

Oct. 30, 1934.

H. P. LUNDSKOW

1,979,041

FIRE APPARATUS

Filed May 3, 1933

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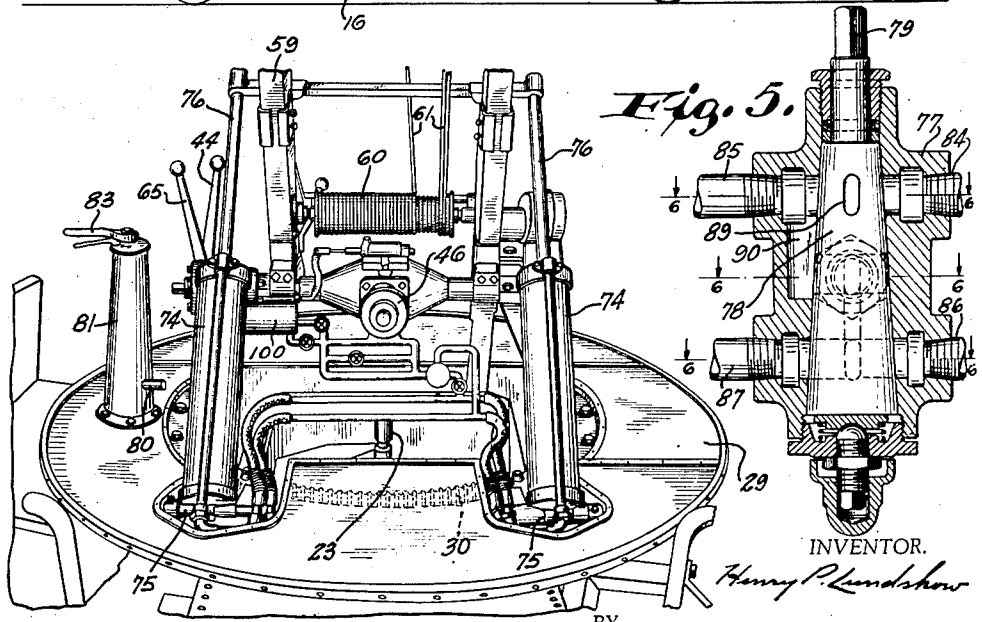
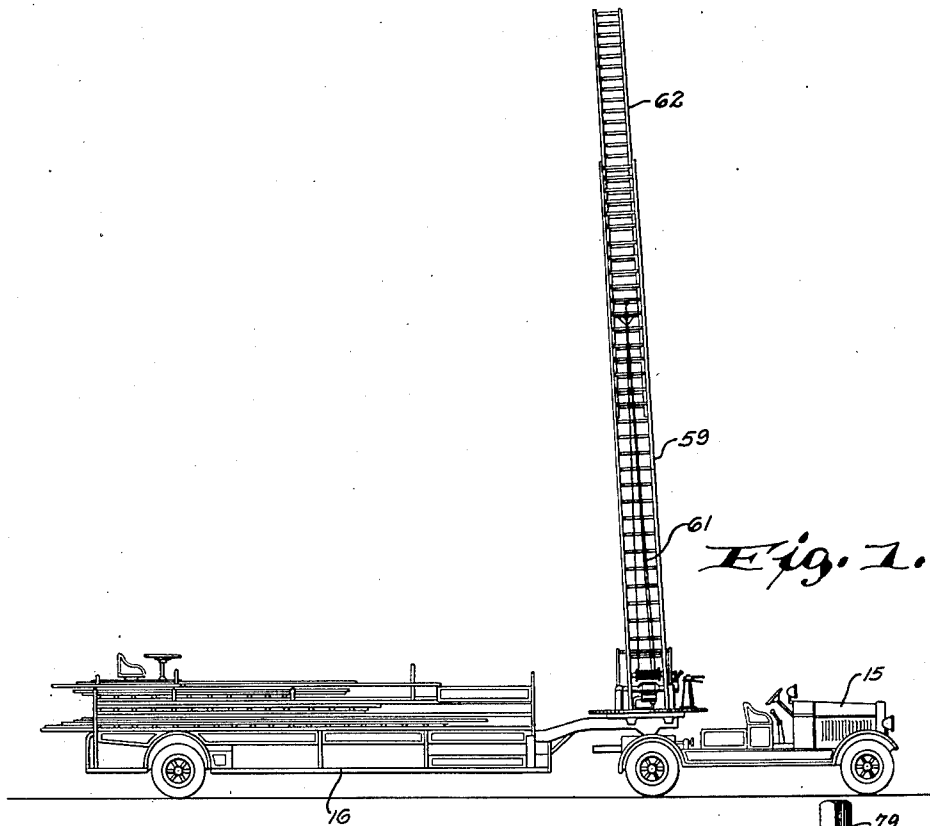


Fig. 2.

Fig. 5.

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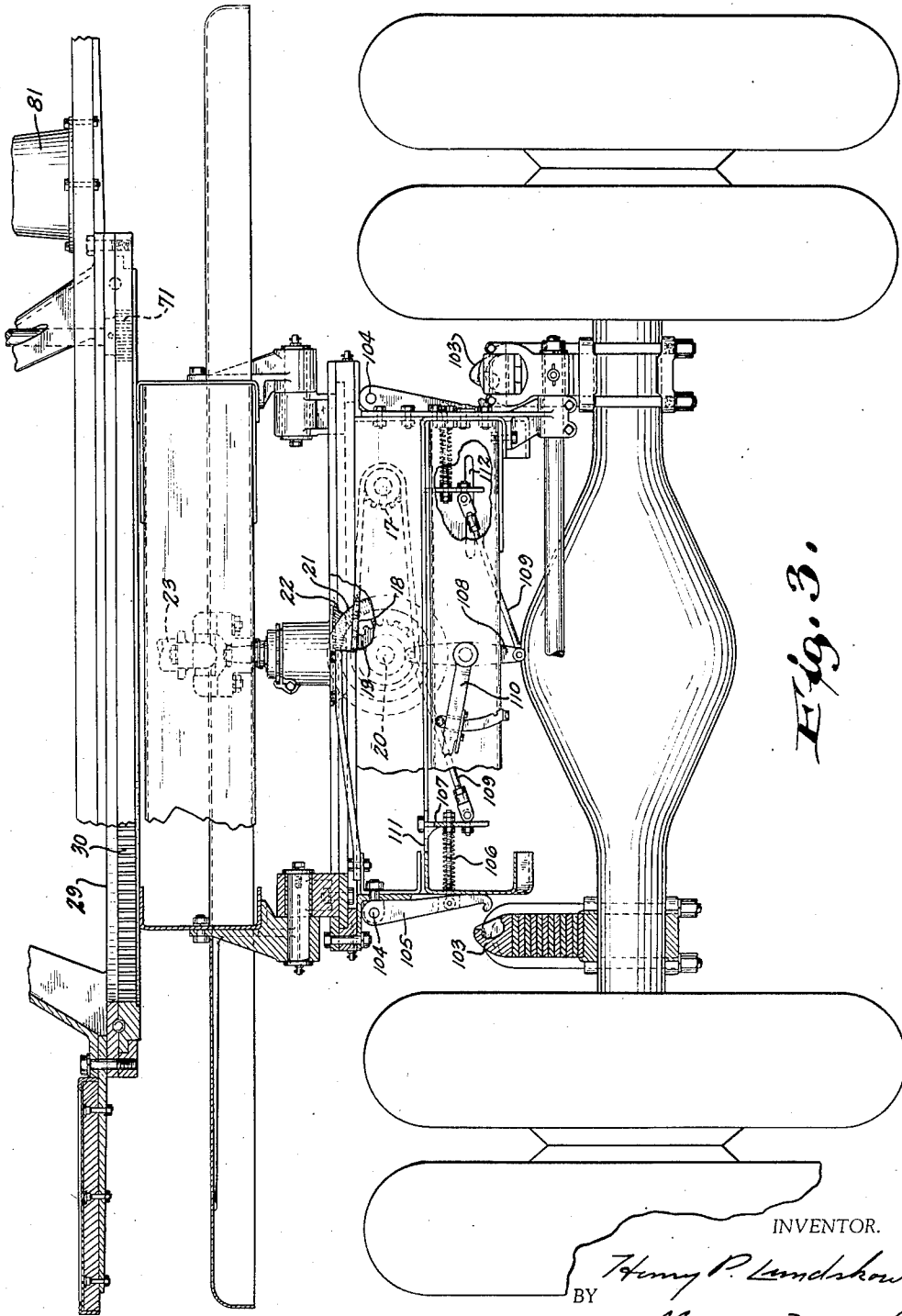
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1,979,041

FIRE APPARATUS

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6 Sheets-Sheet 2



*Fig. 3.*

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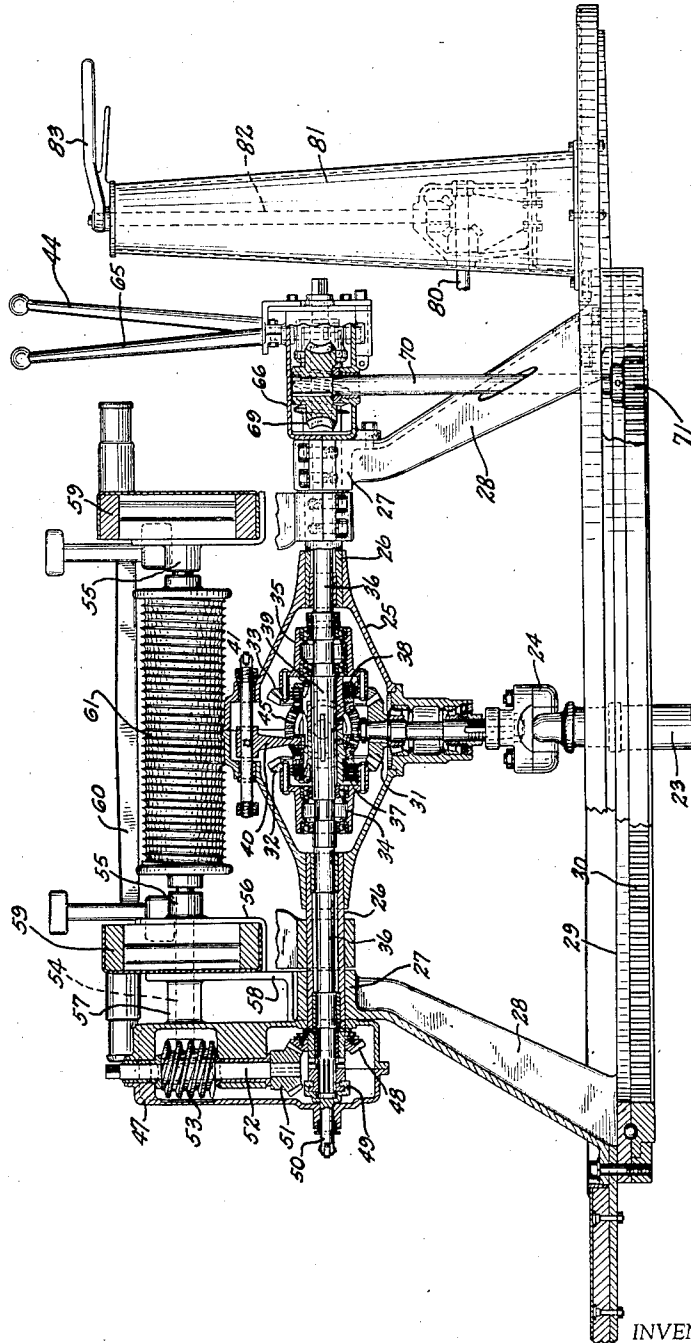
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*Fig. 4.*



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Oct. 30, 1934.

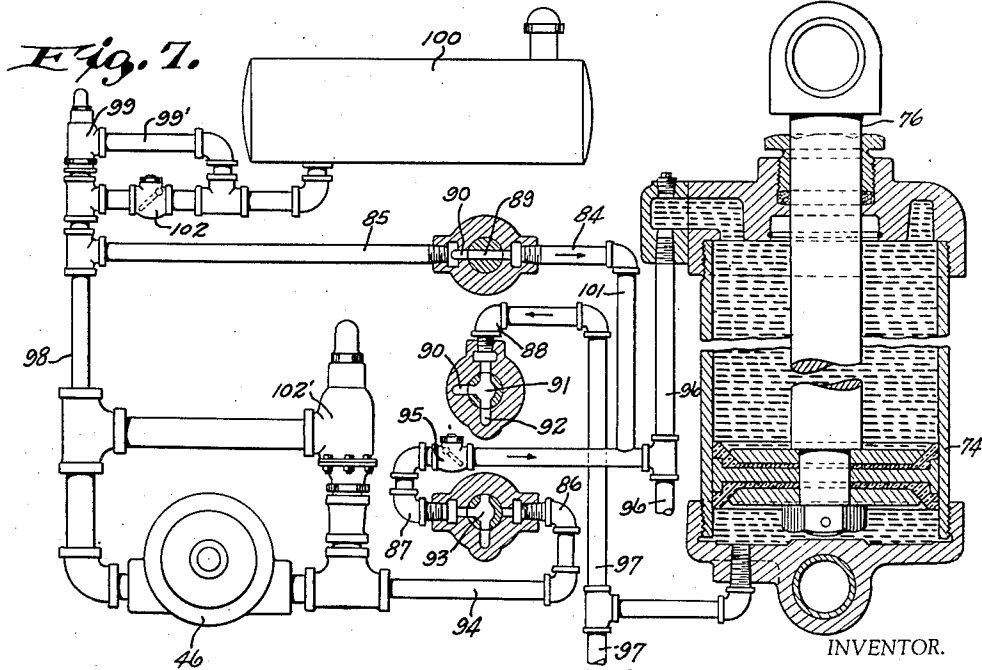
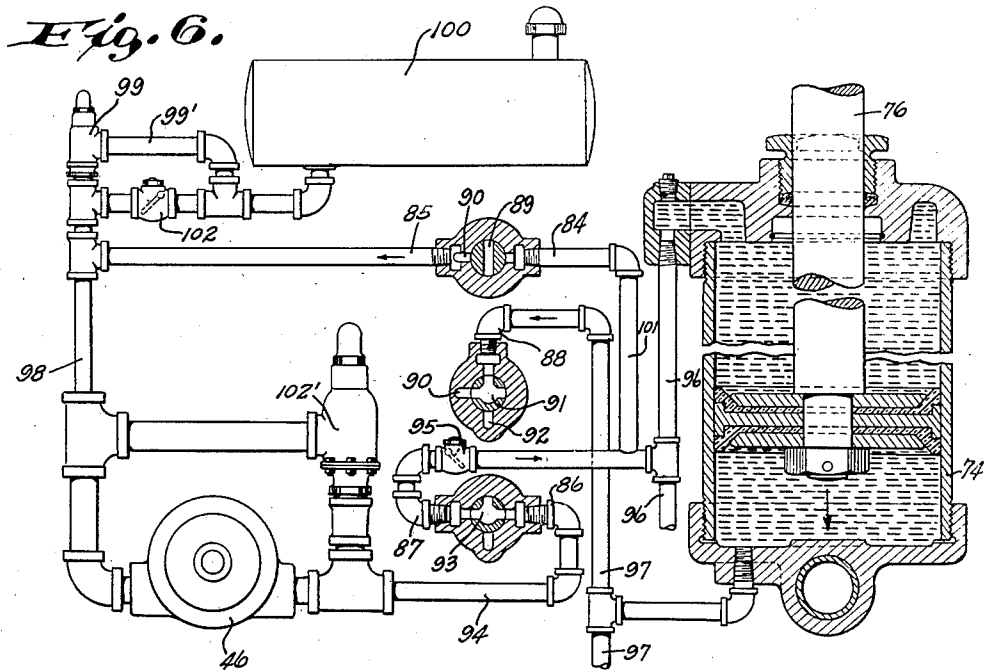
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FIRE APPARATUS

Filed May 3, 1933

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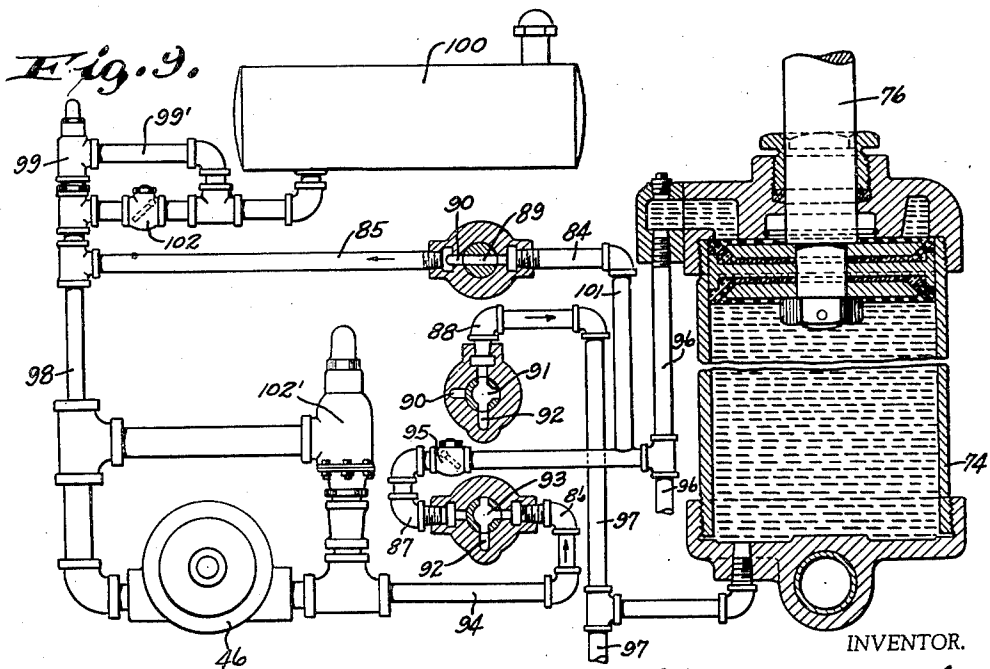
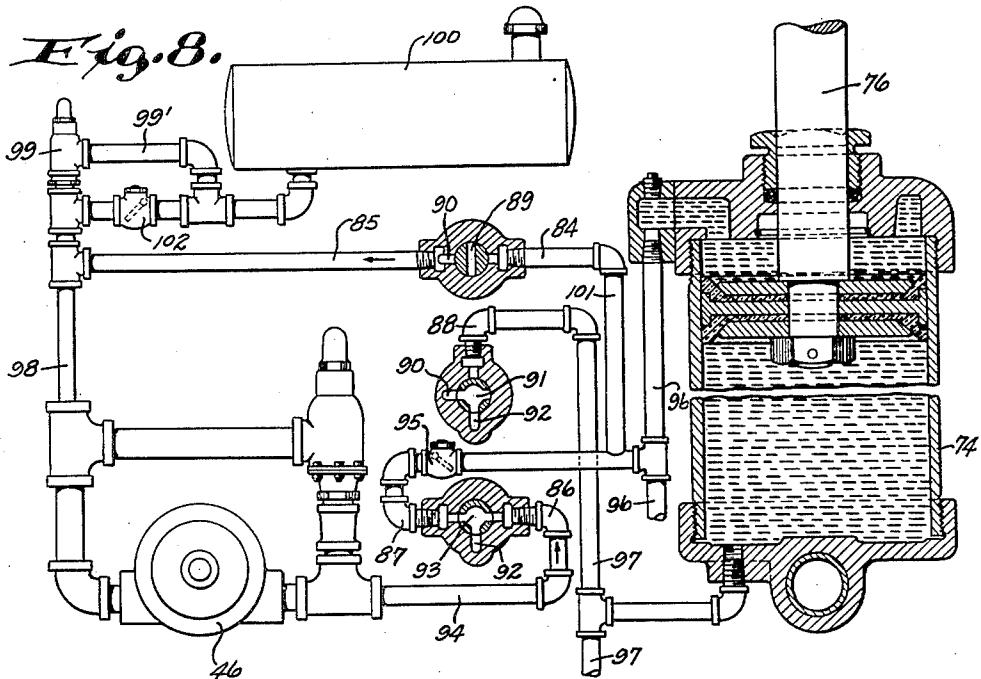
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FIRE APPARATUS

Filed May 3, 1933

6 Sheets-Sheet 5



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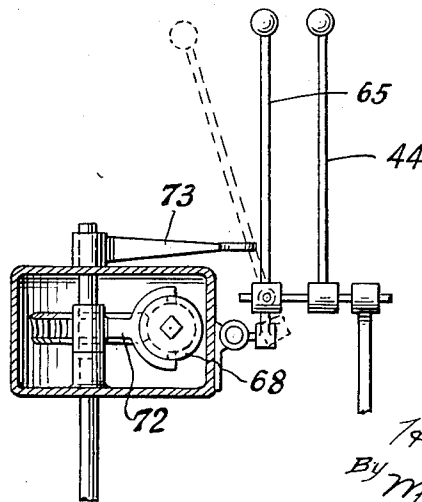
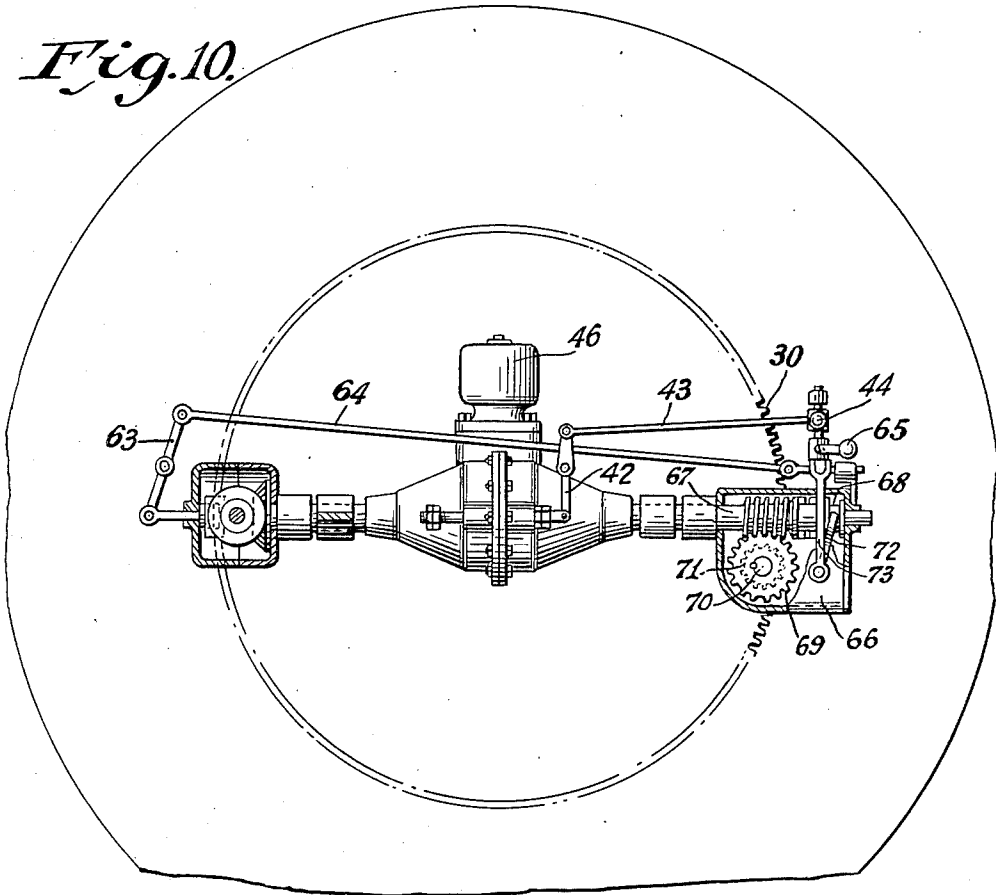
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*Fig. 10.*



*Fig. 11.*

*Inventor:*

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# UNITED STATES PATENT OFFICE

1,979,041

## FIRE APPARATUS

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Application May 3, 1933, Serial No. 669,124

14 Claims. (Cl. 228-8)

This invention relates to improvements in fire apparatus.

Heretofore, fire apparatus embodying an aerial ladder mounted on a turntable has for the most part been so constructed as to require manual operation of the turntable on which the ladder is mounted, and manual operation of the extension or fly ladder. This made it necessary for several men to be in constant attendance on the truck to take care of the required movements.

It is a general object of the present invention to provide fire apparatus including an aerial ladder, in which the raising of the main ladder, the operation of the fly ladder, and the operation of the turntable are all effected automatically under the control of a single man.

A more specific object of the present invention is to provide fire apparatus of the class described wherein the main ladder is mounted on a trunnion on the turntable, and wherein the power for causing operation of the main ladder, fly ladder and turntable is transmitted through the center of said trunnion, with the resulting advantage that the fly ladder may be mechanically raised or lowered regardless of the position of the main ladder.

A further object of the invention is to provide fire apparatus as above described in which the various mechanical operations are controlled through a novel selector clutch.

A further object of the present invention is to provide apparatus wherein the raising of the main ladder is accomplished by hydraulic means and wherein said hydraulic means includes novel valve mechanism which is particularly adapted for the requirements of aerial ladders.

A further object of the present invention is to provide in an aerial ladder equipped fire truck, means for bracing the truck against lateral tilting caused by a change in the center of gravity when the ladder is in an extended and laterally inclined position.

A further object of the invention is to provide fire apparatus of the class described which is strong and durable, efficient in operation and well adapted for the purpose described.

With the above and other objects in view the invention consists of the improved fire apparatus and all its parts and combinations as set forth in the claims and all equivalents thereof.

In the accompanying drawings illustrating one complete embodiment of the preferred form of the invention in which the same reference numerals designate the same parts in all of the views:

Fig. 1 is a side view of the fire apparatus showing the aerial ladder in extended position;

Fig. 2 is a fragmentary perspective view on an enlarged scale showing the turntable and associated mechanism, looking from the rear of the truck when the turntable is in normal position;

Fig. 3 is a rear view of the truck, parts being broken away and shown in section;

Fig. 4 is a front view of the turntable mechanism, parts being shown in vertical section and parts being broken away, the section through the housing 47 being taken in the plane of the paper for clarity whereas in reality said housing extends at an angle rearwardly;

Fig. 5 is a longitudinal sectional view through the control valve for the hydraulic cylinders;

Figs. 6, 7, 8 and 9 are diagrammatic views showing the valve mechanism and connections to one of the hydraulic cylinders, the cylinder being shown in longitudinal section and having a part broken away, and the various views showing different positions of adjustment of the valve;

Fig. 10 is a plan view showing a portion of the turntable structure and more particularly the control and connections for the selective clutches;

Fig. 11 is a side view of the clutch control.

Referring more particularly to the drawings, the apparatus comprises a motor driven truck 15 of conventional form having connected thereto a trailer structure 16 for holding ladders and other equipment. The truck is equipped with standard transmission and this is suitably connected to a sprocket wheel 17 and said sprocket wheel is connected by a chain 18 with a sprocket 19 mounted on a horizontal shaft 20 carrying a rigidly mounted bevel gear 21 (see Fig. 3). Through a horizontally disposed bevel gear 22 the power is transmitted to a substantially vertically extending shaft 23 extending upwardly at the rear of the truck.

The shaft 23 is formed with a universal joint 24 and extends into the bottom of a gear housing 25 (see Fig. 4). The gear housing 25 is secured to the end tubular trunnion members 26 which are journaled in bearings 27 formed on the upper ends of supporting arms 28. The arms 28 are mounted on a turntable 29 and said turntable is formed with a circular internal gear 30.

The shaft 23 has mounted on its upper end within the gear housing 25 a bevel gear 31 which engages a pair of bevel gears 32 and 33. The latter bevel gears are rigidly secured to roller bearing members 34 and 35 respectively which are normally loose on a shaft 36 extending entirely through the gear housing and through the

tubular trunnions 26. Disc clutches 37 and 38 surround a sleeve 39 which is keyed to the shaft 36 and said clutches may be selectively operated by means of a selector arm 40 to cause engagement of either the rotating bevel gear 32 or 33 with the shaft 36 through the fixed sleeve 39 to cause rotation of said shaft in a desired direction according to which clutch member is operated by the selector.

The selector arm 40 is fixed to a sliding rod 41 and the latter is connected by means of a pivoted arm 42 with a rod 43 secured to control handle 44 (see Fig. 10). It is obvious that manipulation of the control handle 44 will cause movement of the selector in a desired direction to cause engagement of the selected bevel gear with the shaft 36.

A bevel gear 45 mounted at the rear side of the housing 25 is in constant engagement with the bevel gears 32 and 33 and said bevel gear drives a shaft for a gear pump 46 the latter being utilized for circulating the hydraulic medium used in causing operation of the main ladder and to be hereinafter described.

One end of the shaft 36 projects into a side housing 47 and said housing is fixed to the trunnion 26 to move with the latter around and independently of the shaft 36. The end of the shaft 36 within the housing 47 has normally loosely mounted thereon a bevel gear 48 which may be caused to rotate with the shaft 36 by operation of a jaw clutch 49, said jaw clutch having an operating extension 50 projecting through the side of the housing 47. The bevel gear 48 engages a bevel gear 51 rigidly mounted on the lower end of a shaft 52 carrying a worm 53.

The worm 53 suitably engages a worm wheel mounted on a shaft 54 and said shaft is suitably journaled in bearings 55 carried by L-shaped brackets 56 and through bearings 57 carried by brackets 58 to which the brackets 56 are secured. The main ladder 59 is supported between the brackets 56 and 58 and there is therefore a connection between the ladders, brackets 58 and housing 47 and trunnions 26 so that these parts can all be rotated independently of the shaft 36 to cause raising of the ladder. In Fig. 4, the section through the housing 47, for purposes of clarity, is taken in the plane of the paper. In reality, however, said housing inclines rearwardly when the parts are in the position shown in Fig. 4.

Rigidly mounted on the shaft 54 is a reel 60 on which is wound a cable 61 the latter having its ends connected to a fly ladder 62, see Fig. 1, which is slidable relative to the main ladder 59. It is, therefore, apparent that when the jaw clutch 49 causes the bevel gear 48 to be driven, that this will in turn, through the bevel gear 51, worm 53 and shaft 54, cause rotation of the reel 60 to cause raising or lowering of the fly ladder relative to the main ladder according to the direction in which the shaft 36 is being driven and, as before mentioned, this direction is controlled through the selector 40.

The extension 50 of the clutch 49 is connected through a pivoted link 63 and arm 64 (see Fig. 10) with a control handle 65. The latter when in the full line position shown in Fig. 11 is in detachable engagement with the end of the rod 64 and may be moved forwardly or rearwardly, looking at said figure, to cause movement of the rod 64 and shifting of the clutch 49.

The other end of the shaft 36 extends into a housing 66 (see Fig. 10) and carries a normally loosely mounted worm 67. The jaw clutch 68

is operable to cause rotation of said worm 67 with the shaft 36 and driving of a worm gear 69 mounted on a shaft 70. The latter shaft carries on its lower end a gear 71 which engages the circular gear 30 of the turntable to cause rotation of the latter in a direction determined by operation of the selector 40.

The clutch 68 is operated by means of connected members 72 and 73 the latter being formed with a forked end which is engaged by the control lever 65 when the latter is moved laterally to the dotted line position shown in Fig. 11. When in said position the lower end of the lever disengages the rod 64 so that there is no operation of the clutch 49 when the clutch 68 is being controlled. The control lever 65, therefore, takes care of the operation of the turntable and the operation of the fly ladder.

By referring to Fig. 2 it may be seen that there are a pair of hydraulic cylinders 74 having their lower ends pivotally mounted as at 75. Said cylinders are formed with projecting piston rods 76 which engage the main ladder and which are adapted when the hydraulic cylinders are operated to cause raising of the main ladder from a position parallel to the other ladders on the trailer to an elevated position.

Figs. 6 to 9 inclusive illustrate diagrammatically the connection between the pump 46 and the hydraulic cylinders. Fig. 5 illustrates the control valve for the hydraulic cylinders and it will be seen that this valve consists of a housing 77 having a conical valve member 78 therein which is rotatable through a connection with the valve stem 79. Said valve stem 79 may be connected by suitable transmission with a shaft 80 (see Fig. 4) extending into a control housing 81. Said shaft is connected by means of bevel gears to a vertically extending shaft 82 and the latter carries a suitable operating handle 83 on its upper end (see Fig. 4). Movement of the handle 83 will cause rotation of the valve member 78 of Fig. 5 and control of the flow of hydraulic medium through the system. The valve housing 77 has extending therefrom tubular connections 84, 85, 86, 87 and 88. The valve member 78 has its upper end formed with a transversely extending passageway 89 and the side of the housing is formed with a duct 90 which extends to an intermediate portion of the valve body. The intermediate portion of the valve body is formed with a T-shaped passageway 91 (see Fig. 6) and the lower portion of the valve member is formed with a T-shaped passageway 93. The housing 77 is provided with a second duct 92 extending from the intermediate portion of the valve member to the lower portion thereof.

In the diagrams shown in Figs. 6 to 9 inclusive the valve structure of Fig. 5 is shown by means of three sections which are taken on the lines 6-6 of Fig. 5 and which are arranged in a position corresponding to the position of the valve in Fig. 5.

Referring to Fig. 6 the diagram indicates the position of the valve parts when it is desired to cause the aerial ladder to be forced down from an elevated position to a position on the trailer. The pump 46 is adapted to circulate any suitable hydraulic medium but it is found that a product such as Prestone which is not volatile under high velocity is desirable. When the ladder is to be forced down the hydraulic medium is caused to flow from the pump 46 through the conduit 94, to the inlet 86 in the lower portion of the valve. With the lower valve passageway 93 in the position shown in Fig. 6 the fluid will pass through

and will emerge from the conduit 87. From there it will pass a check valve 95 and will proceed through conduits 96 to the top of the hydraulic cylinders. In view of the fact that the fluid is entering the top of the cylinders the piston will be forced downwardly, causing lowering of the aerial ladder. The fluid from the bottom portion of the hydraulic cylinders will pass through conduits 97 to the conduit 88 of the valve body and with the passageway 91 of the valve member in the position shown in Fig. 6 the fluid will pass into the side duct 90 and through said duct to the conduit 85 at the upper end of the valve body. From said conduit the fluid will pass through conduit 98 back to the pump. In view of the fact that the fluid displaced from the bottom of the cylinders is more than sufficient to fill the top thereof above the piston because of the amount of room taken up by the piston rod, there will be a certain excess of fluid which will be by-passed through the relief valve 99 and line 99' into the reservoir 100.

Referring to Fig. 7, valve positions are shown for permitting lowering of the ladder by gravity. When there is no unusual wind condition and when there is no necessity for lowering the ladder with great rapidity the gravity lowering may be relied upon. However, it frequently happens in connection with an aerial ladder that when it is in raised position wind or the like will offer such resistance to its being lowered as to require a forced lowering operation and when this is the case or when unusual speed is required, then the valve is turned to the position of Fig. 6. When the ladder is being lowered by gravity the fluid in the bottom of the hydraulic cylinders is forced through the conduits 97 into the conduit 88 at the middle of the valve and from said conduit it passes through the valve member to the side housing duct 92 to the passageway 93 of the valve, and from said passageway through the conduits 87 and 96 into the top of the cylinder. Thus, the fluid is forced by gravity from the bottom to the top of the cylinder without being affected by the pump, and when this is being accomplished the pump may be shut off. Any excess fluid will pass through the conduit 101, through the valve passageway 89, through the conduits 85 and 99', to the reservoir 100.

When the ladder has been raised to a desired position it is necessary that it be maintained in said raised position. When this is done the valve passageways or ports are in the position shown in Fig. 8 and referring to said figure the fluid pumped by the pump 46 will pass through the conduit 94, through the valve passageway 93, to the duct 92, from said duct through the intermediate valve passageway 91, through the duct 90 and out the conduit 85. Thus the fluid will be circulated without passing through the cylinders and the position of the valve passageways 91 and 89 will prevent movement of the fluid in the cylinders.

When it is desired to raise the ladder, the arrangement is as shown in Fig. 9 wherein fluid from the pump 46 passes through conduit 94, passageway 93, duct 92, passageway 91 and conduits 97 to the bottom of the cylinders, thereby forcing the piston upwardly. The fluid from the top of the cylinders will be forced out through conduits 96, through conduit 101, through the valve passageway 89 and through the conduits 85 and 98 back to the pump. In view of the fact that the fluid displaced from above the piston is not sufficient to fill the lower part of the cylinder below the piston, the non-return check valve 102

will function to permit additional fluid to enter the system from the reservoir 100. Whenever there is a stoppage in any part of the system the relief valve 102' functions to permit by-passing of the fluid around the pump.

It may thus be seen that an arrangement has been provided incorporating a novel valve structure particularly adapted to meet the requirements in the raising, lowering and holding of an aerial ladder and that it particularly fulfills the requirement of providing for a particular need in connection with aerial ladders, that is the need of a force down action.

When the aerial ladder is in the position shown in Fig. 1 and is inclined laterally from the truck, due to its height the center of gravity of the truck is changed and there is a tendency for the truck body to tilt. In order to prevent undesirable tilting a locking arrangement has been provided as shown in Fig. 3. The spring assembly on each side is formed with a socket 103 and the body of the truck has pivoted thereto on each side as at 104 dogs 105 which are engageable with the sockets 103. Rods 106 extend rearwardly from each dog and have their outer ends secured to a slidable member 107. An intermediate pivoted arm 108 has links 109 connected to opposite ends thereof and said arm is adapted to be moved by a lever 110. Movement of said lever will cause outward projection of the links 109 and movement of the members 107 which are guided in upper slots 111 and side slots 112. This will cause outward movement of the lower ends of the dogs 105 against the tension of the coiled springs 106 and engagement of the dogs with the sockets 103 to prevent tilting of the truck body. The lever 110 can be locked in holding position when desired.

From the above it may be seen that a very novel arrangement has been provided which makes it possible for a single man to control the rotation of the turntable, the raising of the main ladder and the raising of the fly ladder, and to also control the direction of said movements. It may also be seen that a very novel form of valve construction has been provided to meet the particular requirements connected with the hydraulic raising of the main ladder. It may also be seen that effective means has been provided for preventing lateral tilting of the truck body when the aerial ladder is in raised position.

Although only one form of the invention has been shown and described, it is obvious that various changes and modifications may be made and that all of such changes are contemplated as may come within the scope of the claims.

What I claim is:

1. Fire apparatus comprising, a supporting structure; a ladder pivotally mounted on said supporting structure for movement from a substantially horizontal position to an inclined raised position; hydraulic means for raising said ladder; and valve mechanism embodied in said hydraulic means constructed to selectively provide for raising of the ladder, forced lowering, lowering by gravity, and holding of the ladder in a desired position.

2. Fire apparatus comprising, a supporting structure; a turntable mounted on said supporting structure and having spaced bearings; a tubular trunnion journaled in said bearings; a ladder mounted on said trunnion; means for elevating said ladder; a drive shaft extending into said trunnion; a second shaft journaled within

said trunnion; means between said second shaft and said turntable for rotating the latter; transmission means between said ladder elevating means and the drive shaft; and clutch mechanism for causing driving connection between said drive shaft and the second shaft to operate the turntable.

3. Fire apparatus comprising, a supporting structure; a turntable mounted on said supporting structure and having spaced bearings; a tubular trunnion journaled in said bearings; a ladder mounted on said trunnion; means for elevating said ladder; a drive shaft extending into said trunnion; a second shaft journaled within said trunnion; means between said second shaft and said turntable for rotating the latter; transmission means between said ladder elevating means and the drive shaft; and reversible clutch mechanism for causing driving connection between said drive shaft and the second shaft to operate the turntable.

4. Fire apparatus comprising, a supporting structure; a turntable mounted on said supporting structure and having spaced bearings; a tubular trunnion journaled in said bearings; a main ladder mounted on said trunnion; a fly ladder movable with respect to said main ladder; means for operating said fly ladder; means for elevating said main ladder; a drive shaft extending into said trunnion; a second shaft journaled within said trunnion; means between said second shaft and said turntable for rotating the latter; means between said second shaft and the fly ladder operating means for driving the latter; transmission means between said main ladder elevating means and the drive shaft; clutch mechanism for causing driving connection between said drive shaft and the second shaft to operate the turntable and the fly ladder; and means for causing engagement and disengagement of the fly ladder operating means and the turntable with said second shaft.

5. Fire apparatus comprising, a supporting structure; a turntable mounted on said supporting structure and having spaced bearings; a tubular trunnion journaled in said bearings; a main ladder mounted on said trunnion; a fly ladder movable with respect to said main ladder; means for operating said fly ladder; means for elevating said main ladder; a drive shaft extending into said trunnion; a second shaft journaled within said trunnion; means between said second shaft and said turntable for rotating the latter; means between said second shaft and the fly ladder operating means for driving the latter; transmission means between said main ladder elevating means and the drive shaft; reversible clutch mechanism for causing driving connection between said drive shaft and the second shaft to operate the turntable and fly ladder; and means for causing engagement and disengagement of the fly ladder operating means and the turntable with said second shaft.

6. Fire apparatus comprising, a supporting structure; a turntable mounted on said supporting structure and having spaced bearings; a tubular trunnion journaled in said bearings; a main ladder mounted on said trunnion; a fly ladder movable with respect to said main ladder; means for elevating said main ladder; means for operating said fly ladder; a drive shaft extending into said trunnion and having a bevel gear rigid thereon; a second shaft journaled within said trunnion at right angles to said drive shaft and having a pair of loosely mounted bevel gears en-

gageable with opposite sides of the drive shaft bevel gear; clutch controlled transmission means between said second shaft and said turntable; clutch controlled transmission means between said second shaft and said fly ladder operating means, transmission means between said main ladder operating means and the drive shaft, and disc clutch mechanism for causing selective engagement of the bevel gears on the second shaft with said shaft.

7. In a ladder elevating apparatus, a pivotally mounted ladder; hydraulic pistons in connection with said ladder; cylinders in which said pistons are movable; a pump for circulating hydraulic medium; connections between said pump and said cylinders; and a valve interposed in said connections; said connections and valve being constructed to provide for forced raising of the ladder, forced lowering, lowering by gravity, and holding of the ladder in a desired position.

8. In a vehicle having an aerial ladder in connection therewith; means for preventing lateral tilting of the vehicle when the ladder is elevated and extended at an angle, comprising, sockets in connection with the vehicle axle, pivoted dogs in connection with the vehicle body, and means for causing movement of said dogs into and out of said sockets.

9. In a vehicle having an aerial ladder in connection therewith; means for preventing lateral tilting of the vehicle when the ladder is elevated and extended at an angle, comprising, a socket in connection with each side of one of the vehicle axles, a dog pivoted to each side of the vehicle body, and means for causing movement of said dogs simultaneously into and out of the sockets.

10. Fire apparatus comprising, a supporting structure; a turntable mounted on said supporting structure and having spaced bearings, a tubular trunnion journaled in said bearings, a ladder mounted on said trunnion, means for elevating said ladder, a drive shaft extending into the center of said trunnion, a second shaft journaled within said trunnion, means between said second shaft and said turntable for rotating the latter, and means providing a driving connection between said drive shaft and said second shaft.

11. Fire apparatus comprising, a supporting structure; a turntable mounted on said supporting structure and having spaced bearings, a tubular trunnion journaled in said bearings, a ladder mounted on said trunnion, means for elevating said ladder, a drive shaft extending into said trunnion, means between said second shaft and said turntable for rotating the latter, and clutch mechanism for causing driving connection between said drive shaft and the second shaft to operate the turntable.

12. Fire apparatus comprising, a supporting structure having spaced bearings; a tubular trunnion journaled in said bearings, a main ladder mounted on said trunnion, a fly ladder, means for elevating said main ladder, operating means for the fly ladder, a drive shaft extending into the center of said trunnion, a second shaft journaled within said trunnion, means between said second shaft and the fly ladder operating means for driving the latter, and means providing a driving connection between the drive shaft and the second shaft to operate the fly ladder.

13. Fire apparatus comprising, a supporting structure having spaced bearings; a tubular trunnion journaled in said bearings, a main ladder mounted on said trunnion, a fly ladder movable

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with respect to the main ladder, means for operating said fly ladder, means for elevating said main ladder, a drive shaft extending into said trunnion, a second shaft journalled within said trunnion, means between said second shaft and the fly ladder operating means for driving the latter, clutch mechanism for causing driving connection between said drive shaft and the second shaft to operate the fly ladder, and means for causing engagement and disengagement of the

fly ladder operating means with said second shaft. 14. In a vehicle having an aerial ladder in connection therewith, means for preventing lateral tilting of the vehicle when the ladder is elevated and extended at an angle, comprising a socket in connection with the vehicle axle, a pivoted dog in connection with the vehicle body, and means for causing movement of said dog into and out of said socket.

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