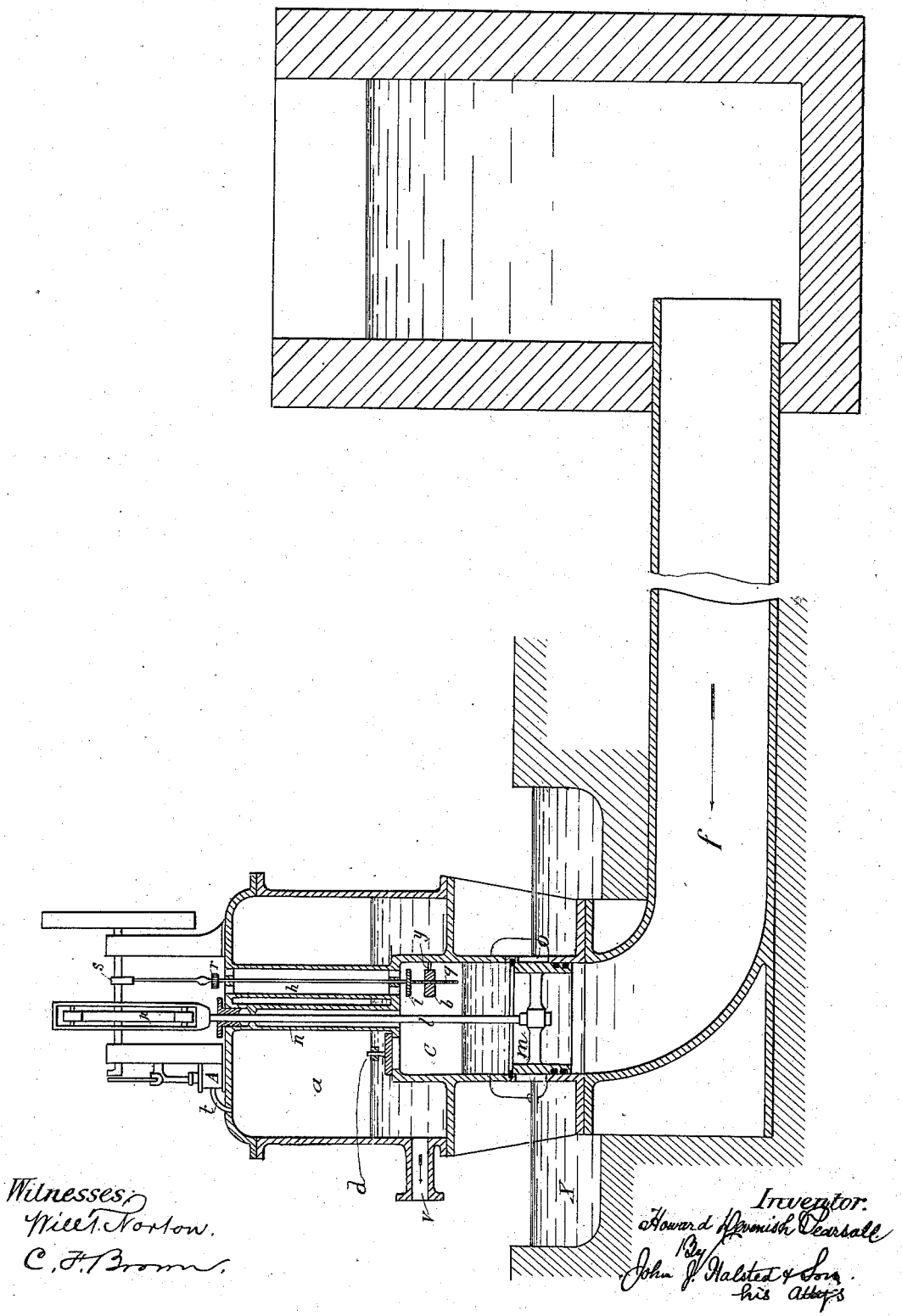
(No Model.)

H. D. PEARSALL.

HYDRAULIC APPARATUS FOR RAISING WATER, &c.

No. 382,380. Patented May 8, 1888.



Witnesses:
Will. T. Norton.
C. F. Brown.

Inventor:
Howard Hamish Pearsall
By
John J. Halsted & Son
his Attys

UNITED STATES PATENT OFFICE.

HOWARD D. PEARSALL, OF LONDON, ENGLAND.

HYDRAULIC APPARATUS FOR RAISING WATER, &c.

SPECIFICATION forming part of Letters Patent No. 382,380, dated May 8, 1888.

Application filed March 10, 1886. Serial No. 194,718. (No model.)

To all whom it may concern:

Be it known that I, HOWARD DEVENISH PEARSALL, a subject of the Queen of Great Britain, residing at London, England, have invented new and useful Improvements in Hydraulic Apparatus for Raising or Forcing Water and other Liquids, or for Forcing or Exhausting Air and other Gases, of which the following is a specification.

This invention relates to improvements in apparatus of the hydraulic-ram class.

The arrangement shown in the figure, which is a longitudinal section, contains all the improvements which I claim in this application.

f represents the flow or supply pipe of the apparatus, which is substantially the same as that in an ordinary hydraulic ram.

o o are orifices at the end of the flow-pipe for the discharge of the waste water.

c is a chamber, which I adapt between the end of the flow-pipe *f* and the usual air-vessel *a*, the said chamber *c* communicating with the air-vessel *a*, the entrance being closed or covered by any suitable valve, such as *d*, (or valves,) opening from the said chamber *c* outwardly.

m is the main valve for alternately opening and closing the orifices *o*.

h is a passage forming a communication between the chamber *c* and the atmosphere.

i is a valve (carrying an adjustable float, *b*,) for closing and opening, as required, the said passage *h*, as hereinafter described.

l is the spindle of the valve *m*, working fluid-tight in the sleeve *m*. The said spindle *l* and its valve *m* are operated by the motor A through the medium of suitable gearing—such as by means of a cam, *p*.

q is the rod which connects the valve *i* with the float *b*. It has a screw-thread throughout its length and passes through a nut in the float *b*. The valve *i* can be revolved by hand by means of a small wheel, *r*, for the purpose of adjusting the position of the float *b*. The float is prevented from revolving by the tongue *y* running in a groove in the side of the chamber *c*.

s is a small cam on the shaft of the motor, and is connected with the spindle of the valve *i*.

A movable packing-ring acting as the equivalent of a seat is shown above the valve *m*; but this I do not claim in this application, as it forms the subject-matter of an independent application, Serial No. 214,185, filed September 21, 1886.

In the arrangement shown in the drawing the motor is driven by the fluid under pressure from the vessel *a*, through the pipe *t*. *v* is a delivery-pipe from the air-vessel *a*.

The operation of this apparatus is as follows: The pipe *f* being full of water the valve *m* is opened, (it is shown open in the figure,) and allows water to flow away by a channel, *x*. After a certain period (determined with regard to the velocity of flow which it is desired to use) the valve *m* is closed, but the water continues to flow during the closing of the valve *m* and is not interrupted by the closing, as it is able to flow into the chamber *c*, the air from which has a free exit through the passage *h*. When the water has risen to a certain height in the chamber *c*, it presses on the float *b* and closes the valve *i*, either having driven out all the air from the chamber *c*, or when a certain portion is still confined therein according to the position in which the float *b* is adjusted. The time of closure of the valve may also be regulated by a cam, *s*, on the shaft of the motor. As soon as the valve *i* is closed, the main valve *m* being also closed, the momentum of the water causes the pressure in the chamber *c* to rise, (thereby opening the valve *d*,) and a portion of the water and the air (if any has been retained) to enter the air-vessel *a*. In one way of operating this apparatus the water is permitted to be thus brought to rest by the resistance within the air-vessel *a*, whereupon the valves *d* close. The main valve *m* is then opened by its motor and water is again allowed to flow away through the orifices *o*, and the valve *i* opening under pressure of the atmosphere (assisted, if required, by the motor) the water remaining in the chamber *c* also flows away through the waste-orifices *o*. The same cycle of operations being repeated the air in the air-vessel *a* is compressed and causes a continuous flow of water through the delivery-pipe *v* at any desired pressure, as in the ordinary hydraulic ram.

In the preceding description I have described the water as being brought to rest; but I sometimes arrange the gear for operating the said valve so that it is opened and the escape of water permitted while the water is still in mo-

tion, by which arrangement, it will be obvious, the stream will only be retarded by the resistance and not arrested; whereas in all rams as hitherto constructed the water has first to come to rest, and even to regurgitate, in order to suck open the waste-valve, from which regurgitation the violent action ensues which has given these machines the name of "rams." Besides avoiding this violent action, another result of this method is that the mean velocity of the flow can be made to approximate to the maximum velocity to any desired extent, and thereby the size of the machine is very materially diminished.

By providing the valve *i* with adjustable mechanism and so adjusting the time of its shutting in the way described the proportion of air and water injected into the air-vessel *a* may be varied to any degree, so that in the extreme position of the float only air and no water is injected, which is therefore the position of the float when it is desired only to compress air. A further advantage of this arrangement is that in starting the machine for forcing water the float is first adjusted as just hereinbefore described, and I fill the air-vessel *a* with air at the pressure I desire to use, thus enabling me to employ a much smaller air-vessel than in the ordinary ram. The air-vessel having been charged with the required quantity of air, the float *b* is readjusted for the apparatus to force water.

The apparatus may be employed for exhausting air or gas by connecting the passage *h* with the compartment to be exhausted.

In the above description, when water is mentioned the machine is equally adapted for any other liquid—such as petroleum or sewage—and where air is mentioned any other gas may be used.

The points in which hydraulic rams according to my invention differ from all other hydraulic rams are as follows: I have added a receiver, *c*, above the level of the tail-water *x*, into which receiver air freely enters at every stroke, and from which air freely escapes while the main valve is being closed, (and after the closure when desired,) so that water from the flow-pipe can enter the receiver during the closing of the said main valve, and I have devised an arrangement by which the quantity of air which is allowed so to escape is exactly regulated. The advantages gained by this are, first, that the valve *m* may be closed without causing obstruction of the flow of water, and, second, that the quantity of air forced into the air-vessel may be exactly regulated. The second of these two advantages is obvious; but as regards the first some further explanation may be desired.

In ordinary rams, while the waste-valve is in the act of closing, the water way or orifice through which the water escapes is evidently being all the time reduced in size, and this lessening of the size of the orifice has the effect of checking the flow of the water in the flow-pipe. If the waste-valve were closed very slowly, it is evident that the flow of the water would be entirely checked and the flow would in fact be stopped by the time the valve was completely closed. In this case the water would of course have no momentum by the time the waste-valve was completely shut, and, therefore, there would be no force left to open the delivery-valve or to inject any water into the air-vessel. The hydraulic ram, therefore, would not work at all if the waste-valve were closed very slowly. A similar loss of momentum, but less in amount, occurs when the waste-valve is closed more quickly. My improvement entirely prevents this loss, because, while the valve is closing and the orifice of escape is therefore being diminished, the water can flow into the empty space, *c*, provided to receive it, and the closing of the valve, therefore, does not check the flow of water at all. Moreover, it is usual in all hydraulic rams to close the valve very quickly in order to reduce this loss of momentum to the smallest amount possible. This quick closing gives rise to shocks or concussions which are serious drawbacks to the use of such machines, and indeed entirely prevent their being used except for small quantities of water; but my improvement having now got rid of the loss of momentum altogether, there is no longer any necessity to close the valve quickly or violently, and it may therefore be closed as gently as may be desired, and consequently injurious concussions are also got rid of.

I am aware that an air-vessel under the delivery-valves is used in some other rams, and into which air is sucked by the recoil of the column of water through a snift-valve; but my arrangement differs entirely from such air-vessels in the method of introducing the air, and in the fact that part of it escapes again freely into the atmosphere and in the exact regulation of the quantity so escaping, and it is on these facts that the useful new effect of my arrangement depends, as explained above.

I am also aware that in rams used only for compressing air there is a chamber which is filled with air at every stroke; but such chambers differ from my invention in the matter of the egress of the air and the means provided therefor, and in the regulation of the quantity of air compressed and in the valve arrangements, as follows: Other rams used for this purpose (of which the only successful example is, I believe, Sommeiler's French Patent No. 17,564, of 1853) have a separate valve for discharging the water from the air-chamber. According to my invention I dispense with this second valve and cause the chamber to be emptied through the same valve which controls the flow of water in the flow-pipe. This has an enormous effect in simplifying the machine, and still greater effect in simplifying its action. By reference to Sommeiler's patent it will be seen that the waste-valve had first to be opened to allow of escape of water from the air-chamber, and it was not until after this was completed and the waste-valve

again closed that the valve controlling the flow of water in the flow-pipe was opened. This caused such delays that only three strokes per minute could be made by the machine. With my machine there are no such delays, and I can consequently make thirty strokes of equal power in the same time. In Sommeiler's machine it was also necessary to have a head of water of eighty feet in order to compress air to a pressure of five atmospheres. At the Modane end of the Mont Cenis tunnel (the only place where this machine has been used) only thirty feet head of water was available, and Sommeiler was therefore obliged first to use this fall to pump the water into a reservoir eighty feet above the ram in order to obtain head enough to operate the ram. By my machine the head of thirty feet would have been ample to compress the air at once in the ram to the desired pressure.

An important part of my invention therefore is the single valve in combination with an air-chamber and its passage for ingress and egress of air, and another important part is the combination of this single valve with a fluid-pressure motor for operating it, because I effect entirely new results by this combination also. These results are partly those above described, but those might, though less effectively, be attained without the further combination of this motor; but there is one further effect which I obtain, and which is entirely my invention or discovery, and which can only be attained by this further combination, and cannot at all be attained either by a motor and two valves, or by one valve if it were worked in any way without a motor. It is the method mentioned above in describing the operation of my machine—namely, operating the ram by only retarding the flow of water instead of by entirely arresting the flow. This is applicable whether the ram be used for water or air, and has never before been accomplished or even suggested for either. It has the result of at once reducing the size of the machine very considerably, because it increases the mean velocity of the water in the flow-pipe.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is—

1. In hydraulic rams, the combination, with a flow-pipe and main valve, of a receiver, *c*, into which some of the water from the flow-pipe flows during the closing of the main valve, the receiver having a passage, *h*, through which air enters it and also escapes from it during the closing of the main valve, and a valve, *i*, in receiver *c* opening inwardly to close the passage *h*.

2. In hydraulic rams, the combination, with a flow-pipe and main valve, of a receiver, *c*, into which some of the water from the flow-pipe flows during the closing of the main valve, the receiver having a passage, *h*, through which air enters it and also escapes from it during the closing of the main valve, a valve, *i*, closing the passage *h*, and a float, *b*.

3. In hydraulic rams, the combination, with a flow-pipe and main valve, of a receiver, *c*, into which some of the water from the flow-pipe flows during the closing of the main valve, the receiver having a passage, *h*, through which air enters it and also escapes from it during the closing of the main valve, a valve, *i*, closing the passage *h*, a float, *b*, and a screw, *q*, by which the distance of the float from the top of receiver *c* is varied at will.

4. In hydraulic rams, the combination of a flow-pipe, an air-vessel, *a*, a single valve, *m*, acting as main and waste valve, a valve-rod, *l*, and a motor, A, operatively connected with the valve-rod and actuated by the fluid under pressure in the air-vessel.

5. In hydraulic rams, the combination, with flow-pipe, main valve *m*, and an air-vessel, of a receiver, *c*, into which some of the water from the flow-pipe flows during the closing of the main valve, the receiver having a passage, *h*, through which air enters, and also escapes from said receiver during the closing of the main valve, a valve, *i*, closing the passage *h*, and a float, *b*, a screw, *q*, by which the distance of the float from the top of the receiver is varied at will, and a valve-rod, *l*, driven by a motor, A, actuated by the fluid under pressure in the air-vessel *a*.

H. D. PEARSALL.

Witnesses:
G. T. REDFERN,
A. S. ALBUTT.