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R. I. BLAKNEY.

HYDRAULIC AIR COMPRESSOR.

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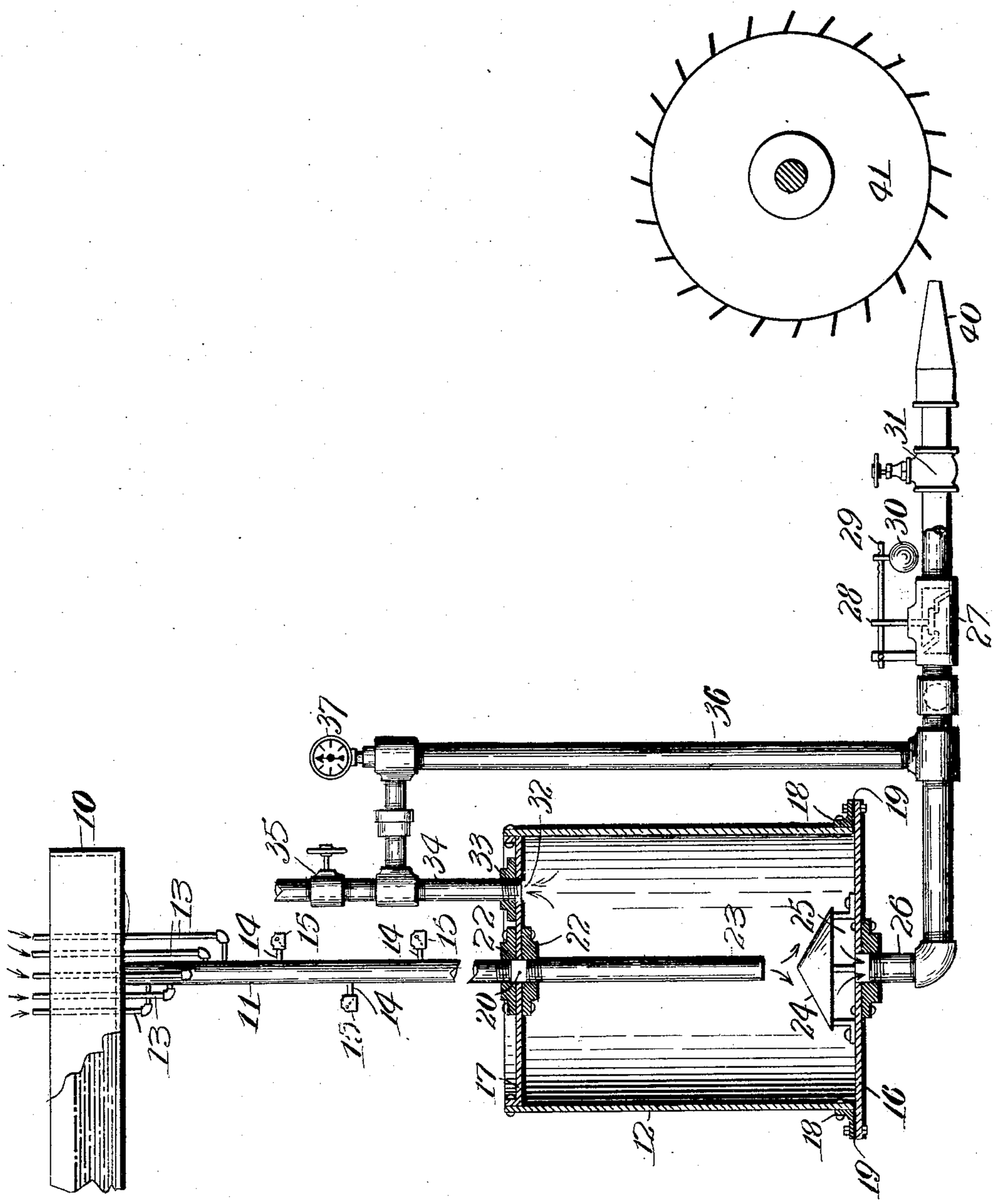

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HYDRAULIC AIR-COMPRESSOR.

No. 880,187. Specification of Letters Patent. Patented Feb. 25, 1908.

Application filed April 24, 1907. Serial No. 369,899.

To all whom it may concern:

Be it known that I, ROBERT I. BLAKNEY, a citizen of the United States, residing at Seattle, in the county of King and State of Washington, have invented a new and useful Hydraulic Air-Compressor, of which the following is a specification.

This invention relates to the compression of air by the use of falling water. Heretofore it had been proposed to compress air in this way by allowing the water to pass down through a vertical pipe having openings at the top to admit air. On account of the increase in the velocity of the falling water as it descends, air is drawn into the water and carried down with it into a receptacle. This receptacle has usually been located at the bottom of a well or the like, and the water discharged passes from the bottom of the receptacle into the well where it acts to compress the air. Separated at the top of the receptacle the air can be drawn off and used for any of the purposes for which compressed air can be employed. These devices have been theoretically operative and they can be used in practice in some cases, but for ordinary use, the expense was greater than for some other kinds of power plants, as they involved sinking a shaft or well and all the parts were under water where they could not be repaired. Moreover, there was no way of regulating the air pressure.

The principal objects of this invention are to carry out this principle in a practical and simple manner in such a way that the expense of installation will be comparatively small, and the pressure of the air can be regulated, or the air can be conveyed by the apparatus substantially at atmospheric pressure; also to provide a construction in which all the parts will be more readily accessible, and to provide for collecting and saving any air that may be carried out of the receptacle by the water which flows therefrom.

Further objects and advantages of the invention will appear hereafter.

Reference is to be had to the accompanying drawing which shows a plant constructed according to this invention in side elevation, parts being in section.

As has been the case with the experimental plants which have been referred to, the water is taken from a head-race 10 through a vertical downwardly-extending in-take 11 to a tank or receptacle 12. The flow of water down through the in-take 11 will, as in the previous devices proposed, draw air in through air inlet tubes 13. Heretofore the tubes extended up a short distance from the plate at which they left the in-take. In the present invention however, they are preferably extended upwardly to a point above the level of the water in the head-race, and they may extend directly through the head-race in cases in which that is convenient. It will be seen therefore that the upper ends of these air inlet pipes being above the level of the water, no water will flow from them under any conditions of operation. These air inlet pipes may be supplemented or replaced by additional air inlets 14 which may be located anywhere along the in-take, and which extend horizontally therefrom, or in any other desired direction. Each of these inlets is provided with a check-valve 15, of the swinging type or of any other desired construction, so that they will readily yield to permit air to enter when a vacuum is created in the pipe by the falling of the water, but they will close if for any reason there is pressure enough to force the water or air out through them. Either form of these tubes or inlets may be used to the exclusion of the other, but they are preferably used in conjunction with each other. It will be seen that they both serve to admit air, but will not under any conditions permit water to be discharged through them, and that those having the check valves are more suitable when they are to be placed far from top of the in-take.

The tank 12 is provided with a bottom 16 and a head 17, the bottom being fixed to the walls of the tank by means of a ring 18 which is riveted to the tank and bolted to the bottom so that the bottom may be removed if desired. Suitable packing 19 is preferably employed. The head is riveted to the upper end of the tank and is provided with a passage 20.

Secured to the head adjacent to the passage 20 are a couple of castings 22 into the upper of which the in-take pipe is secured. The lower one of these castings receives a pipe 23 which forms the discharge end of the in-take pipe. The in-take pipe terminates at a short distance above the bottom of the tank and immediately below it is a conical breaker or separator 24. The incoming water and air strikes the apex of the cone and this tends to separate the air from the water. This cone is spaced from the bottom of the tank so as to have passages 25

through which the water can flow. Immediately under the cone is an outlet pipe 26 preferably fixed to the bottom in a manner similar to that described for the in-take pipe. This outlet pipe is of greater diameter than the in-take 23, and is provided with one or more valves through which the water is discharged. The preferred form of valve is a pressure regulating valve 27 having a valve stem 28 provided with a lever 29 which is adapted to hold the valve to its seat in any desired manner, as for example by an adjustable weight 30. This weight may be adjusted so that it will require any desired head of water or pressure contained in the tank to open it and allow it to be discharged; consequently, this will regulate the pressure of air in the tank and act as a safety valve by preventing the pressure getting above any desired point.

Preferably one or more additional globe valves 31 are employed adapted to be opened or closed by hand so that when desired the water may be allowed to flow out without exerting any pressure on the air in the tank, so as to cause the air to be discharged at substantially atmospheric pressure. This is desirable, because it has been found that while atmospheric air blown into a mine or any other closed space will serve to quickly remove smoke or gases, air under pressure will not do this efficiently.

Of course without the additional globe valve the valve 27 can be manipulated for the same purpose, but by the use of such an additional valve it is not necessary to disturb the adjustment of the regulating valve, and it will be ready to operate at once when the additional globe valve is closed.

The air is drawn out of the tank in the ordinary way through a passage 32, on the outside of which a casting 33 is secured in which an air outlet pipe 34 is secured, as will be readily understood. This pipe is provided with a valve 35 and leads to the compressed air tank or any place where the air is to be used.

It has been found that in the use of the apparatus some air, depending upon the adjustment of the valve 27, will be carried out of the tank 12 with the water. In order that this air may be saved and returned to the air outlet pipe, a by-pass 36 is connected with the water outlet pipe 26 and extends upwardly therefrom. It is connected with the pipe 34, and the air entering it will be carried out with the air collected in the tank and discharged therefrom. A gage 37 may be applied to this pipe or in any other convenient place.

It will be observed that by the construction of the hydraulic air compressor in accordance with this invention leakage of water through the pipes is avoided, efficient means is provided for separating the water and air, and any air carried along with the water after its separation is withdrawn and brought back to the position in which it can be used. Moreover the pressure of the air can be regulated in a very efficient manner, and free air at substantially atmospheric pressure can be carried through the device for the purpose of cleaning shafts and drifts. Moreover the separating tank is constructed in a simple and inexpensive manner, and it can be located where it can be readily inspected and taken apart if desired to clean it or to repair it. Moreover a device constructed in this manner is not subject to any appreciable amount of wear, and if the in-take pipe is protected from the entrance of stones and dirt it will not require frequent cleaning.

This device is especially useful for supplying air for use in mining, not only to operate the machinery, but to clear the mines and drifts of powder-smoke and gases. However it is of equal utility for many other purposes.

In some mining countries there are waterfalls having several hundred feet fall, and the invention is especially useful in such cases. For example, if we have a fall of 500 ft. and wish to carry 100 lbs. air pressure, approximately 230 ft. of hydrostatic head will be required to produce this pressure. This leaves 270 ft. of fall in the in-take pipe. The only function this fall performs is to entrain and carry down the air, but if there is any pressure on the air in its descent it will be compressed. The proportion of course, changes with the depth. It will be obvious, therefore, that a pipe of any given diameter will handle a large column of free air. It will be observed that the air is drawn in at different heights, and by the use of the check-valves or the pipes extending upwardly, the air may be drawn in at points all the way along the in-take pipe, consequently, a great deal more air can be compressed than is the case with the devices heretofore proposed.

In order to utilize the power of the water discharged in some instances, I place a nozzle 40 on one of the discharge pipes and an impulse wheel 41 at the end thereof. Thus a large percentage of the power of the water may be utilized. The nozzle may be placed on the pipe having the automatic valve or on one of the other pipes.

While I have illustrated and described a particular form of the invention, I am aware that many modifications may be made therein without departing from the scope of the invention as expressed in the claims. Therefore, I do not wish to be limited to the particular form shown, but

What I do claim is:—

1. In a hydraulic air compressor, the combination of a head-race, a water in-take extending vertically downwardly therefrom, air inlet tubes from the upper part of said

in-take extending above the level of the air in the head-race, additional air inlets below the first named inlet tubes, a check-valve in the additional inlets to allow air to enter and to prevent air or water being discharged through them, a separating tank into which the open lower end of the water in-take discharges, a breaker immediately below the discharge end of the in-take spaced from the bottom of the tank, a water outlet under the breaker, and an air outlet from the upper end of the separating tank.

2. In a hydraulic air compressor, the combination of a head-race, a water in-take extending downwardly therefrom, air inlets in the in-take having means whereby air may be admitted but cannot be discharged through them, a separating tank into which the open lower end of the water in-take discharges, a breaker below the discharge end of the in-take, a water outlet at the bottom of the tank, and an air outlet at the upper end of the tank.

3. In a hydraulic air compressor, the combination of a vertical water in-take, air inlets extending therefrom at intervals along the same, and check-valves in each of said inlets to admit air and prevent the outlet of water or air, and a separating tank into which the in-take discharges having means for separating water and air.

4. In a hydraulic air compressor, the combination of a head-race, a water in-take extending downwardly therefrom air inlets in the in-take having means whereby air may be admitted but cannot be discharged through them, a separating tank into which the open lower end of the water in-take discharges, a breaker below the discharge end of the in-take, a water outlet at the bottom of the tank, an air outlet at the upper end of the tank, and an adjustable valve in the water outlet whereby the pressure of water in the separating tank, and consequently the pressure of air, may be regulated.

5. In a hydraulic air compressor, the combination of a vertical water in-take having means for admitting air, a separating tank into which said in-take discharges, the bottom of the in-take being near the bottom of the tank, a separator or breaker immediately below the lower end of the in-take and spaced from the bottom of the tank, a discharge outlet from the tank located under said breaker, a safety valve communicating with said outlet and having means whereby the pressure at which it opens to discharge water from the tank may be regulated, whereby the pressure of the air in the separating tank will be regulated.

6. In a hydraulic air compressor, the combination of a separating tank, means for discharging air and water into said tank, an outlet pipe for the water, a regulating valve in the outlet pipe having means whereby the pressure at which it will open may be regulated, and an additional valve communicating with said outlet pipe, whereby the water may be discharged without putting the air in the separating tank under pressure.

7. In a hydraulic air compressor, the combination of a separating tank, means for discharging air and water into said tank, an outlet pipe for the water, a safety or regulating valve in the outlet pipe having means whereby the pressure at which it will open may be regulated, an additional valve communicating with said outlet pipe, whereby the water may be discharged without putting the air in the separating tank under pressure, an air outlet pipe from the upper part of said tank, and an air up-take or by-pass communicating with the water discharge pipe and with the air outlet pipe.

8. In a hydraulic air compressor, the combination of a separating tank, a water outlet pipe from the bottom thereof, an air outlet pipe from the top of the tank, and a by-pass or up-take communicating with the outlet pipe at a point below the tank and adapted to discharge air into the air outlet pipe.

9. In a hydraulic air compressor, the combination of a separating tank, a water outlet pipe therefrom, an air outlet pipe therefrom, and a by-pass or up-take extending from the water outlet pipe upwardly and communicating with the air outlet pipe so as to discharge air into the air outlet pipe.

10. In a hydraulic air compressor, the combination of a separating tank, means for discharging air and water into said tank, an outlet pipe for the water, a safety or regulating valve in said outlet pipe, an additional valve communicating with the outlet pipe whereby the water may be discharged without putting the air in the separating tank under pressure, means for collecting the air from the separating tank, a nozzle on the outlet pipe, and an impulse water wheel located adjacent to said nozzle to be operated by the water discharged therethrough.

In testimony whereof I have hereunto set my hand, in the presence of two subscribing witnesses.

ROBERT I. BLAKNEY.

Witnesses:
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