port 19 in the usual manner, but for reasons which will appear hereinafter, the valve preferably has appreciable lap over the ports. The exhaust cavity 20 is formed partly in the valve chest and partly in the seat 14, exhaust to the atmosphere occurring through the port 21 (see Fig. 7). Compressed air is led to the valve chest 15 from a suitable source of supply, such as the reservoir 22 (see Fig. 1) by means of a pipe 23, and steam is supplied in case of an air failure or in case it is preferred to operate the reverse mechanism by steam, through the pipe 24. The rear admission port 18 supplies pressure to the forward end of the reverse cylinder through connection 18^{aa}, and the forward admission port supplies pressure to the rear end of the cylinder through the connection 18^{bb} (see Fig. 3); in other words, the ports are cross connected.

The valve 17 is operated by means of a rod or shaft 25 which is provided with a screw thread 26 at its forward end. This rod extends through the exhaust passage 20 and is provided, at opposite ends of the valve chest, with suitable bearing sleeves 27, the seat 14 and the bottom of the valve chest being shaped to fit about said sleeve (see Figs. 2 and 6). An upwardly extending tongue-like member 28 is carried on the shaft 25 by means of a suitable bearing permitting rotation of the shaft and is held against relative longitudinal displacement by the shoulders 29 and 30 between which the bearing is fitted. The tongue 28 fits into a recess formed in the D-valve 17. It will be seen that when the shaft 25 is shift-

ed either way, the slide-valve will be shifted accordingly. The movement of the shaft 25 in either direction is limited by the stops 31 and 32. The screw threaded end of the shaft 25 turns in a nut 33 which is secured to the trunk 10^a of the piston by the clamp members 34 and 35 and the studs 36 (see Figs. 2 and 5). Stop shoulders 37 and 38 are located at the ends of the threaded portion of the shaft. It will be noted that the arrangement of the shaft 25 between the valve chest and cylinder is such as to avoid the necessity of a stuffing box. The thread 26 has a pitch such that one half turn of the shaft 25 is the equivalent of one notch in the ordinary reverse lever arrangement.

The shaft 25 is turned by means of the hand wheel 39 located at a suitable point in the cab through the medium of the rod 40 which has a universal joint at its rear and another universal 41 at its forward end, there being a slip joint 42 between such latter universal and the squared end 25^a of the shaft 25 (see Figs. 1 and 2).

For forward positions the shaft 25 is rotated to the left (if left hand thread is used and to the right if a right hand thread is used) and the thread 26 in engaging the nut 33 pushes the shaft rearwardly by reason of the fact that, although the piston is of course a movable element its weight alone is sufficiently greater than that of the shaft as to cause it to act as an anchor.

As the shaft 25 moves rearwardly, it of course, moves the valve 17 and uncovers the forward admission port 18 and connects the rear admission port 18 with the exhaust port 19. Pressure is thus admitted to the rear end of the cylinder and the forward end of the cylinder is open to exhaust. The piston now moves forwardly and, of course, carries with it the shaft 25 for the reason that the piston and shaft move in unison, save when the shaft is being rotated. The piston and shaft move forwardly until such time as the valve 17 is again brought to neutral position covering both ports 18, at which time further movement would ordinarily cease. However, in going from mid gear to full forward position, that is to a position equivalent to having the reverse lever in the corner forward notch, the engineman continues to rotate the shaft 25, and since the shaft can be spun very rapidly it can be caused to be pushed back through nut 33 more rapidly than it is being advanced by the piston, so that the valve can be continuously maintained in open position until the full forward position is obtained, at which time the stop 38 will be adjacent to or in contact with the nut 33, as the particular design may call for. As soon as the engineman stops turning the shaft, the shaft will again move in unison with the piston and the pis-

ton will shift the parts to neutral position, closing both admission ports. The piston will then ordinarily come to a stop.

If however, the pressure on the forward side of the piston has dropped to a point too low to maintain the piston in the desired position against the pressure if any on the rear face thereof plus whatever load there may be from the valve motion parts, the movement of the piston in a forward direction would continue until such time as the rear admission port 18 would be cracked open immediately admitting pressure to the forward end of the cylinder, arresting the movement of the piston and automatically bringing it back to proper position, and in so doing shifting the valve to neutral position. Stated in other words, since the shaft and, therefore, the valve, move in unison with the piston at such times as the shaft is not being rotated, it will be seen that the valve is actuated by the piston itself to automatically build up the pressure on either side of the piston as the case may be so as to stabilize the piston in any desired position of cut-off.

As the speed of the engine picks up, and it is desired to shorten the cut off, the operator turns the shaft 25 to the right, or left depending on the thread, at the rate of one half turn per notch. Thus, if he wants to cut back one notch the shaft would be turned one half revolution to the right and the shaft would move forwardly, uncovering the rear admission port and admitting pressure to the forward end of the cylinder. The piston would then move back to the rear, causing the shaft to move back with it and the valve to again close the port. If the engineman desired to cut back two notches he would give the shaft one complete revolution and so on, and in cases of reversal from full forward to full rear position, the shaft 25 would be continuously rotated until the stop 37 would be adjacent to the nut 33. I have found by experience that the operation of the mechanism is so delicate that the piston will automatically be stabilized in the selected position. I have also found by experience that the piston will automatically be returned to any given position in case any sudden load or shock is imposed thereon.

It will be seen that the mechanism has the precision of adjustment of the hand operated screw reverse, while at the same time it avoids the disadvantages of this form of reverse. In this latter connection, it will be noted that with the present mechanism, the only load that the engineman has to overcome in turning the shaft 25 is that which is incident to the weight of the shaft 25 and the friction of the thread in the nut and the sticking of the valve in case it is dry, whereas in the hand operated screw reverse the entire load of the valve motion parts is on

the hand wheel. Furthermore, in the hand operated screw type of reverse gear, the screw shaft takes all of the shocks, whereas by my improvements all of the shocks are taken by the piston and are cushioned by the air in the cylinder and no shocks are taken by the screw shaft except in case of a failure.

The mechanism also has the advantage of the ordinary power operated power reverse in so far as speed of operation is concerned, and is, perhaps, even more quickly operated. It is, however, much more simple than the usual power reverse mechanism in number of parts, wearing surfaces and the like. In my present improvements what is known as "creeping" is eliminated as are ratios between the valve and piston movements. In ordinary reverse gears there are a great many points at which lost motion occurs, such lost motion increasing as the parts wear. Since the ratio of movement between the piston and valve is ordinarily as one to four or as one to six, it will readily be seen that the lost motion may become greatly amplified so that the position of the reverse lever is no accurate criterion of the position of the piston and, therefore, of the valve motion parts. Considerable "creeping" may thus take place before the valve is operated by the piston. In my improvements practically the only place where lost motion could exist would be between the tongue 28 and the faces of the valve which it engages but no wear takes place at this point as there is no relative movement between the tongue and the valve. The valve, therefore, immediately responds to movement of the piston and any tendency to "creep" is at once rectified by the automatic control exercised by the valve. Furthermore, assuming that the engine is standing with no air or steam, or that there has been a failure, the piston can move only to the extent of the clearance between the stops 31 and 32 and the valve chest. This clearance is preferably made equal to or slightly greater than the stroke of the valve or the equivalent of one notch and, of course, in thus shifting the piston would cause the valve to uncover one or the other of the admission ports, so that as soon as air or steam is turned on, the piston would be automatically stabilized in the position of cut-off to which it had been originally adjusted. Thus unanticipated reversals are entirely avoided.

In addition, in standard power reverse gears the reverse lever acts as a fulcrum or, more properly speaking, the hand is the fulcrum, which is particularly objectionable as in many instances the position of the parts is such as to place not only the load of the power reverse parts but also the valve motion on the arm of the engineman, which makes it difficult to shift the reverse lever and to control its movement with any degree

of accuracy. By my improvements the piston is in reality the fulcrum and no load is imposed on the hand other than that incident to merely turning the shaft. With the piston as the point of fulcrum there is not the opportunity for play which exists where as in standard power reverse gears the reverse lever acts as a fulcrum.

The gear is also an economical one in so far as consumption of power is concerned. Heretofore, in order to overcome "creeping" difficulties it has been the practice to have line-to-line ports, an arrangement which is wasteful of pressure because on the admission of pressure to one side of the piston, exhaust occurs from the other side. This is also true even though the ports are not line to line, because the notched quadrant of present reverse gears does not permit of a close enough adjustment to prevent exhaust occurring when an admission port is opened. By my improvements, I am enabled to provide considerable lap for the exhaust, greater than that for the admission which may have lap or be line to line as described. Thus, the admission ports may be appreciably opened without uncovering the exhaust ports, making it possible to rectify the position of the piston without exhaust. Under certain conditions it may also be possible to alter cut off without exhaust, that is to say, for example, the piston can be shifted from a full forward to approximately mid gear position without opening the exhaust, the pressure on the rear face of the piston being merely raised by compression. The apparatus works mostly with pressure on the forward side of the piston for the load or pull of the valve motion parts is in that direction, and with only such pressure on the other side of the piston as may be required for stabilizing the piston.

It will be further observed that there are no adjustments of any description of the gear and that all moving parts are enclosed, and that full reversal may be obtained with the least physical effort. The gear operates on differential pressures which are automatically brought about and maintained by the valve to stabilize the position of the piston at any predetermined and selected point of cut off under the varying load of the valve motion parts. Expansion and contraction of the boiler does not affect the apparatus, particularly the manual operating means in the cab, which is now the case.

It is to be noted that the piston ring is provided with an annular groove in its periphery, indicated at 37 in Fig. 2, on either side of which the piston rings 38 are disposed. This groove 37 opens into the aperture which receives the wrist pin, so that any air which works past either of the piston rings works itself to the atmosphere

through the piston and is not displaced from one side of the piston to the other.

In the modification shown in Figs. 8 to 10 the same general principle of operation is retained but the valve chest 15 is carried on the rear head 15^a of the cylinder and the shaft 25 extended into the cylinder and also into the recess 10^b, formed in the piston, the nut 33 in this case being secured to the piston. The stops 31 and 32 are eliminated, the shoulders 29 and 30 serving to limit the movement of the shaft.

The arrangement of ports is also somewhat different.

In this modification 19^a is the admission port; ports 18^a and 18^b when connected by the valve exhaust pressure from the rear end of the cylinder; ports 18^c and 18^d when connected serve to exhaust pressure from the forward end of the cylinder; when ports 19^a and 18^b are connected pressure is supplied to the rear end of the piston; and when port 18^c is uncovered pressure is admitted to the forward end of the cylinder.

As before, the piston is provided with two packing rings 38, but it is provided with a central grease groove 43 and with a pair of small grooves 44 located between the grease groove and the packing rings. The grooves 43 and 44 open into the wrist pin receiving aperture 44^a and any air that leaks past either one of the piston rings will be vented to the atmosphere before reaching the grease groove so that the grease will not be blown out into the aperture 44^a.

In Fig. 10 I have also illustrated a novel manner for securing the wrist pin 11 in place. I provide in the wall of the aperture 44^a, at proper intervals, grooves 45 into which split snap rings 46 are adapted to be sprung when the wrist pin is in place. These serve to secure the wrist pin securely since there is no longitudinal thrust on the same, and they can be readily removed by gripping the turned up ends 47 with a suitable tool.

Referring now to Fig. 11, it will be seen that I have diagrammatically indicated the application of my improvements in connection with a rotary instead of a slide valve. When the valve is shifted to connect ports 50 and 51, ports 52 and 53 are brought in register, pressure being admitted to the rear end and being exhausted from the front end of the cylinder; when shifted the other way, ports 54 and 53 are in register to admit pressure to the forward end of the cylinder and ports 50 and 52 in register to exhaust pressure from the rear end.

Referring now to Figs. 12, 13 and 14, it will be seen that the hand wheel shaft 39', which is coupled by a universal joint to the shaft 40, has a bearing in a two part housing 55, the parts of which are constructed so as to leave a slot 56 in the top thereof. The

shaft 39' is threaded and provided with a nut 57 held against rotation by its engagement with the housing (see Fig. 14), as a result of which when the shaft 39' is revolved the nut 57 will move forwardly or rearwardly as the case may be. The nut is provided with a tongue 58 which projects upwardly through the slot 56 and has a pointer 59. On one side of the slot the housing is provided with marks or graduations 60 indicating cut off, such for example, as indications in percentage of cut off. On the other side there is a graduation 61 indicating speed in miles per hour. The two scales are marked out so as to indicate what would be the proper degree of cut off for any given speed under ordinary conditions. The threads on the shaft 39' are proportionate to the threads on shaft 25.

By this arrangement two things are accomplished. In the first place, the engineer is apprised by the pointer 59 as to the exact position of cut off the gear parts are in, and in the next place, since he can ordinarily very closely approximate the speed of his train in miles per hour, he is apprised of whether or not he is in the right position of cut off for the particular speed and if not to what point he should adjust the cut off.

In order to lock the parts in desired positions of cut off, I provide the hand latch 62 mounted on the housing and adapted to engage any one of the notches 63 in the hand wheel hub 39'. No load is transmitted to this lock, and neither does it interfere in the slightest degree with the automatic operation of the gear parts.

In the modification of Fig. 15, all of the gear parts are in line. The piston is threaded to receive the shaft 25 and the valve chest is on a head of the cylinder. The piston is made in two parts 64 and 65, the latter having the trunk 65^a formed therewith and the former having a pipe 66 threaded thereto and adapted to receive the shaft 25. The forward end of such pipe is swaged to close the same and it is supported in the end of the trunk. The space 67 between pipe 66 and trunk 65^a provides the outlet to the atmosphere for any pressure fluid working past the piston packing as before indicated. The pipe 66 is to confine any pressure fluid which would work past the threads of the shaft 25. In order to balance the shaft 25, I provide the member 69 which has a square recess adapted to receive the squared end 70 of shaft 25. The member 69 is packed as at 71 and it is prevented from coming out by the shoulder 72. Pressure, therefore, is effective against the rear end of the shaft 25 to balance the latter since it will leak around the squared end 70.

It will be noted that in all forms of my invention the thread 26 is as long as the piston stroke so that it will be apparent that

when the valve is manually shifted in either direction, the distance between the respective stop 37 or 38 and the nut 33 will be less than the desired piston travel so that under all conditions the piston will shift the valve to neutral position before the piston reaches the end of the travel thus at all times ensuring an air cushion between the piston and the cylinder heads.

It will, of course, be apparent that the stops 37 and 38 may be set for any given length of piston of stroke. Among the advantages incident to this arrangement is that the fact that the application of a given sized gear can be greatly extended.

Furthermore, as will be seen from inspection of Fig. 15, the valve has a portion of its lower face subject to the pressure on one side of the piston which offsets the pressure on the upper face of the valve to some extent, thereby rendering the valve more easy to move.

The device may be adapted for use as a steam gear by merely swinging the rear head and chest 180° which takes care of drainage.

Referring to Figs. 8 and 15, particularly, it will be noted that the cover plate 73 is constructed so as to provide a grease cavity 73' below the tongue 28 and its bearing. Thus the bearing and the adjacent parts of the shaft 25 are easily lubricated and I have found the valve is also lubricated from this point. The screw threads 26 are lubricated by packing the chamber 10^b or the pipe 66 with grease. Lubricant may be supplied to the cylinder as at 74 in Fig. 15.

Referring now to the stop members 29 shown in Figs. 8 and 15, and to the stop members 31 and 32 of Fig. 2, it will be seen that they provide sufficient lost or free motion to permit of the operation of the valve and thus in addition to acting as stop members limiting the movement of the piston when such movement is unintended, they also serve as a means whereby the piston may be operated in case there is a failure of air. In case of such a failure, by rotating the hand wheel and taking up the lost or free motion, the piston can be shifted manually, making it possible to operate the locomotive. The screw 25 and its manual operating means, therefore, constitute in effect a mechanical means for operating the piston and the gear is thus one which is capable of both pressure and mechanical operation.

I claim:

1. In a power reverse gear, the combination of a cylinder, a piston, a controlling valve, a shaft operatively associated with the valve, a nut movable with the piston, said shaft having threaded engagement with the nut, and stop means on the shaft for limiting the movement of the shaft and through it the movement of the piston.
2. A compressible fluid operated servo

motor power reverse gear for locomotives including in combination a cylinder, a piston, a controlling valve connected to the piston, rotary means for operating the
5 valves provided with a slip joint for transmitting rotary movement without the transmission of longitudinal movement, and a cut-off indicator operated by said rotary means, the slip joint being located between
10 the indicator and the gear.

3. A compressible fluid operated servo motor power reverse gear for locomotives including in combination a cylinder, a piston, a controlling valve connected to the piston, rotary means for operating the valves
15 provided with means for transmitting rotary but not longitudinal movement, and a cut-off indicator operated by said rotary means, said means for transmitting rotary
20 but not longitudinal movement being located between the gear and the indicator.

4. In a power reverse gear, the combination of a cylinder, a piston, a controlling valve, an operating connection operatively

associated with the valve and variable to
25 move the valve to secure cut-off adjustment through movement of the piston, said connection preserving a fixed relation between valve and piston except when varied to secure said cut-off adjustment, and stop means
30 for said connection for limiting its movement and through it the movement of the piston.

5. In a power reverse gear, the combination of a cylinder, a piston, a controlling
35 valve, a rotary operating connection operatively associated with the valve and variable to move the valve to adjust cut-off through movement of the piston, said connection preserving a fixed relation between
40 valve and piston except when varied to secure said cut-off adjustment, and stop means for said connection for limiting its movement and through it the movement of the
45 piston.

In testimony whereof, I have hereunto signed my name.

MONTAGUE H. ROBERTS.