Aug. 5, 1958 H. E. RITTENHOUSE 2,845,965

TANK FILLING APPARATUS

Filed Dec. 30, 1953 7 Sheets-Sheet 1

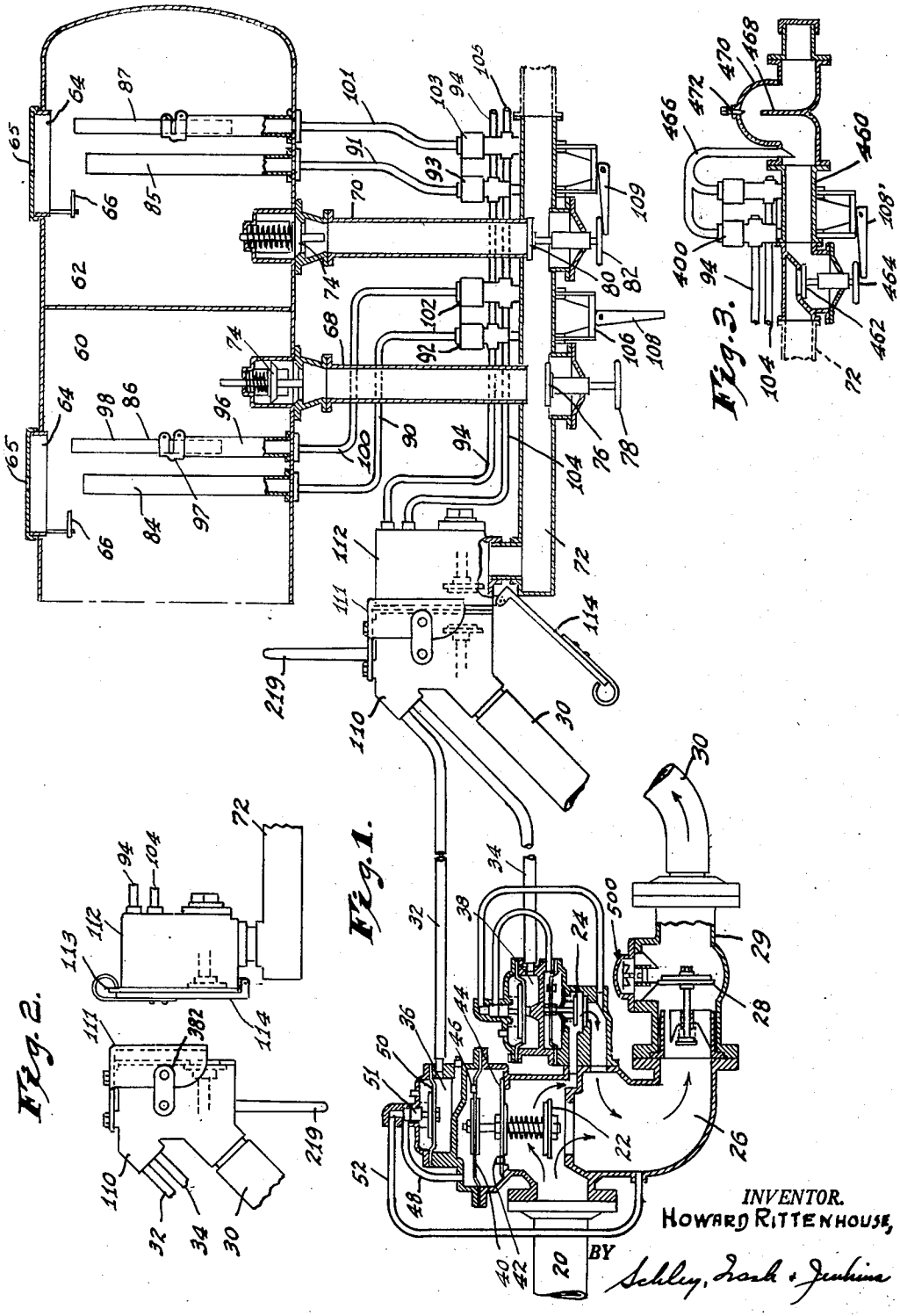


Fig. 1.

Fig. 2.

Fig. 3.

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TANK FILLING APPARATUS

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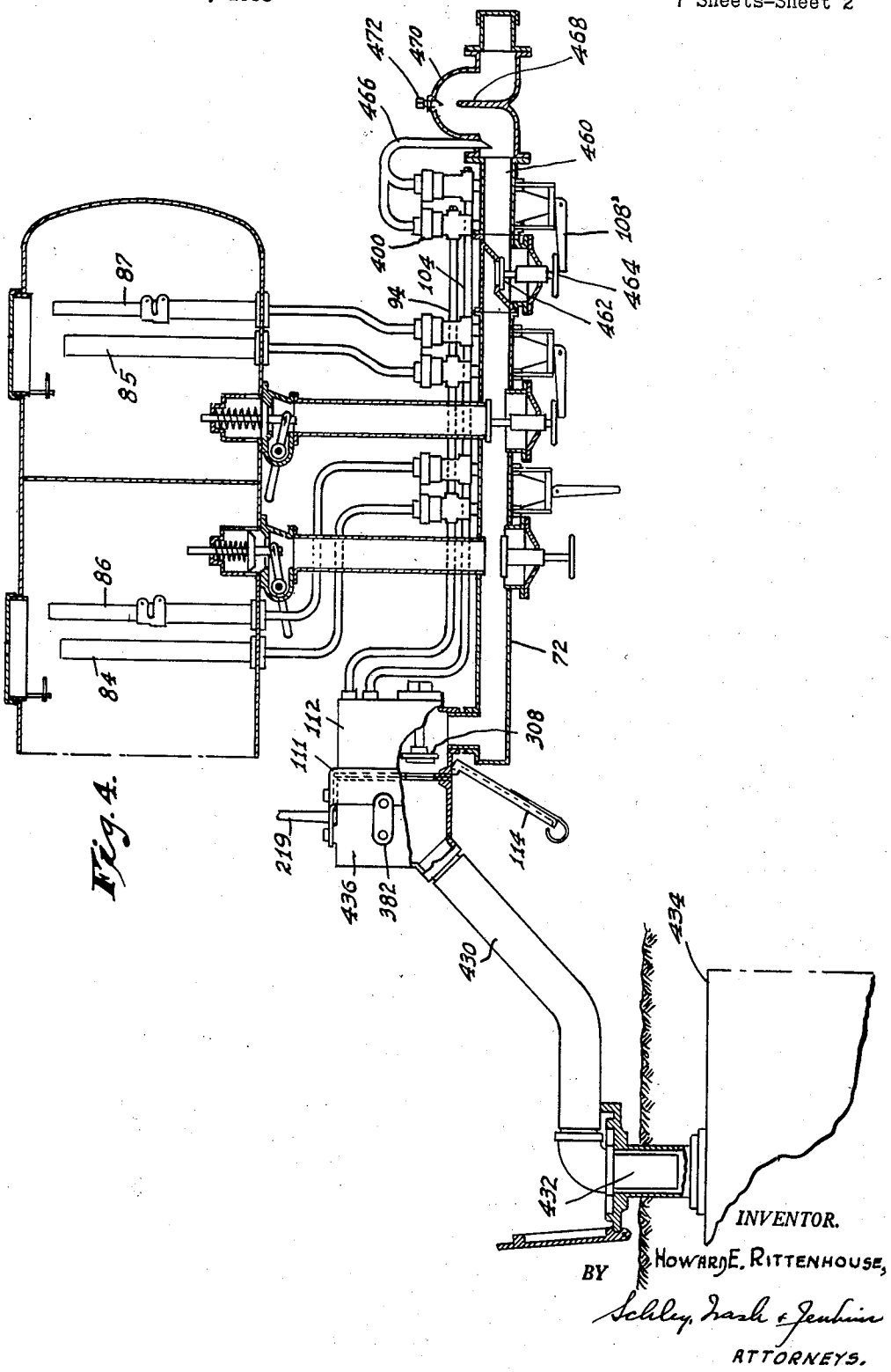


Fig. 4.

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TANK FILLING APPARATUS

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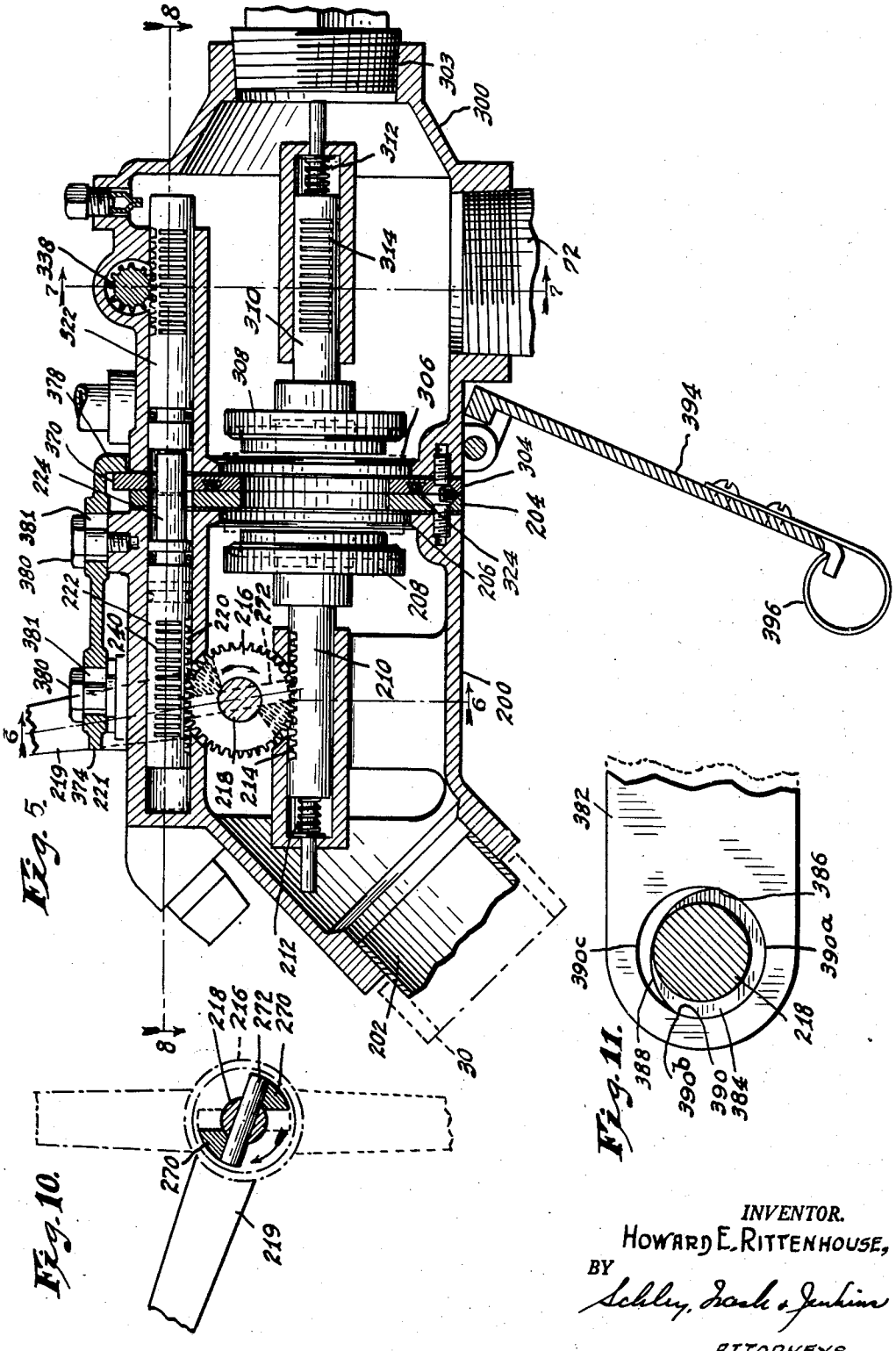


Fig. 5.

Fig. 11.

Fig. 10.

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TANK FILLING APPARATUS

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Fig. 6.

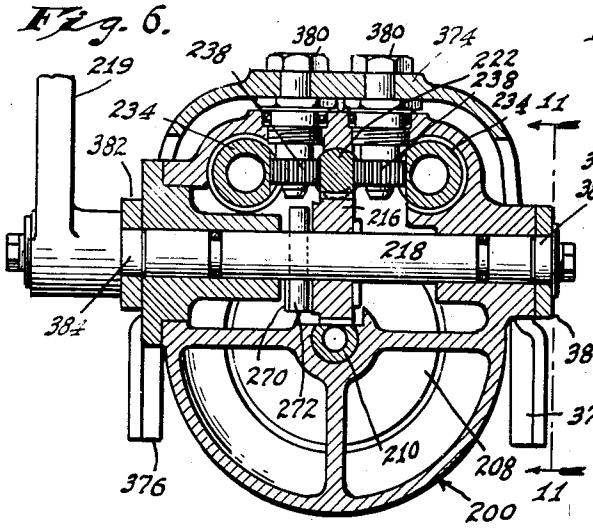


Fig. 7.

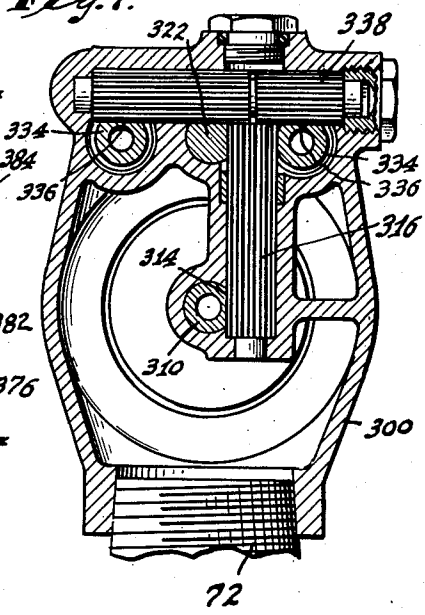
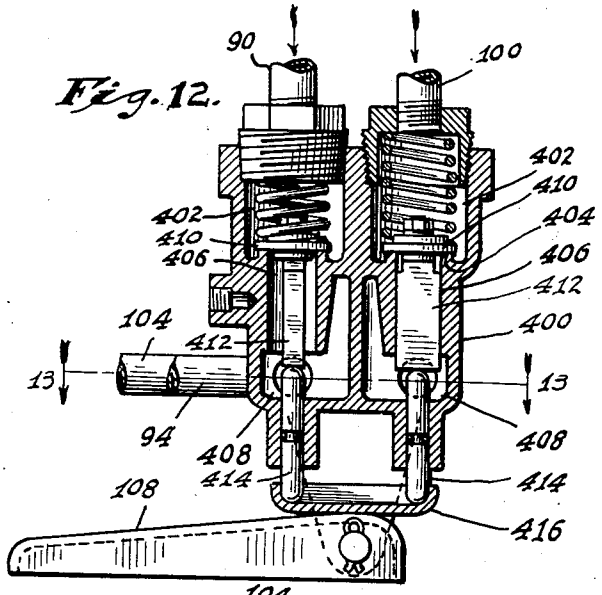


Fig. 12.



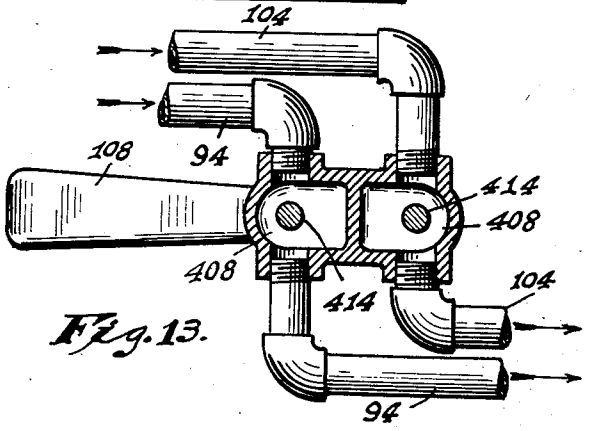


Fig. 13.

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TANK FILLING APPARATUS

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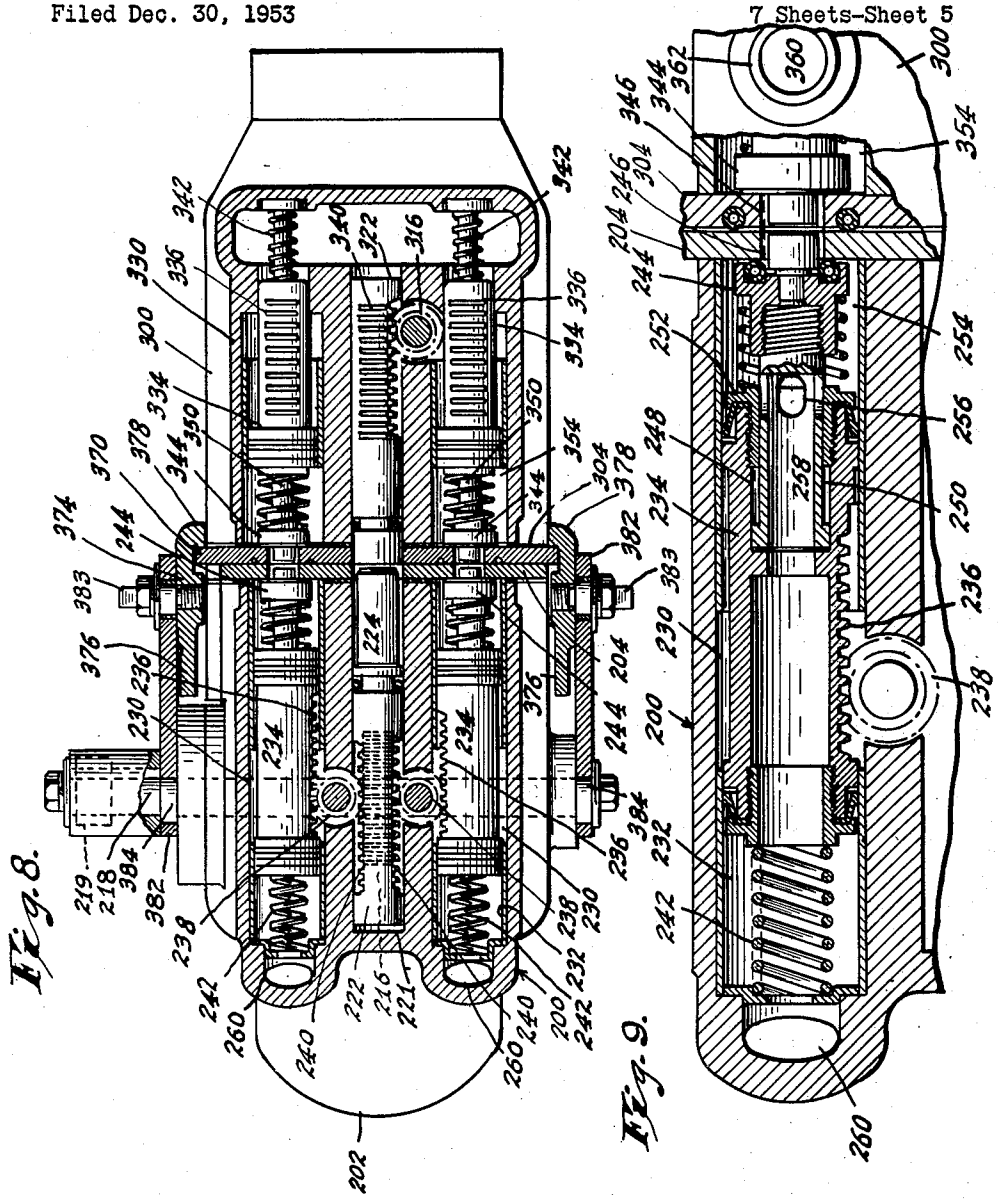


Fig. 8.

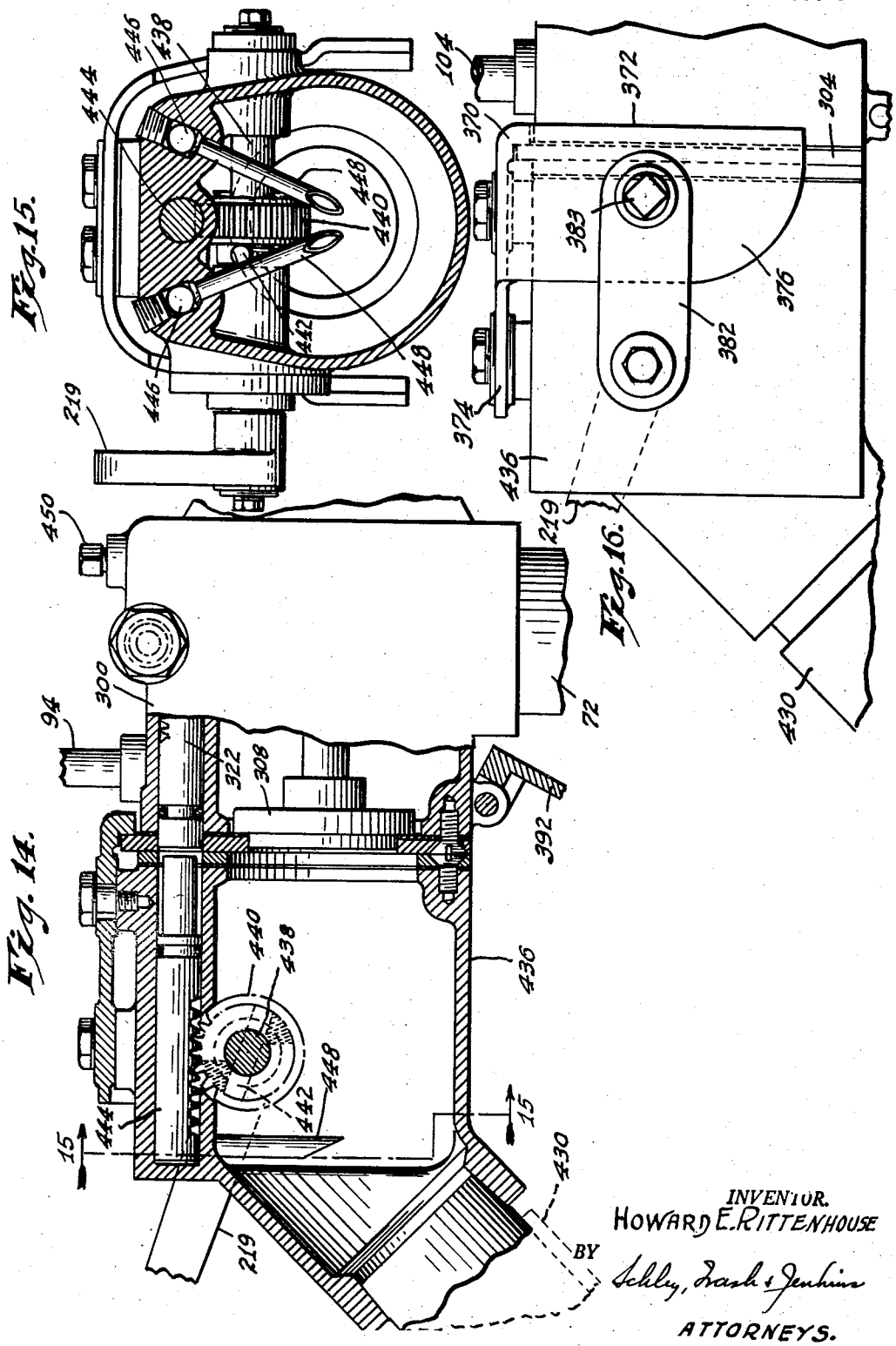
Fig. 9.

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TANK FILLING APPARATUS

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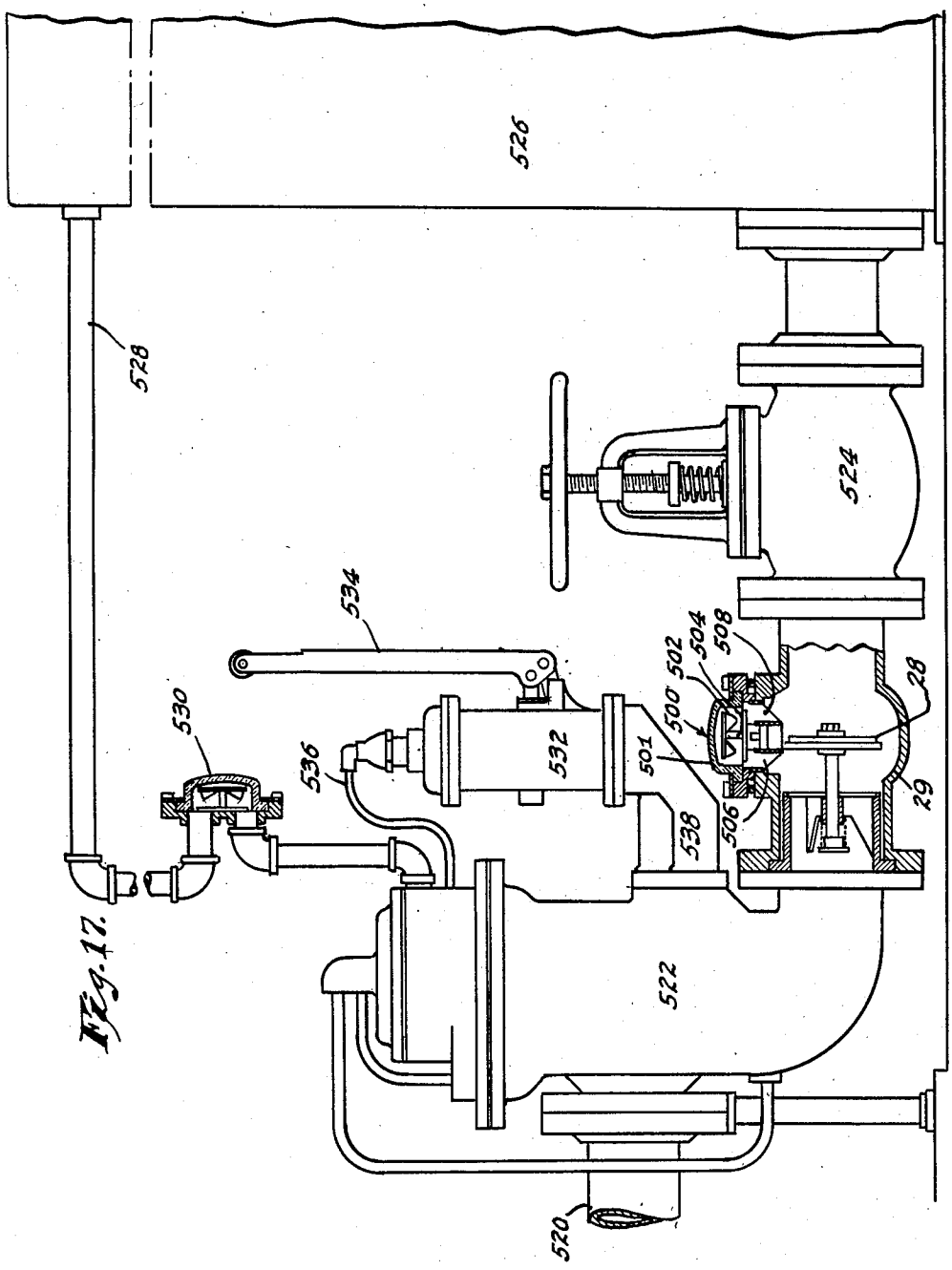


Fig. 17.

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TANK FILLING APPARATUS

Howard E. Rittenhouse, Fort Wayne, Ind., assignor to Tokheim Corporation, Fort Wayne, Ind., a corporation of Indiana

Application December 30, 1953, Serial No. 401,211

56 Claims. (Cl. 141—207)

This invention relates to apparatus for automatically filling tanks with liquids, especially for filling the tanks of delivery trucks with liquid fuels such as gasoline and fuel oil. The invention relates to improvements in the type of apparatus shown in my prior co-pending applications Serial No. 193,701, filed November 2, 1950, now Patent No. 2,678,658 granted May 18, 1954, and Serial No. 224,529, filed May 4, 1951, now Patent No. 2,731,029 granted January 23, 1956, and in the prior application of myself and Sherwood Hinds, Serial No. 160,266, filed May 5, 1950.

It is a primary object of the invention to provide improved apparatus for automatically filling a tank, such as the tank of a delivery vehicle, which automatically starts the filling operation when the appropriate connections are made and which automatically stops the filling flow at a predetermined fill-point, and especially apparatus in which the filling rate is decreased as the filling nears completion and is subsequently stopped at the predetermined fill-point for which the tank is calibrated. It is an object of the invention to provide improved apparatus of this type in which the filling is controlled by sensing means, such as one or more overflow tubes, which sense the level of liquid in the tank being filled. It is an object of the invention to provide such apparatus which is selectively operable to fill a plurality of tank compartments. It is an object of the invention to provide apparatus for draining such tanks, and to interrelate such draining apparatus with the sensing apparatus, so as to insure that the sensing tubes will be conditioned for a refilling operation during initial stages of draining. It is a special object of the invention to improve the convenience and practicability of such tank filling and draining apparatus, and to insure that proper connections will be made and that the sensing tubes of the tank or compartment being filled will control the filling operation. It is an object of the invention to provide relationships which will insure that the sensing apparatus will be in controlling condition during each filling operation. It is an object of the invention to embody in such filling and draining apparatus means by which draining operations may be stopped at a predetermined constant point without entrapment of variable liquid residues in the apparatus to give erroneous measurements. It is an object of the invention to provide a connector to which the supply mechanism may deliver liquid, and a receptacle adapted to receive that connector and to pass the liquid therefrom to the tank or tank compartments being filled. It is an object of the invention to provide such a connector and receptacle which by one operation will both connect the supply conduit to the tank and simultaneously connect the sensing apparatus of the tank to the control mechanism associated with the supply installation, and which will contain interrelated supply and control-line valves. It is an object of the invention to so relate the system to such valves that such control-line valves will maintain the supply valves closed until proper connections are made for filling, and by their opening will

initiate the filling operation. It is an object of the invention to combine in automatic tank-filling apparatus means to prevent back-flow through the supply connections, and means to permit observation of the operation of the enclosed apparatus, preferably with the observation means operatively associated with the back-flow preventing means. It is an object of the invention to embody in such filling and draining apparatus means by which the liquid may be discharged from the tank or compartment to metering apparatus, and to interrelate such discharging means with the sensing tube apparatus to condition it for a subsequent filling operation.

In apparatus embodying the invention as applied for filling vehicle tanks, a liquid supply source is connected through automatic valve mechanism to a hose assembly terminating in a coupling connector adapted to be releasably coupled to a coupling receptacle. Each tank vehicle is supplied with such a receptacle connected to the tank or tank compartments of the vehicle by fill pipes. The vehicle equipment also includes control lines connected to sensing elements which sense the liquid level in the tank or compartments as they are filled; and the automatic valve mechanism for the supply source is responsive to signals transmitted from such sensing elements through the control lines to the valve mechanism. In accordance with the invention, the vehicle receptacle, its mating connector, and the hose assembly, provide releasably connectible lines not only to transmit liquid from the supply source to the vehicle, but also to transmit control signals from the sensing elements to the valve mechanism. The connector and the receptacle fill passages contain normally closed coupling valves, desirably positioned at the meeting faces between the connector and receptacle, which are opened by manual actuation when the connector is clamped to a receptacle, and the valve operating and clamping mechanisms are interrelated to ensure that clamping will occur in advance of valve opening. Desirably, the primary actuating mechanism is carried by the connector and directly controls both the clamping mechanism and the connector valve mechanism, and is made effective to control the receptacle valve mechanism, as through an element which actuates a companion element of the receptacle.

Desirably, the control mechanism is hydraulic, in which case the connector and receptacle desirably include control-line valves which operate jointly with the main coupling valves. When closed, the control-line valves of the connector will normally trap in the supply system the small amount of liquid flow by which the fill-stopping signal is transmitted to the supply valve mechanism, and such entrapped signal liquid will normally maintain the supply valve closed. When the connector is then coupled to a vehicle receptacle for filling an empty tank of the vehicle, the opening of the connector control-line valves will release the entrapped signal liquid to the normally empty control lines of the vehicle. In consequence, the automatic supply valve will open and filling will start automatically, immediately as the coupling operation is completed. Desirably, therefore, the control-line valves of the connector are opened slightly later than the main coupling valves. Among other things, this will prevent the application of supply pressure on those main coupling valves and on the hose until after the coupling valves are at least partly open, and will facilitate the coupling operation.

When the vehicle carries a plurality of separate tank compartments, each may be individually connected to an individual receptacle. Desirably, however, a single receptacle may be used and valves are interposed between the compartments and the receptacle, to permit selective filling of the compartments; and the control lines of the vehicle contain inter-related control elements

such as valves, by which the sensing elements of the compartment being filled are placed in operative control of the supply valve mechanism and the sensing elements of other compartments are rendered inoperative.

Two methods of discharging or draining the filled vehicle tank compartments may be used. In one, a drain hose is provided having a terminal connector which is adapted to be received on the tank receptacle and which includes mechanism for clamping the coupling parts together, and desirably inter-related mechanism for opening the receptacle valves. For the second draining method, the fill piping of the vehicle is provided with an outlet for connection to a meter through which metered discharge may be made. For either method, the flow passages are arranged and equipped, as with anti-siphon devices, to ensure that complete draining will stop at a point which leaves a predetermined residue of liquid in the piping. The draining equipment for both methods is inter-related with the sensing mechanism, to condition the sensing mechanism for a refilling operation. For this purpose, the discharge mechanism may be provided with ejector devices to empty the hydraulic sensing tubes and lines of the vehicle during initial stages of discharging.

Since the automatic filling apparatus will normally be an otherwise closed system in which operation cannot be readily observed, the system in accordance with the invention desirably includes a visually observable indicator. This is desirably included in the supply mechanism in combination with a check valve therein which diverts at least part of the filling flow to a flow indicator, especially under slow-flow conditions. This and certain other aspects of the invention will be useful in automatic tank filling systems generally, without restriction to systems for filling vehicle tanks.

The above-mentioned and other objects and aspects of the invention will be evident from and illustrated by the following description and claims and the accompanying drawings.

The accompanying drawings illustrate the invention. In such drawings:

Fig. 1 is a schematic view of a filling apparatus as a whole, including supply control valve mechanism, connector and receptacle mechanism, and interrelated mechanism associated with the tank or compartments to be filled;

Fig. 2 is a fragmentary view of the apparatus shown in Fig. 1, showing the connector and receptacle separated;

Fig. 3 is supplemental to Fig. 1 and shows means for use in discharging liquid to a metering device;

Fig. 4 is a view similar to Fig. 1, showing the tank equipment connected for draining;

Fig. 5 is a central longitudinal vertical section of the preferred form of connector and receptacle;

Fig. 6 is a transverse section of the connector shown in Fig. 5;

Fig. 7 is a transverse section of the receptacle shown in Fig. 5;

Fig. 8 is a horizontal section of the connector and receptacle shown in Fig. 5, taken on the line 8—8 of Fig. 5;

Fig. 9 is an enlarged fragmentary section of one of the connector valve carriers appearing in Fig. 8, and showing the construction thereof;

Fig. 10 is a diagrammatic view, taken generally from the same point of view as Fig. 5, and showing the lost motion connection between the operating shaft of the connector and the valve-operating gear which that shaft carries;

Fig. 11 is a section taken on the line 11—11 of Fig. 6, showing the cam by which the yoke of the connector is operated to clamp the connector to the receptacle;

Fig. 12 is an axial section of one of the sensing mechanism valves shown in Fig. 1;

Fig. 13 is a section taken on the line 13—13 of Fig. 12;

Fig. 14 is a longitudinal vertical section of a drain-hose connector, coupled to the receptacle of Fig. 5;

Fig. 15 is a transverse section taken on the line 15—15 of Fig. 14;

Fig. 16 is a side elevation showing the clamping mechanism by which a fill or drain connector is clamped to the receptacle; and

Fig. 17 is a diagrammatic view showing apparatus for filling a stationary tank and in which certain aspects of the present invention are embodied.

Supply control apparatus

The supply control apparatus shown in Fig. 1 is generally similar to that of my prior co-pending application Serial No. 224,529. It comprises a supply pipe **20** through which the liquid is supplied under suitable pressure, as from a gravity tank or from a pump. It includes a main valve **22** and an auxiliary valve **24** which, when open as shown, pass liquid from the supply pipe **20** to the elbow **26**, and thence through a check valve **28** in a fitting **20** to a fill hose **30**. Small control-line hoses **32** and **34** are associated with the fill hose **30** and are connected to transmit to control chambers **36** and **38** of the supply valve operating mechanism pressure signals from the sensing apparatus mounted in the tank compartments, as described below. The main valve **22** closes in the direction of flow, is spring pressed to closed position, and is controlled by a diaphragm **40**. A by-pass control stream of liquid flows from the supply pipe **20** through a nipple **42** in the valve supporting plate **44**, thence through a restricted-opening nipple **46** in the diaphragm **40**, thence through a pipe **48** to a pilot valve **51** closing with flow and controlled by a diaphragm **50** exposed to the control chamber **36**, and thence through a pipe **52** to the elbow **26** at the discharge side of the main valve **22**. When the pressure in the control chamber **36** is low, the diaphragm **50** opens the valve **51** to permit flow through the path just described. The restriction on that flow imposed by the restricted nipple **46** creates such a pressure drop across the diaphragm **40**, that the higher pressure below that diaphragm and the lower pressure above it cause it to lift the main valve **22** to an open position. When a sensing response or signal transmitted through the hose **32** from the tank raises the pressure in the control chamber **36**, that increased pressure lifts the diaphragm **50** and closes the valve **51**, thus shutting off at that point the by-pass control flow. With that flow cut off at the valve **51**, the pressures on the opposite sides of the diaphragm **40** are promptly equalized by flow through the nipple **46**, and the main valve **22** then closes under the pressures of its spring and of the supply liquid. A substantially similar control mechanism is associated with the auxiliary valve **24**, and is responsive to pressure signals transmitted through the hose **34** to the control chamber **38**.

Tank apparatus

In Fig. 1, the tank to be filled is shown as the tank of a delivery vehicle, divided into two compartments **60** and **62**. In accordance with standard practice, each of these has a covered manhole **64**, and has been calibrated to contain a certain quantity of liquid when filled to the calibration marker **66**. The compartment **60** is connected by a fill and drain pipe **68**, and the compartment **62** is connected by a similar pipe **70**, to a manifold pipe **72**. The drain and fill pipes **68** and **70**, hereinafter called fill pipes, are connected to their compartments through spring-closed valves **74**, which open in the direction of filling flow and which prevent draining flow unless those valves **74** are opened manually by means not shown in Fig. 1. Communication between the fill pipe **68** and the manifold pipe **72** is controlled by a manually operable main tank-valve **76**, operated by a hand wheel **78**. Com-

munication between the fill pipe **70** and the manifold pipe **72** is controlled by a main tank-valve **80** operated by a hand wheel **82**.

The tank **60** contains a pair of sensing tubes, including a "slow-tube" **84**, and the "stop-tube" **86**. The tank **62** contains similar tubes **85** and **87**. The "slow-tube" **84** is open at the top and terminates at a point spaced below the calibration mark **66**. Its bottom end is connected by a pipe **90** to a normally closed selector valve **92**, and through that valve to a "slow" control line **94**. The "stop-tube" **86** is desirably of adjustable height, as by being made of a pair of telescoping tubes **96** and **98**, suitably sealed to each other and secured in adjusted position by a clamp **97**. The upper end of the "stop-tube" **86** is adjusted to the calibrated level indicated by the marker **66**, and its upper end is open. At the bottom, it is connected by a pipe **100** to a normally closed selector valve **102**, and through that valve to a "stop" control line **104**. The valves **92** and **102** are controlled in common by a yoke **106**, and this in turn is controlled by a manual lever **108**. The valves **92** and **102** are positioned in interfering relationship with the main tank-valve **76**. Thus, in closed position, the lever **108** overlies the closed position of the hand wheel **78** for the main tank-valve **76** which controls filling flow to the compartment **60**. When the lever **108** is swung outward to the position shown in Fig. 1, its cam-shaped inner end pushes the yoke **106** inward to open both of the paired valves **92** and **102** and to put the two sensing tubes **84** and **86** into open communication with the control lines **94** and **104**.

The sensing tubes **85** and **87** contained in the compartment **62** are similarly connected by pipes **91** and **101** to normally closed valves **93** and **103**, through which they may be put in open communication with the control lines **94** and **104**, by operation of the manual valve lever **109**.

Coupling

The supply apparatus is connected to the tank apparatus by a separable coupling comprising a connector **110** and a receptacle **112**, shown in side elevation in Figs. 1 and 2. The connector **110** is connected to the fill hose **30** and to the control-line hoses **32** and **34** and contains separate valved fill and control passages for connection to similar valved passages in the receptacle **112** and through them to the manifold **72** and to the control-lines **94** and **104**. The receptacle **112** carries a flange **113** at its coupling face, and the connector **110** carries a reciprocable clamp **111** to engage that flange and secure the coupling parts **110** and **112** together. Desirably, the receptacle **112** carries a hinged cover plate **114** to protect its coupling face when no connector is engaged with it.

General operation

When the supply apparatus and the tank apparatus shown in Fig. 1 are connected for filling through a fill-connector **110** and a receptacle **112**, the fill hose **30** communicates with the manifold pipe **72** through valves held in open position as by the mechanism described below, and the small hoses **32** and **34** respectively communicate with the control lines **94** and **104**. If it is assumed that the sensing tubes **84** and **86** of the compartment **60** are empty, as they would normally be at the beginning of the filling-operation, and that the main tank-valve **76** between the manifold **72** and the tank compartment **60** is open as shown, the pressures in the control chambers **36** and **38** will be low, so that the diaphragms responsive to those pressures will be in their downward positions and the valve **51** responsive to the control chamber **36** and the valve correspondingly responsive to the control chamber **38** will be open. By-pass control flow will then occur to create upward pressure drops across the diaphragm **40** controlling the main valve **22** and across the corresponding diaphragm controlling the auxiliary valve **24**. Both valves will open, and supply flow will occur from the supply pipe **20** through the valves **22** and **24**, through the check valve **28**, the hose **30**, the connector **110** and receptacle **112**, the manifold pipe **72**, and the fill pipe **68**, to the compartment **60**. That filling flow will be at the full rate determined by the supply source, and the compartment **60** will rapidly fill with liquid. When the level of that liquid reaches the top of the slow-tube **84**, liquid will overflow into that slow-tube **84**, and its static head will cause flow through the pipe **90**, the valve **92**, the "slow" control line **94**, and the small hose **32**, to the control chamber **36**. This static head and resulting flow will constitute a "slow" control signal, which will raise the diaphragm **50** and close the control valve **51** to cut off the by-pass control flow. The pressure drop across the diaphragm **40** will disappear, and the main valve **22** will be closed by its spring and by the pressure of the supply liquid. The flow rate will accordingly be reduced to that which is permitted by the auxiliary valve **24**. A slow-rate filling flow will then continue through the same path, until the liquid in the compartment **60** reaches the top of the stop tube **86** and overflows into that stop tube. The static head and flow of the liquid which overflows into the stop tube **86**, will be transmitted as a "stop" control signal, through the pipe **100**, the valve **102**, the stop control line **104**, and the small hose **34** to increase the pressure and volume in the control chamber **38**. This will lift the control diaphragm for the auxiliary valve **24**, and will result in the closing of that auxiliary valve **24**. Flow will now stop, with the compartment **60** filled to its calibrated volume.

Each tank-compartment is provided with a vent, here shown as an opening **65** in the manhole cover, to release air displaced by the incoming liquid. In the event the tank compartment vent is clogged, and back-pressure builds up in the compartment, such back pressure will be transmitted through the sensing tubes and control-lines to actuate one or both of the supply valve control diaphragms. Such actuation will close one or both of the supply valves **22** and **24** to decrease the fill flow until the back-pressure has dropped. As the back-pressure drops, the filling will be resumed.

By closing the main tank-valve **76** and the sensing control valves **92** and **102** for the filled compartment **60**, and by opening the corresponding valves **80**, **93**, and **103** for the compartment **62**, that compartment **62** can be filled in the same manner. The opening of the valves **93** and **103** to connect the empty sensing tubes **85** and **87** of the compartment **62** with the control lines leading to the control chambers **36** and **38** will drop the pressures in those control chambers, with the result that the supply valves **22** and **24** will open. Flow will immediately start and will continue, to fill the compartment **62**, until first slowed and then stopped by the sensing action of the sensing tubes **85** and **87**.

Connector and receptacle

In Figs. 1 through 4, for explanatory purposes, the control lines **94** and **104** are shown connected to the receptacle **112** in vertically spaced relationship, and the small control-line hoses **32** and **34** are similarly shown connected to the connector **110** in vertically spaced relationship. While the parts might be so located, a side-by-side arrangement is used in the preferred form of connector and receptacle shown in Figs. 5 through 14.

As shown in Fig. 5, the fill hose connector **200** comprises a housing having a downwardly inclined nipple **202** at its rear end for connection to the fill hose **30** and which communicates with a main supply or fill passage through the housing. At its opposite end, the housing is closed by a coupling face-plate **204**. The inside of that plate **204** forms a seat **206** for a main connector valve **208**, which closes in the direction of flow from the connector **200**. The port defined by the valve seat **206** is the outlet for the fill passage of the connector **200**, and the valve **208** may be referred to as the connector

outlet valve. The head of the valve **208** is carried by a stem **210**, and the valve is spring pressed to closed position by a spring **212**. One side of the stem **210** carries a rack **214** in mesh with a gear **216** carried by the operating shaft **218**, and operated thereby (with certain lost motion) as set forth below. At the top, the gear **216** meshes with a rack **220** on the bottom of a reciprocable element or plunger **222**. When the operating shaft **218** is rotated clockwise in Fig. 5, it retracts the valve **208** from seated position, and thrusts the plunger **222** forward, to project its reduced forward end **224** through an opening in the face-plate **204**.

The receptacle **300** shown in Fig. 5 comprises a housing having a lower threaded opening to which the manifold pipe **72** is connected, as indicated in Fig. 1, and may have a rear threaded opening **303** for use when the receptacle is connected directly to a fill pipe (**68** or **70**). The receptacle **300** has a coupling face-plate **304** at its forward end, which forms a seat **306** for a main receptacle valve **308**, carried by a stem **310**, and spring pressed to closed position by a spring **312**. The stem **310** of the main valve **308** carries a rack **314** on its side. Immediately above and parallel with the stem **310** there is a reciprocable element or plunger **322**, alined with the connector plunger **222** and adapted to be moved axially by the projected forward end **224** of the connector plunger. The plunger **322** and the stem **310** are interconnected for movement together, by an elongated gear **316**, as shown in Fig. 7. Accordingly, when the operating shaft **218** is actuated to open the valve **208** and to advance the connector plunger **222**, the advancement of the connector plunger moves the receptacle plunger **322** to the right in Fig. 5, and the gear **316** transmits this motion to the stem **310**, and opens the valve **308**. Accordingly, the two valves **208** and **308** are opened and closed substantially simultaneously by action of the operating shaft **218** when the connector and receptacle are in relationship shown in Fig. 5.

In this relationship, the plates **204** and **304** are clamped face-to-face, and are sealed about the valve openings by annular sealing gaskets **324**, preferably carried by the plate **304**.

The movement of the plungers **222** and **322** also control certain valves through which the control lines **94** and **104** are connected to the control hoses **32** and **34**, as shown in Fig. 8. At each side of the bore **221** containing the plunger **222**, the housing of the connector **200** forms a bore **230**, preferably containing a liner **232**, for the reception of a valve-controlling slide or piston **234**. Each piston has a rack **236** on its inner side, in mesh with a gear **238**, which is also in mesh at a diametrically opposite point with a rack **240** formed on the side of the plunger **222**. Each piston **234** is spring pressed toward the end plate **204** of the connector by a spring **242**, and at its opposite end carries a control-line valve **244** which controls flow through a port **246** in the plate **204**. Figs. 8 and 9 show the pistons **234** in their normal fully advanced positions, corresponding to the normal fully retracted position of the plunger **222** from which they are driven. As the plunger **222** is advanced from its retracted position, as to the position shown in Fig. 5, by clockwise rotation of the gear **216** in Fig. 5, its advance movement drives the gears **238** in directions to retract the pistons **234**, and to open the valves **244**.

It is desirable to open the control-line valves 244 at a time after the main valve **208** has been at least partially opened. To this end, the valves **244** are connected to their pistons **234** by a lost-motion connection shown in Fig. 9. As shown in Fig. 9, the piston **234** is hollow. At its forward end, it is provided with a bore **248** for the reception of the stem **250** of the valve **244**. The stem **250** is flanged at its rear end and has a limited amount of lost-motion sliding movement axially of the piston **234**. It is retained in the piston by a bushing **252** threaded into the open end of the piston and serving also to clamp a sealing ring to the piston. When the valve **244** is open, its valve port **246** communicates with the valve chamber **254** about the stem of the valve ahead of the piston **234**. The valve chamber **254** communicates through cross bores **256** with the bore **258** in the valve stem **250**, which is in open communication with the rearwardly extending passage in the piston **234**. At the rear of the housing, the piston passage communicates with a port **260** leading to one of the two control-line hoses **32** and **34**. Thus, when the valve **244** is open, its port **246** is put in open communication with a hose **32** (or **34**) leading to the control chamber of a supply valve **22** (or **24**).

The valve ports **246** in the face-plate **204** of the receptacle communicate with alined valve ports **346** of the end plate **304** of the recpectable **300**. These alined ports **346** are normally closed by control-line valves **344**, which open simultaneously with the valves **244**.

Opening and closing movements of the receptacle control-line valves **344** are effected in response to the movement of the main control plunger **222** in the connector. As has been pointed out in connection with Fig. 5, when the plunger **222** is advanced, it actuates an alined plunger **322** in the receptacle **300**, and this in turn actuates the valve **308** through the connecting gear **316**.

As shown in Figs. 7 and 8, the receptacle control-line valves **344** are carried by pistons **334** which are movable axially in bores **330** extending parallel with and at opposite sides of the receptacle plunger **322**. The valves **344** may have a lost-motion connection with those pistons **334** similar to the lost-motion connection shown in Fig. 9, but in this case the valve stems **350** are solid, and there is no passage of fluid through the pistons **334**.

The pistons **334** are spring pressed toward the end plate **304** by springs **342**, and the valves **344** are yieldingly urged toward their outermost positions with respect to their pistons **334** by springs surrounding their stems **350**.

The tops of the two pistons **334** carry racks **336**, and the top of the receptacle plunger **322** carries a rack **340**. An elongated gear **338** overlies the three racks **336** and **340** and operatively interconnects the pistons **334** to the receptacle plunger **322**. In consequence, when the plunger **322** is retracted by the advance movement of the main control plunger **222**, it actuates the gear **338** to retract the pistons **334** of the receptacle and to open the control-line valves **344** of the receptacle.

When those valves **344** are open, their ports **346** are interconnected with the valve chambers **354**, which respectively interconnect directly with ports **360** in nipples **362** which are respectively connected to the control lines **94** and **104**. Accordingly, when the valves **344** of the receptacle are open, the control lines **94** and **104** are put into open communication respectively with the two ports **346** in the end plate **304** of the receptacle, and through the alined ports **246** and the piston mechanism shown in Fig. 9, are put into communication with the ports **260** leading to the control-line hoses **32** and **34**.

Clamping mechanism

As indicated in Fig. 1, the receptacle **300**, like the receptacle **112** in Fig. 1, will be carried by the tank vehicle, and permanently connected to a fill pipe or manifold by which the tank or tanks are filled and drained. The connector **200**, like the connector **110** in Fig. 1, will be permanently connected to the fill hose **30** and the control hoses **32** and **34** of the supply mechanism shown at the left in Fig. 1, and is adapted to be releasably clamped to the vehicle receptacle **300**, with its main and control-line valve ports in alinement with the main and control-line valve ports of the receptacle, and with its main actuating plunger **222** in alinement with the receptacle actuating plunger **322**. For the purposes of clamping the connector to the receptacle, the

end plate **304** of the receptacle projects upwardly (Fig. 5), and laterally (Fig. 8) beyond the sides of the housing of the receptacle **300**, to form a flange **370** to receive a clamping yoke **372** carried by the connector **200**. As shown in Figs. 6 and 16, the yoke **372** comprises a top plate **374** and depending side members **376**, which are formed at their front edges with inturned flanges **378** to engage behind the flange **370** on the receptacle. The yoke **372** is slidable axially of the connector **200**, and is held thereon by bolts **380** extending through slots **381** in the top plate **374**. The depending side members **376** of the yoke are conneced by draw bars **382** to cams **384** (Fig. 6) on the ends of the operating shaft **218**. Desirably, the draw-bars **382** are attached to the yoke by eccentric studs **383** which may be adjusted to adjust the clamping pressure exerted by the yoke.

The connector **200** may be coupled to the receptacle **300** by bringing the connector **200** into face-to-face engagement with the connector **300** in an elevated position, then lowering the connector **200** to engage the yoke flange **378** behind the receptacle flange **370**, and then actuating the operating shaft **218** by its handle **219** to draw the yoke rearwardly and to secure the connector in firm sealing engagement with the receptacle **300**.

It is desirable to complete this clamping operation before any of the valves of the receptacle or connector are opened. To this end, the parts are arranged so that the first movement of the operating shaft **218** and its handle **219** effects the clamping without actuating the valve control gear **216**, and subsequent movements maintain the clamping force while driving the valve-actuating gear **216**. As shown in Figs. 5, 6, and 10, the gear **216** is loosely carried by the operating shaft **218**, and is provided on its face with a pair of lugs **270** which lie in the path of a cross pin **272** carried by the operating shaft **218**.

A suitable clamping cam **384** for the operating shaft **218**, to actuate the yoke draw-bars **382**, is shown in Fig. 11. The cam **384** carries a cylindrical land **386** of about 180° length, extending counterclockwise from a rise **388** which joins the cylindrical land at a cam lead point **390**. As shown in Fig. 11, clamping movement of the cam is clockwise, and the cam is shown in its position at the end of its clamping movement.

The operation and inter-relationship of the clamping mechanism and the valve actuated mechanism of the connector **200** may be explained with special reference to Figs. 10 and 11. When the handle **219** lies in its downward or released position as shown in dotted lines in Fig. 10, the pin **272** of the operating shaft **218** which drives the valve-operating gear **216** is at the counterclockwise limit of its lost motion with respect to the lugs **270** on the gear **216**. Under these conditions, the cam **384** lies in a position in which its lead point **390** is at the position indicated in Fig. 11 by the reference numeral **390***a*, and the draw-bar **382** is in its release position shown in dotted lines in Fig. 11. By swinging the handle **219** from its downward dotted line position (Fig. 10) clockwise through about 110°, to its position shown in full lines in Fig. 10, the valve gear driving pin **272** is moved through its lost motion with respect to the lugs **270** on that gear **216**, and during this movement of the handle and of the shaft **218**, the cam **384** moves to the position shown in full lines in Fig. 11. At this position it has moved the draw-bar to its clamping position, and its lead point lies at the point marked **390***b*. The draw-bar **382** now engages the cylindrical land of the cam, and the cam can be moved further without releasing the clamping force. If the handle **219** is now moved from its full line position in Fig. 10 to its upward final position shown in chain lines, the pin **272** drives the gear **216** clockwise, and that clockwise gear movement through about 70° actuates the valve mechanism shown in Figs. 5 through 9 to open all of the main and control-line valves of the connector **200** and the receptacle **300**. The filling operation will then proceed automatically.

As has been noted, the main or supply-passage valves **208** and **308** will open in advance of the control-line valves of the coupling. When the control-line valves are opened, they will release liquid and pressure from the control-line hoses **32** and **34** and from their connected supply-valve control chambers **36** and **38**. That release will cause the supply valves **22** and **24** to open, and when the supply passages therefrom to one of the tank compartments are open, the filling operation will start as a consequence of opening the control-line valves of the coupling.

When the filling operation is completed, and stopped by the presence of liquid in the sensing tubes of the tank, the coupling valves are closed by swinging the handle **219** to its full-line position shown in Fig. 10. The closing of the connector control-line valves **244** will trap in the connector control-lines and chambers the liquid which flowed as the "slow" and "stop" signals, and the supply-valve mechanism will be held in valve-closed condition as a result. The connector **200** may now be released from the receptacle **300**, by swinging the handle **219** counterclockwise as shown in Fig. 10 to its downward position. Normally, the handle will be moved continuously from its upward to its downward positions, and during the first part of this movement, the several valves of the connector and receptacle will be closed, and during the latter part of this movement, the clamping yoke will be released. The receptacle **200** is then lifted to release the yoke flange from the receptacle flange.

To protect the receptacle in the absence of a coupled connector, as when the vehicle is delivering the filled liquid, the receptacle is desirably provided with a hinged cover plate **394** which can be swung upward from the position shown in Fig. 5 to a position against the face plate **304** of the receptacle. It may be retained in closed position by a spring clip **396** which latches over the flange **370**.

Control selector valves

As has been noted in connection with Fig. 1, when the tank contains a plurality of compartments, the sensing tubes of the compartment to be filled must be selectively connected to the control lines **94** and **104**, while the sensing tubes of other compartments are rendered inoperative. For this purpose, the valves **92** and **102** (and **93** and **103**) of Fig. 1 are desirably combined in a duplex valve as shown in Figs. 12 and 13. The valve body **400** contains two valve chambers **402** which are respectively connected to the control lines, **90** and **100** or **91** and **101** in Fig. 1, leading from the sensing tubes of the related tank compartment. Valve seats **404** are formed at the bottoms of these compartments **402**, and valve ports **406** lead downwardly therefrom to separate outlet chambers **408**, which are respectively connected to the control lines **94** and **104**. Valves **410** are spring pressed to closed position against the valve seats **404**, and close in the direction of flow from the valve chambers **402** to the outlet chambers **408**. The valves are held in alinement with their seats by rectangular stems **412** which ride in the valve ports **406**. The valve stems are respectively engaged by operating plungers **414** which are jointly operable by a yoke **416** actuated by a cam lever, for example, cam lever **108** shown in Fig. 1.

Gravity discharge

Gravity discharge is normally used when one or more tank compartments are to be completely emptied into an underground storage tank. Apparatus for this purpose is shown in Figs. 4, 14, and 15. A drain-hose fitting is provided having a hose **430** terminating at its free end in an outlet nozzle **432** for insertion in the fill pipe of the underground tank **434**. The opposite end

of the hose 430 is connected to a connector 436 adapted to be clamped to the vehicle receptacle 112 shown in Figs. 1 and 4, or in the preferred modification, and as shown, to the receptacle 300 shown in Figs. 5 and 14. The connector 436 carries a clamping yoke 372, contains operating mechanism for opening the valves of the receptacle, and forms a drain passage for communication with the main valve port of the receptacle.

As shown in Figs. 14 and 15, the operating mechanism comprises an operating shaft 438 which has cams on its ends, similar to the cams shown in Fig. 11, for operating the clamping mechanism. It also carries a loosely mounted gear 440 similar to the gear 216 of the connector 200, and similarly driven with lost motion by a cross pin 442 similar to the pin 272 of the connector 200. The gear 440 drives a plunger 444, to advance it into the receptacle 300 to operate the plunger 322 and the valves of that receptacle. But the drain connector 436 need contain no valves.

To drain the sensing tubes and the control lines associated with the tank compartment being drained, the connector 436 is provided with passages 446 positioned for alinement with the ports 346 of the receptacle 300. Preferably, such passages 446 lead to ejector tubes 448, whose open ends are positioned centrally in the discharge flow passage through the connector 436. These will produce an ejector action, effective to drain the sensing tubes and their lines during even a partial draining of the tank compartment, and will thus condition the sensing tubes for controlling a refilling operation even though the tank compartment is not completely emptied.

It is desirable that a complete draining operation should stop at a point which leaves a predetermined residue of liquid in the vehicle piping system, and preferably a residue which maintains the manifold pipe 72 of the vehicle full of liquid. Conveniently, the residue level is predetermined by the lowest point of the valve port of the receptacle valve 308. To prevent siphoning to a lower residue level, the receptacle 300 is provided at its top portion with a siphon-breaking bleed valve 450, of any suitable construction which will admit air under siphon conditions and will prevent leakage of liquid from the receptacle.

Metered discharge

The vehicle tank may also be drained through a meter of any suitable or standard construction. For this purpose the vehicle apparatus desirably includes a meter outlet mechanism such as is shown in Fig. 3 and at the right of Fig. 4. This comprises a main outlet pipe 460 connected to the manifold pipe 72 through a valve 462 operable by a hand wheel 464. A pair of valves 400 are positioned adjacent the valve 462, and their operating lever 108' is in interfering relation with the hand wheel 464 so that such lever must be in valve-opening position when the hand wheel is retracted to open the main valve 462. The valves 400 are respectively connected to the control lines 94 and 104, and when open, interconnect those lines to a discharge pipe 466 which leads to the outlet passage of the pipe 460. The discharge pipe 466 desirably terminates as an ejector which will operate during discharge flow to induce drain flow from the sensing tubes of the compartment from which liquid is discharged.

To maintain the desired residue level in the vehicle piping system, the outlet pipe 460 leads to a trap fitting 470 in which the liquid must flow over a dam 468 whose upper edge is normally at the same level as the port of the receptacle valve 308. The top of the fitting 470 is provided with a siphon-breaking valve 472, to prevent a siphon action which would lower the desired residue level. As shown, the outlet assembly 460–470 is closed by a cap, but it will be understood that for metered discharge this assembly will be connected to the meter inlet.

Operator control

The filling system of this application is completely automatic. Both the start of the filling operation resulting from the opening of the supply valves 22 and 24, and the ending of the filling operation resulting from the closing of those valves, is controlled by the conditions in the sensing tubes and their connected control lines. The system is totally enclosed, by pipes and hoses. When an operator has made appropriate connections between the supply installation and a vehicle to be filled, he cannot tell whether or not the system is operating as it should, and cannot tell when the filling operation is completed, because of the complete enclosure. To give him a measure of control, and to permit him to observe whether or not the system is operating appropriately, certain indicator mechanism is desirably associated with the fill hose. To this end, the fill hose is connected to the main supply valves through a check valve fitting 29 containing the check valve 28. At the top of this fitting, it carries a flow indicator 500 which is interrelated to the check valve 28. As shown in Fig. 1, and on an enlarged scale in Fig. 17, the flow indicator comprises a transparent globe 501 containing a freely rotatable paddle wheel 502 mounted on a shaft 504. Leading upward from the check valve fitting 29 to the globe 501, there is an inlet tube 506 to admit liquid from the fitting 29 to the globe 501. An outlet tube 508 leads downwardly from the globe 501 to the fitting 29. Flow upward through the tube 506, thence through the globe 501 and thence back down the tube 508 will cause rotation of the freely rotatable paddle wheel 502, and will indicate that flow is taking place. To insure that this flow through the indicator will occur, the indicator is positioned with its inlet tube 506 at a point which will receive liquid diverted or deflected radially by check valve 28 when that check valve is open. Accordingly, even under conditions of slow flow, liquid will be diverted upwardly to the flow indicator by the check valve 28, and under any conditions of flow, the indicator will show that flow is occurring. The operator can thus observe the operating condition of the mechanism, and can be guided accordingly.

Such a flow indicator and check valve combination may also be used in filling apparatus for stationary tanks, as shown in Fig. 17. The apparatus shown in that figure comprises a supply pipe 520 leading to a main supply control valve 522, similar in construction and operation to the valve 22 shown in Fig. 1. The main valve 522 is connected to discharge through a fitting 29, containing a check valve 28 and equipped with an interrelated flow indicator 500. Flow then passes through a manually operable valve 524, and thence to the stationary tank 526. When the stationary tank is filled, it overflows into a control line 528, and the overflow liquid passes through a flow indicator 530 to the control chamber of the valve 522. The resulting pressure rise in that control chamber actuates the valve controlling mechanism to cause the valve to close and the filling flow to cease. When it is desired to refill the tank 526 after use, the control line 528 and the control chamber of the valve 522 are emptied of liquid by operation of a manual pump 532, by its manually operable handle 534. Operation of such pump draws liquid from the control chamber of the valve 522 through a pump inlet tube 536, and discharges it through an outlet 538 to the outlet chamber of the main valve 522. This produces a pressure decrease in the control chamber of the valve 522, which causes that valve to open and the refilling operation to begin. That refilling operation continues until the tank is again refilled and the overflow actuates the valve 522 to closed position.

I claim as my invention:

1. Tank-filling apparatus, comprising supply-valve means and operating mechanism therefor responsive to a fill-level control signal, a hose assembly including a fill

hose connected to receive liquid from and under the control of said valve means, a control line connected to said operating mechanism to transmit control signals thereto, and a single connector attached to said hose and control line and adapted to be releasably engaged with a fill receptacle to establish concurrently both a fill passage to the receptacle and a control line from the receptacle, a connector valve in said connector and normally closing the fill-passage, and means to open said connector valve when the connector is engaged with the receptacle, whereby proper control-line connection is ensured when the connector fill line is open.

2. Tank-filling apparatus as defined in claim 1, in which the control line is a fluid conduit, with the addition of a control line valve normally closing said line in the connector, said last-named means being operable to open both said connector valve and said control-line valve.

3. Tank-filling apparatus as defined in claim 2, in which said last-named means comprises a reciprocable element interconnected to the valves to move in a direction opposite to that of the valves.

4. Tank-filling apparatus as defined in claim 3, in which said reciprocable element is projected through the receptacle-engaging face of the connector as the valves are opened.

5. Tank filling apparatus as defined in claim 1, in which the connector valve is carried by a stem provided with toothed rack and said means to open said connector valve comprises a plunger provided with a toothed rack and a gear meshing at opposite points with both racks, in combination with manually operable means for actuating said means to open said connector valve.

6. Tank-filling apparatus as defined in claim 3, in which the valves are carried by stems provided with rack teeth and said reciprocable element carries opposed rack teeth, and said element is interconnected to the valves by gears meshing with said rack teeth.

7. Tank-filling apparatus as defined in claim 6, with the addition of manually operable means to actuate one of said gears.

8. Tank-filling apparatus as defined in claim 1, in which said connector includes manually operable means to secure the connector to a receptacle.

9. Tank-filling apparatus as defined in claim 1, in which said last-named means includes a manually operale member carried by the connector.

10. Tank-filling apparatus as defined in claim 1, in which said connector carries clamping means for securing the connector to a receptacle, and carries a manually operable member having initial lost-motion connection with the valve operating means and initially operable connection with the clamping means, and has subsequently acting operating connection with the valve operating means and subsequently acting lost-motion connection with the clamping means.

11. Tank-filling apparatus as defined in claim 2, in which said connector carries clamping means for securing the connector to a receptacle, and carries a manually operable member having initial lost-motion connection with the valve operating means and initially operable connection with the clamping means, and has subsequently acting operating connection with the valve operating means and subsequently acting lost-motion connection with the clamping means.

12. Tank-filling apparatus, comprising a supply valve and operating mechanism responsive to a return-liquid flow signal to close said supply valve, a conduit assembly including a fill conduit connected to receive liquid from said supply valve, and a control conduit connected to said operating mechanism to transmit a return-liquid flow signal thereto, a single connector connected to said supply and control conduits, a normally closed connector outlet valve closing in the direction of supply flow from said connector, a control valve in said connector normally closing said control conduit and operative to trap in the operating mechanism and control conduit the liquid flowing thereto as a supply-valve closing signal, whereby to maintain said operating mechanism in valve-closing condition when said control valve is closed, means for attaching said connector to a receptacle, and common means for opening the outlet and control valves of said connector, said valve opening means being operable to open said outlet valve in advance of said control valve, whereby said outlet valve is opened before the control valve releases the trapped signal liquid and permits the supply valve to pass liquid under supply pressure to said outlet valve.

13. Tank-filling apparatus, comprising a tank to be filled, a fill-pipe connected thereto, a fill-level sensing device, a control line for transmitting signals from said device for the control of a supply source, a single receptacle connected to said fill-pipe and control line and adapted to releasably receive a fill connector to establish concurrently both a fill passage from the connector to the receptacle and a control-line from the receptacle to the connector, a receptacle valve in said receptacle and normally closing the fill-passage, and means to open said receptacle valve, said valve opening means being responsive to operation of a fill connector received on the receptacle.

14. Tank-filling apparatus as defined in claim 13, in which the control line is a fluid conduit, with the addition of a control-line valve normally closing said line in the receptacle, said last-named means being operable to open both the receptacle valve and the control-line valve.

15. Tank-filling apparatus as defined in claim 14, in which said last-named means comprises a reciprocable element which moves away from the connector-engaging face of the receptacle as it opens the valves.

16. Tank-filling apparatus as defined in claim 15, in which the reciprocable element is alined with an opening in the connector-engaging face of the receptacle, to be actuated by means advanced through said opening.

17. Tank filling apparatus as defined in claim 13 in which the receptacle valve is carried by a stem provided with a toothed rack and said means to open said receptacle valve comprises a plunger provided with a toothed rack and a gear meshing with both racks.

18. Tank-filling apparatus as defined in claim 15, in which the valves are carried by stems provided with rack-teeth and said reciprocable element carries similar teeth, and said element is interconnected to the valves by gears meshing with said teeth.

19. Tank-filling apparatus as defined in claim 14, which comprises a plurality of tanks or tank compartments, each having a fill pipe connected thereto and each containing a fill-level sensing device connected to a control line, said single receptacle being connected to all of said fill pipes and lines, sensing devices, a main tank valve for each fill pipe and controlling its communication with the receptacle, a selector valve for each sensing device and controlling its connection to the receptacle, whereby said tanks or compartments can be selectively connected for filling and control through said single receptacle.

20. Tank-filling apparatus as defined in claim 19, in which said control valves respectively have interfering relation with the tank valves for the same tanks or compartments, said relation being such that the control valve must be open when the related tank valve is open.

21. Tank-filling apparatus as defined in claim 13, with the addition of a second fill-level sensing device responsive to a different liquid level of the same tank as that of the first sensing device, a second control line for transmitting signals from said second sensing device, said second control line being separately connected to the same single receptacle as the first control line for establishing a second control line to a connected connector.

22. Tank-filling apparatus as defined in claim 21, in which the control-lines are fluid conduits, with the addition of control-line valves normally closing the control lines in the receptacle, said valve-operating means being operable to open both the receptacle valve and said control-line valves.

23. Tank-filling apparatus as defined in claim 22, which comprises a plurality of tanks or tank compartments, each having a fill pipe connected thereto and each containing first and second fill-level sensing devices connected to first and second control lines, the first and second control lines of each tank or compartment being connected to the receptacle through separate paired valves, and a common operating means for operating the valves of each pair.

24. Tank-filling apparatus as defined in claim 23, in which the operating means for the pair of valves controlling the sensing of each tank or compartment has interfering relationship with the main tank valve for that tank or compartment, the relationship being such that the operating means must be in valve-open position when the main valve is open.

25. Tank-filling apparatus for filling a plurality of tanks or tank compartments, comprising a manifold, a fill pipe for each tank and connecting the same to the manifold, a tank valve for each tank and controlling flow in the fill pipe for such tank, means to connect the manifold to a supply source of liquid, a fill-level sensing device in each tank, a fluid conduit for transmitting control signals from the sensing devices to the supply source, a control valve for each tank and through which the said sensing device of the tank is connected to the fluid conduit, whereby said tanks can be selectively connected for filling from said supply source and for transmitting control signals to said supply source, and interrelated operating means for said control and tank valves, the interrelation being such that the control valve for a tank is open when the tank valve of such tank is open.

26. Tank-filling apparatus as defined in claim 25 in which said operating means comprises tank-valve operating means including a member movable through a predetermined path during opening of the tank valve of a tank, and control-valve operating means including a member which lies in interfering relation in said predetermined path when the control-valve for such tank is closed and which is moved out of said interfering relation by operation of said control-valve operating means to open position.

27. In combination with tank-filling apparatus as defined in claim 13 in which the receptacle valve is operable by a reciprocable element alined with an opening in the connector-receiving face of the receptacle, a drain connector adapted to be engaged with the receptacle and to establish a drain passage therefrom, said connector including a plunger advanceable into said opening to operate the reciprocable element, and manually operable means for advancing the plunger.

28. In combination with tank-filling apparatus as defined in claim 13 in which the receptacle valve has a port located above the lowermost point of the fill-pipe, a drain connector adapted to be engaged with the receptacle and to establish a drain passage through said port, and an anti-siphon air-inlet valve communicating with the drain passage at a point above the lowermost point of said port.

29. In combination with tank-filling apparatus as defined in claim 13 in which filling apparatus the sensing device is a tube into which filled liquid flows at the sensed fill level and the control line is a fluid conduit, a drain connector adapted to be engaged with the receptacle and to establish a drain passage therefrom, means to open the receptacle valve, and an outlet passage in the connector adapted to communicate with the control line for discharging liquid from the sensing tube during draining operations.

30. Tank-filling apparatus as defined in claim 13, in which the sensing device is a tube into which filled liquid flows at the sensed fill-level and the control line is a fluid conduit, with the addition of outlet means through which liquid may be discharged from the tank, said outlet means comprising an outlet conduit, a drain valve for connecting said outlet conduit with the tank, and a tube-drain valve for connecting the control line to said outlet conduit beyond said drain valve.

31. Tank-filling apparatus as defined in claim 30, in which said tube-drain valve is connected to the outlet conduit through an ejector device operable by drain flow through said outlet conduit to empty the sensing tube during initial draining operations.

32. Tank-filling apparatus as defined in claim 30, in which the receptacle valve has a port located above the lowermost point of the fill pipe, with the addition of a dam in said outlet conduit over which liquid discharged therethrough must flow, said dam being positioned at the normal level of the lowermost point of said port.

33. Tank-filling apparatus, comprising a liquid supplying mechanism automatically operable in response to a fill-level signal, a liquid-receiving means including a signal-generation device responsive to a fill condition in said means, hydraulic supply and control lines for connecting the supply mechanism to the liquid-receiving means and transmitting signals from said device to said mechanism, and a common coupling for connecting the supply and control lines, comprising a receptacle and a connector releasably engageable therewith, each containing a supply passage and a separate control passage adapted to communicate with its counterpart in the other of said receptacle and connector when the same are engaged.

34. Tank-filling apparatus, comprising a liquid supplying mechanism automatically operable in response to a fill-level signal, a liquid-receiving means including a signal-generation device responsive to a fill condition in said means, hydraulic supply and control lines for connecting the supply mechanism to the liquid-receiving means and transmitting signals from said device to said mechanism, and a common coupling for connecting the supply and control lines, comprising a receptacle and a connector releasably engageable therewith, each containing a supply passage and a separate control passage adapted to communicate with its counterpart in the other of said receptacle and connector when the same are engaged, each said passage containing a valve to close the same when the coupling is disengaged, and manually operable means on one of said receptacle and connector, and means operatively connecting said manual means to operate all said valves in both the receptacle and the connector.

35. Tank-filling apparatus, comprising a liquid supplying mechanism automatically operable in response to a fill-level signal, a liquid-receiving means including a signal-generation device responsive to a fill condition in said means, hydraulic supply and control lines for connecting the supply mechanism to the liquid-receiving means and transmitting signals from said device to said mechanism, and a common coupling for connecting the supply and control lines, comprising a receptacle and a connector releasably engageable therewith, each containing a supply passage and a separate control passage adapted to communicate with its counterpart in the other of said receptacle and connector when the same are engaged, each said passage containing a valve to close the same when the coupling is disengaged, means to clamp the coupling in engaged relationship, manually operable means on one of said receptacle and connector, said manual means being operatively arranged and connected to have a first movement to clamp the coupling

and a second movement to open all said valves in both the receptacle and the connector.

36. Tank-filling apparatus, comprising a liquid supplying mechanism automatically operable in response to a fill-level signal, a liquid-receiving means including a signal-generation device responsive to a fill condition in said means, hydraulic supply and control lines for connecting the supply mechanism to the liquid-receiving means and transmitting signals from said device to said mechanism, and a common coupling for connecting the supply and control lines, comprising a receptacle and a connector releasably engageable therewith, each having an engagement face and each containing a supply passage and a separate control passage terminating at supply and control ports through its engagement face, the two supply ports and the two control ports being respectively positioned in communicating alinement when the coupling is engaged, a valve in each of said passages normally closing its said port, and openable by retraction therefrom, the valves of each of said coupling and receptacle being operatively interconnected, and manually operable valve-opening means on one of said receptacle and connector, and means to actuate the valves of the other in response to actuation of said manual means.

37. Tank-filling apparatus as defined in claim 36, in which the operative interconnection between the supply-valve and the control valve includes lost-motion means to delay the opening of the control-valve with respect to the opening of the supply-valve.

38. A coupling for connecting a liquid supply source to a liquid receiver and connecting a fluid control-line from the receiver to the source, comprising a receptacle coupling part and a connector coupling part having engageable coupling faces, a supply passage in each coupling part terminating at a port in the coupling face thereof, a valve normally closing the port in each and openable by retraction into the coupling part from its face, a control passage in each coupling part terminating at a port in the coupling face thereof, a valve normally closing the port in each and openable by movement with the supply-port valve of its coupling part, the supply and control ports of the coupling parts being respectively positioned for communicating alinement when the coupling is engaged, means operatively interconnecting the valves of each coupling part, and means to open said valves.

39. A coupling as defined in claim 38, in which said valve-opening means comprises a manually operated member carried by one coupling part, and means to actuate the valves of the other coupling part in response to actuation of said manual member.

40. A coupling as defined in claim 38, in which said valve opening means comprises a manually operable member carried by one coupling part, a reciprocable element operatively connected to said member for projection through the face of its coupling part, and means in the other coupling part actuated by said projectible element to open the valves of said other coupling part.

41. A coupling as defined in claim 38, in which the supply and control valves are carried by spaced parallel slides, racks on said slides, and gear means interconnecting the slides of each coupling part for concurrent movement in the same direction.

42. A coupling as defined in claim 38, in which the supply and control valves are carried by spaced parallel slides, a plunger in one of said coupling parts and movable parallel with its valve slides, gear means interconnecting the plunger and said valve slides for concurrent movement in opposite directions, manually operable means for actuating said gear means, said plunger having a forward end which is projected through the face of its coupling part on valve-opening retraction movement of the valves thereof and means in said other coupling for opening the valves thereof in response to projection movement of said plunger.

43. A coupling as defined in claim 38, in which the supply-valve of one coupling part is carried by a slide, a plunger in spaced parallel relation with said slide, a direction-reversing gear interconnecting the supply-valve slide and the plunger, the control valve of said coupling part being carried by a slide in spaced parallel relation with said plunger, and a direction-reversing gear interconnecting the plunger and the control-valve slide, means to actuate one of said gears, a reciprocable element in the other coupling part positioned to be actuated by advance movements of said plunger and operatively interconnected to actuate the valves of said other coupling part.

44. A coupling for connecting a liquid-supply source to a liquid receiver and connecting a fluid control-line from the receiver to the source, comprising a receptacle coupling part and a connector coupling part having engageable coupling faces, a supply passage in each coupling part terminating in a supply port in the coupling face, a control passage in each coupling part terminating in a control port in the coupling face, valves in each of said passages, clamping mechanism to secure the coupling parts together, and a manually-operable valve-opening member on one coupling part, and means interconnecting the valves in all said passages for operation by said member.

45. A coupling as defined in claim 44, in which said manually operable valve-opening member is connected to said valve through a lost-motion connection, and means operative in response to lost-motion movement of said member to actuate said clamping mechanism to securing position.

46. A coupling as defined in claim 44, in which said manually operable member rotates a shaft, a cam on said shaft having a rise for actuating said clamping mechanism to securing position, said cam having a subsequently acting land for maintaining said securing position, the operative connection between said manually operable member and said valves having lost-motion while said cam rise is effective and having a valve-actuating motion while said cam-land is effective.

47. A coupling connector, comprising a housing having a coupling face, a liquid supply passage in said housing terminating in a port through said face, a poppet valve normally closing said port and openable by retraction from the face-end of said housing, a plunger in spaced parallel relation with the stem of said valve, interconnecting means to drive said stem and plunger in opposite directions, a pair of control-line passages in said housing, control-line valves normally closing said control-line passages and carried by slides in parallel spaced relation with said plunger, and direction-reversing operative connections between said plunger and said control-valve slides, said plunger being advanced with respect to said coupling face during valve-opening movement and being adapted to actuate mechanism of a companion coupling part.

48. In automatic tank-filling apparatus comprising a supply-controlling valve, a fill conduit for connecting said valve to a tank to be filled, a control line for controlling the valve in response to fill-level in the tank, the combination therein of flow indicating means comprising a flow-diverter in the fill conduit to divert at least a portion of the flow therein, and a flow-indicator positioned to receive diverted flow and to be actuated thereby.

49. In automatic tank-filling apparatus comprising a supply-controlling valve, a fill conduit for connecting said valve to a tank to be filled, a control line for controlling the valve in response to fill-level in the tank, the combination therein of flow indicating means comprising a check valve in said fill conduit and opening in the direction of flow therein, said check valve being constructed and arranged to divert flow laterally from the axis of the conduit, and a flow indicator positioned to receive flow di-

verted by said check valve and to be operated thereby to indicate the existence of flow through the conduit.

50. A drain device for use with tank-filling apparatus in which a tank is connected by a fill- and drain-pipe to a receptacle normally closed by a valve and which tank-filling apparatus includes a sensing tube into which liquid overflows when the tank is filled and in which liquid is trapped by a sensing tube valve, said drain apparatus comprising a drain conduit adapted to be put into communication with the fill- and drain-pipe, ejector means actuated by drain flow through the drain conduit, and means to connect the ejector to the sensing tube to eject trapped liquid from the sensing tube during initial draining operation.

51. A drain device for use with tank-filling apparatus in which a tank is connected by a fill- and drain-pipe to a receptacle normally closed by a valve and which tank-filling apparatus includes a sensing tube into which liquid overflows when the tank is filled and in which liquid is trapped by a sensing tube valve, said drain apparatus comprising a drain connector adapted to be engaged with receptacle and to establish a drain passage therefrom, means to open the receptacle valve, and ejector means in the connector adapted to communicate with the control line and to be actuated by drain flow through the drain passage for ejecting trapped liquid from the sensing tube during initial draining operation.

52. A coupling, comprising a connector part and a receptacle part each having a pair of passages therein which lie in communicating alinement with the respective passages of the other part when the parts are coupled, a valve in each passage which closes in a direction toward the opposite part, a plunger in one part movable toward the other part and having a forward end which is projected into the said other part on plunger advance movement, direction-reversing means interconnecting the plunger with the valves of its coupling part to retract said valves to open position on advance movement of the plunger, and means in the other coupling part for opening the valves therein in response to projection movement of said plunger.

53. A coupling as defined in claim 52 in which the plunger carries rack teeth and at least one of the valves of its coupling part is operated by a toothed slide movable parallel and opposite to said plunger, and said direction-reversing means comprises a gear in opposite meshing engagement with said plunger and slide, and means to actuate said gear.

54. A coupling as defined in claim 52 in which the valve-operating means in the other coupling part comprises a reciprocable element in said other part positioned to be actuated by advance movement of the plunger and operatively interconnected to actuate the valves of said other coupling part.

55. A coupling as defined in claim 53 in which said gear-actuating means comprises a manually rotatable shaft, with the addition of clamping mechanism for securing the couplings together, a cam on said shaft having a rise for actuating said clamping mechanism to securing position and having a subsequently-acting land for maintaining said securing position, the operative connection between said shaft and gear having lost motion while said cam rise is effective and having a gear-actuating motion while said cam-land is effective.

56. In tank-filling apparatus having a liquid-supplying system automatically operable in response to a fill-level signal, a liquid receiving means including a signal-generation device responsive to a fill-condition in said means, and hydraulic control lines for connecting the supply mechanism to the liquid-receiving means and transmitting signals from said device to said mechanism, the improvement which comprises a common coupling for connecting the supply and control lines, said coupling including a unitary receptacle and a unitary connector releasably engageable with the receptacle, each of said receptacle and connector containing a supply passage and a separate control passage which respectively communicate with their counterparts in the other of said receptacle and connector when the same are engaged.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,845,965 August 5, 1958

Howard E. Rittenhouse

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 23, for "fitting 20" read -- fitting 29 --; column 18, line 29, for "valve" read -- valves --; column 19, line 21, after "with" insert -- the --.

Signed and sealed this 14th day of October 1958.

(SEAL)
Attest:

KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents