July 9, 1940. D. GOLLNER 2,207,318

APPARATUS FOR RAISING LIQUIDS

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Fig. 1

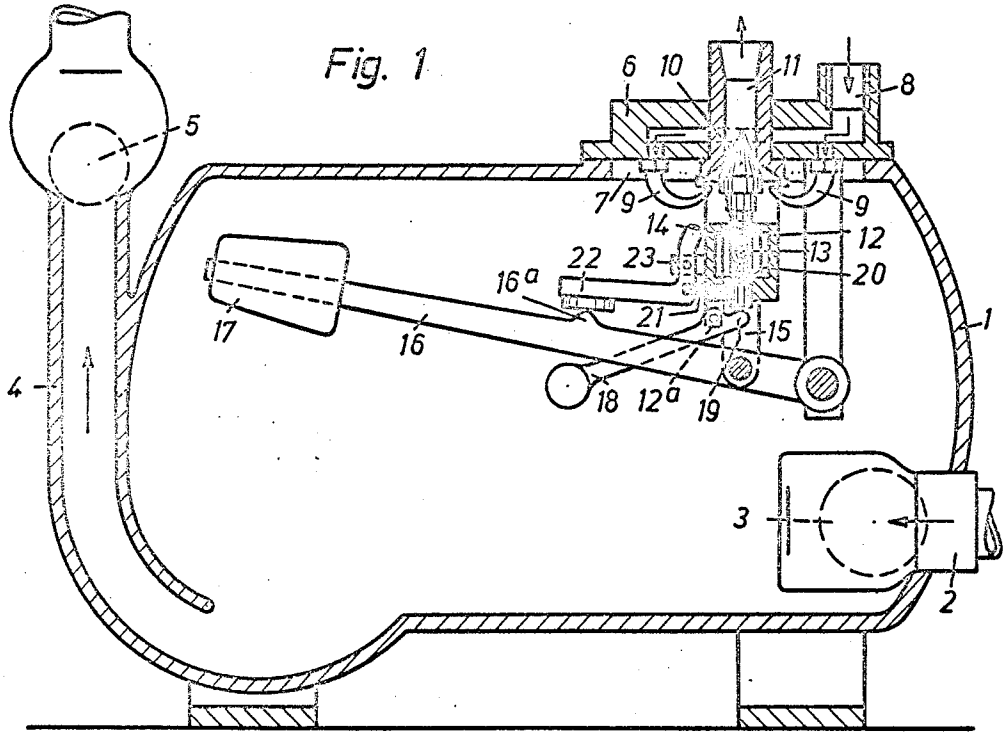


Fig. 2

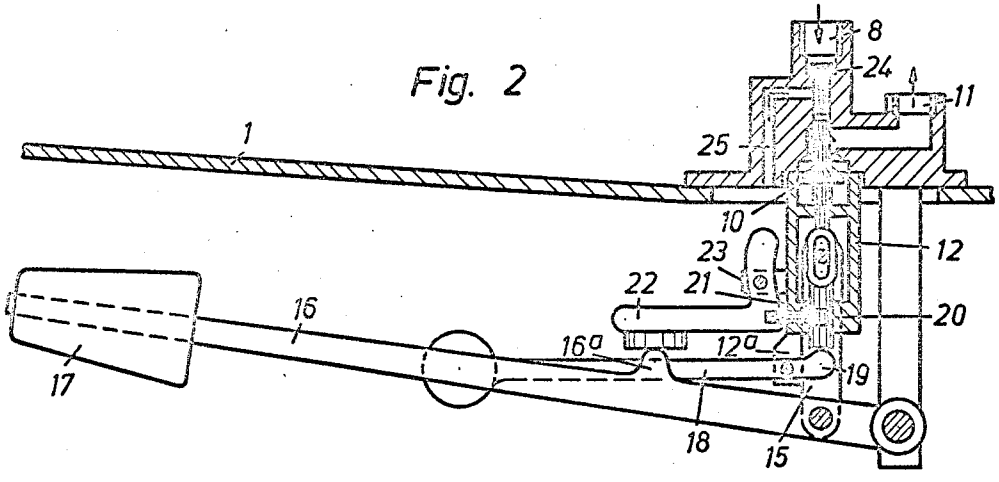
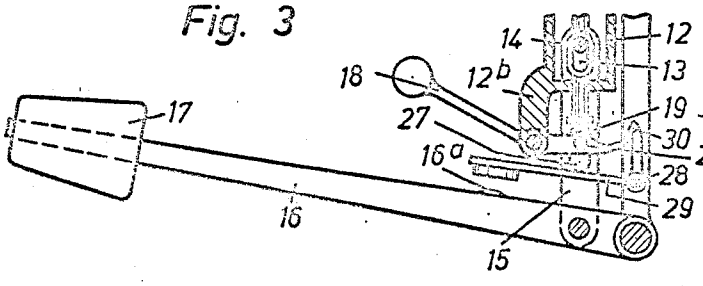


Fig. 3



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APPARATUS FOR RAISING LIQUIDS

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4 Claims. (Cl. 103—248)

The invention relates to automatically working float-controlled apparatus for raising liquids by means of compressed air, such as are more particularly employed in mines for raising accumulating water, the water either flowing into the collecting tank of the apparatus by its own weight (under-water pump) or being sucked into it by an injector-like action of the compressed air.

The invention is more particularly adapted for use in connection with a liquid raising apparatus of the kind forming the subject matter of my British Specification No. 463,032, according to which the stop valve of the exhaust opening is formed as a cone valve, the compressed air being introduced into the tank by one or more nozzles the mouths of which are positioned close to the valve cone in such a direction and at such a level that they blow substantially in the direction of the generator lines of the cone along its conical surface when the valve is open, thus producing by an injector-like action a negative pressure in the collecting tank and drawing the water into the tank. These liquid raising apparatus show a certain drawback as regards the closing motion of the valve. When, for example, the float is approaching its uppermost position during the filling of the collecting tank and the inflow of water suddenly ceases for one reason or the other, the valve remains in an intermediate position in which the section of flow of the exhaust opening is reduced so that the compressed air can neither flow fully past the valve to the exhaust nor fully into the collecting tank. If now an inflow of water sets in again, the compressed air because of the reduced section of passage is unable to overcome the dead point and draw further water into the collecting tank. This may of course entail a disturbance of the working of the apparatus.

The invention has for its object to remove this evil. It consists in an arrangement wherein the stop valve of the exhaust opening of the collecting tank is placed under the action of a closing force (weight or spring force) which is independent from the float but which is released by the float when same reaches its uppermost position, the valve being then instantaneously moved into closed position by said force.

In a preferred form of the invention the closing force is formed by a weighted lever normally held inactive but released to act on the stop valve in the direction of its closing movement when the float reaches its uppermost position.

With a float controlled liquid raising apparatus constructed in accordance with the invention, the stop valve is kept always fully open during the filling of the collecting tank so that the compressed air is allowed to flow with undiminished force past the valve body in every phase of the filling and can exert the required suctional action, while when the filling is coming to its end and the float approaches its uppermost position, the separate closing force produces a safe closing of the valve, whereupon all of the compressed air supplied can exert its action in the collecting tank for forcing out the water drawn in. Therefore, if an interruption of the supply of water should occur in the last part of the filling period, this would be without any injurious effect, because the valve remains either fully open or securely closed which depends on the water level in the collecting tank, it being impossible for the valve to assume an unfavorable intermediate position. Due to the provision of locking mechanism for the stop valve or weighted lever, violent motions in the collecting tank of the inflowing water also do not influence the position of the valve.

The idea of using for the stop valve of the exhaust opening of the collecting tank a closing force independent from the float also renders this control suitable for liquid raising apparatus of particularly large dimensions, with which compressed air is admitted into the tank only during the delivery period and by which large quantities of liquid are raised. With these apparatus a great force is required for closing the stop valve and opening the admission valve for the compressed air. For producing the necessary closing force in liquid raising apparatus of this kind, there have been used so-called submerging floats which fill with the inflowing liquid and are emptied again after the filling. These raising apparatus with submerging floats possess a number of disadvantages. The submerging float occupies the largest part of the collecting tank. There are generally used for these raising apparatus vertical tanks of a height which is usually much greater than the depth of the natural pits in which the water to be raised accumulates. The pits must therefore be excavated to a substantial depth in order to permit placing the collecting tank so low that it may fill with the arriving water in the desired manner. The arriving water first flows into the space surrounding the float and only then from this space into the float. Most of the mud contained in the water therefore deposits in the surrounding space, so that the same will soon be silted and

impede the float movements. As a result thereof the tank requires frequent cleansing by hand or the installation of expensive devices for automatically removing the mud.

The invention will now be described with reference to the accompanying drawing in which:

Fig. 1 shows a longitudinal section of an apparatus for raising liquids by means of compressed air with a control according to the invention,

Fig. 2 is a corresponding longitudinal section of the upper portion of a raising apparatus with a control especially adapted for apparatus by which large quantities of liquid have to be raised and the water flows into the collecting tank exclusively by its own gravity, and

Fig. 3 is a detail view of a modified locking mechanism for the weighted lever.

The collecting tank 1 of the raising apparatus is formed as a horizontal reservoir. 2 is the inlet opening for the water flowing or sucked in, a non-return valve 3 being provided at the inlet. 4 is the delivery pipe also containing a non-return valve 5. The control device of the raising apparatus is carried by a cover 6 which surmounts an opening 7 in the top wall of the collecting tank.

With the embodiment according to Fig. 1, the compressed air is admitted through pipe 8 and flows through ducts of the cover 6 to a number of nozzles 9 arranged around a cone valve 10. There may also be used instead of the several individual nozzles a corresponding annular nozzle which causes compressed air to be blown in the direction of the generator lines of the cone 10. The cone valve 10 serves to close or open the exhaust opening 11 of the collecting tank 1, through which opening the air contained in the tank can freely escape to the atmosphere during the filling of the tank. The cone valve 10 moves with its stem in a guide 12 which is fastened to the cover. The valve stem possesses a longitudinal slot 13 through which is passed a cross pin 14 which interconnects the upper ends of two links 15 which in turn are connected with the lever 16 of the float 17. Swingingly mounted underneath the guide 12 on a bracket 12^a is a weighted lever 18 the free end 19 of which bears against the lower end of the stem of the cone valve 10. This stem is provided with an annular groove 20 with which cooperates a transverse pin 21 which is shiftable in the guide 12 and pivoted to a cranked lever 22 rotatably mounted in a bracket 23 of the guide 12.

The operation of the described liquid raising apparatus is as follows. When the tank 1 is empty, the float 17 occupies its lowermost position in which it has drawn the cone valve 10 into open position through the intermediary of the links 15 and pin 14. In this position, the locking pin 21 engages the annular groove 20 of the valve stem and thereby locks the valve 10 in its open position. At this time the weighted lever 18 is elevated. With the valve 10 open the compressed air emitted from the nozzles 9 flows past the valve into the exhaust opening 11 and like an injector creates a negative pressure in the collecting tank 1 so that the water can flow freely or be sucked into the tank. When in the progression of the filling of the tank 1 the float 17 comes into its uppermost position, its lever 16 by a stud 16^a hits against the cranked lever 22 and tilts it so as to cause the locking pin 21 to be withdrawn from the annular groove 20. Thereby the cone valve is released and positively forced by the weighted lever 18 into its closing position, which is illustrated in Fig. 1. The compressed air emitted by the nozzles now enters into full action in the tank 1 forcing out through the delivery pipe 4 the water and mud contained in the tank. During this period the float in the tank drops and in entering its lowermost position draws the cone valve 10 into its open position through the intermediary of the links 15 and cross pin 14 and against the action of the weighted lever 18, the pin 21 snapping again into the annular groove. The described operation then starts anew.

The control shown in Fig. 2 essentially differs from that according to Fig. 1 by the way in which the compressed air is supplied. In this case the compressed air only serves to force the liquid which has flowed into the collecting tank 1 through a delivery pipe (similar to 4 of Fig. 1). This embodiment therefore relates to a so-called under-water pump with which the water flows by gravity into the collecting tank. The compressed air is admitted through pipe 8, valve 24, and a duct 25. The valve 24 is disposed in the prolonged axis of the cone valve 10 of the exhaust opening 11. When the cone valve 10 is open for allowing the air to escape from the tank 1, the valve 24 must be closed to prevent compressed air admission to the tank 1. Fig. 2 shows the parts in the position which they assume just before the float 17 reaches its highest position. When this position is attained the float lever 16 through the stud 16^a tilts the cranked lever 22 and thereby withdraws the locking pin 21 from the annular groove 20 of the stem of the cone valve 10. As a result thereof the weighted lever 18 by its end 19 moves the cone valve 10 into its closed position so that any further escape of air from the tank 1 cannot take place. The cone valve 10 in its closing movement simultaneously pushes open the compressed air admission valve 24 so that the compressed air can flow unhindered past the latter through the duct 25 into the collecting tank and force from the same through the delivery pipe 4 the liquid and mud contained in the tank. The closing force furnished by the weighted lever can easily be made so strong that it does not only produce the closing of cone valve 10 but also the opening of the valve 24 against the pressure of the compressed air by which valve 24 is loaded. The necessity of using submerging floats, which always entail silting of the collecting tank, is therefore dispensed with.

With both forms of apparatus described, there may be used as an alternative the mechanism illustrated by Fig. 3. With this modified mechanism the weighted lever 18 is mounted in a bracket 12^b of the guide member 12 and lies with its arm 19 below the stem of the exhaust valve. The arm 19 carries a cross-pin 26 which traverses longitudinal slots 27 of the links 15. Mounted at 28 is a pawl consisting of bell crank lever 29 the upright arm of which has a nose 30 adapted to engage the free end of the arm 19 of lever 18 and hold the latter inoperative with its weighted end in elevated position as shown in Fig. 3. The operation of this mechanism is similar to that of the corresponding mechanisms described with reference to Figs. 1 and 2. When the float reaches its uppermost position, its lever 16 by the stud 16^a hits against the bell-crank lever 29 and tilts the same so as to cause the nose 30 to release the weighted lever 18 which instantaneously acts on the stem of the air exhaust valve and closes it as described. When the float drops

again its lever 16 in approaching the lowermost position through the intermediary of the links 15 and cross-pin 26 swings the weighted lever again into the initial position shown in which it is engaged and locked by the nose 30 of the bell-crank lever 29, the exhaust valve being thus allowed to remain again fully open.

Having thus described my invention, what I claim as new and desire to secure by Letters-Patent, is:

1. An apparatus for raising liquids by means of compressed air, comprising a collecting tank for the liquid to be raised having a valve-controlled inlet and a valve-controlled delivery pipe for the liquid, means for introducing compressed air into the collecting tank, a valve for regulating the exhaust of air from the collecting tank, a single float in the tank adapted to control the position of the exhaust valve, connecting means between the float and the exhaust valve through which to open this valve when the float reaches its lowermost position, and power means in the tank separate and independent of the float adapted to act on the exhaust valve for closing it, a locking mechanism for holding the said power means inactive during the filling period of the apparatus, with the said locking mechanism arranged in the path of movement of the float and adapted to be released by the float when same reaches its uppermost position, so as to render the said power means active and cause it to close the air exhaust valve, and means for automatically restoring the power means and the locking mechanism to their inactive and locking positions, respectively.

2. An apparatus for raising liquids by means of compressed air, comprising a collecting tank for the liquid to be raised having a valve-controlled inlet and a valve-controlled delivery pipe for the liquid, means for introducing compressed air into the collecting tank, a valve for regulating the exhaust of air from the collecting tank, a single float in the tank adapted to control the position of the exhaust valve, connecting means between the float and the exhaust valve through which to open this valve when the float reaches its lowermost position, and a weighted lever in the tank separate and independent of the float arranged to act on the exhaust valve in the direction of the closing movement of the same, a locking mechanism for holding the weighted lever inoperative during the filling period of the apparatus, with the said locking mechanism arranged in the path of movement of the float and adapted to be released by the float when same reaches its uppermost position so as to render the weighted lever operative and cause it to close the air exhaust valve, and means for automatically restoring the weighted lever and the locking mechanism to their inoperative and locking positions, respectively.

3. An apparatus for raising liquids by means of compressed air, comprising a collecting tank for the liquid to be raised having a valve-controlled inlet and a valve-controlled delivery pipe for the liquid, means for introducing compressed air into the collecting tank, a valve for regulating the exhaust of air from the collecting tank, a stem on the exhaust valve adapted to move vertically up and down in a guide member, a float in the tank adapted to control the position of the exhaust valve, connecting means between the float and the stem of the exhaust valve through which to open this valve when the float is in its lowermost position, an annular groove in the stem of the exhaust valve, a cranked lever mounted on the stem guide member for swinging movement in a vertical plane, a pin pivoted to the cranked lever and adapted to engage the said groove of the stem of the exhaust valve when the latter is in its lower open position and lock the valve in such position, a weighted lever arranged for vertical swinging movement in the tank with one of its arms operatively engaging the lower end of the stem of the exhaust valve and exert a closing force thereon, the said cranked locking lever being arranged in the path of movement of the float and adapted to be swung by the float upon the same reaching its uppermost position in such a manner as to release the stem of the exhaust valve and allow it to be acted upon by the said weighted lever to thereby close the exhaust valve.

4. An apparatus for raising liquids by means of compressed air, comprising a collecting tank for the liquid to be raised having a valve-controlled inlet and a valve-controlled delivery pipe for the liquid, means for introducing compressed air into the collecting tank, a valve for regulating the exhaust of air from the collecting tank, a float in the tank adapted to control the position of the exhaust valve, connecting means between the float and the exhaust valve through which to open this valve when the float reaches it lowermost position, and a weighted lever in the tank arranged to act on the exhaust valve in the direction of the closing movement of the same, a pawl arranged to hold the weighted lever in inoperative position, this pawl being formed by one arm of a bell-crank lever, the other arm of which lies in the path of movement of the float so as to be tilted to cause the pawl to release the weighted lever and allow it to operate the exhaust valve for closing it when the float reaches its uppermost position, and connecting means between the float and the weighted lever for restoring this lever and the pawl to their inoperative and locking positions, respectively, when the float is returning to its lowermost position.

DETLEV GÖLLNER.