(No Model.) 4 Sheets—Sheet 1.

C. A. MAYRHOFER.

HYDRAULIC AIR COMPRESSOR.

No. 261,560. Patented July 25, 1882.

Fig. 1.

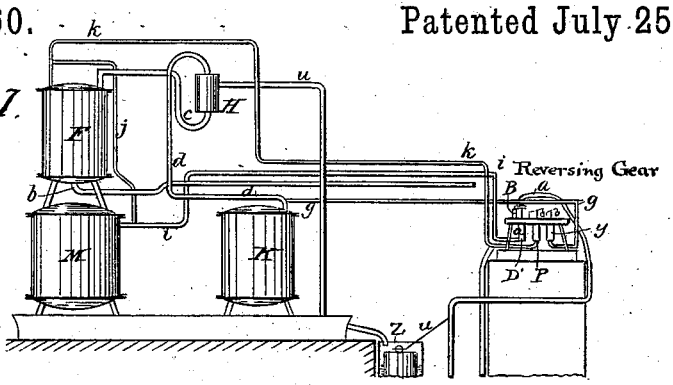

Fig. 2.

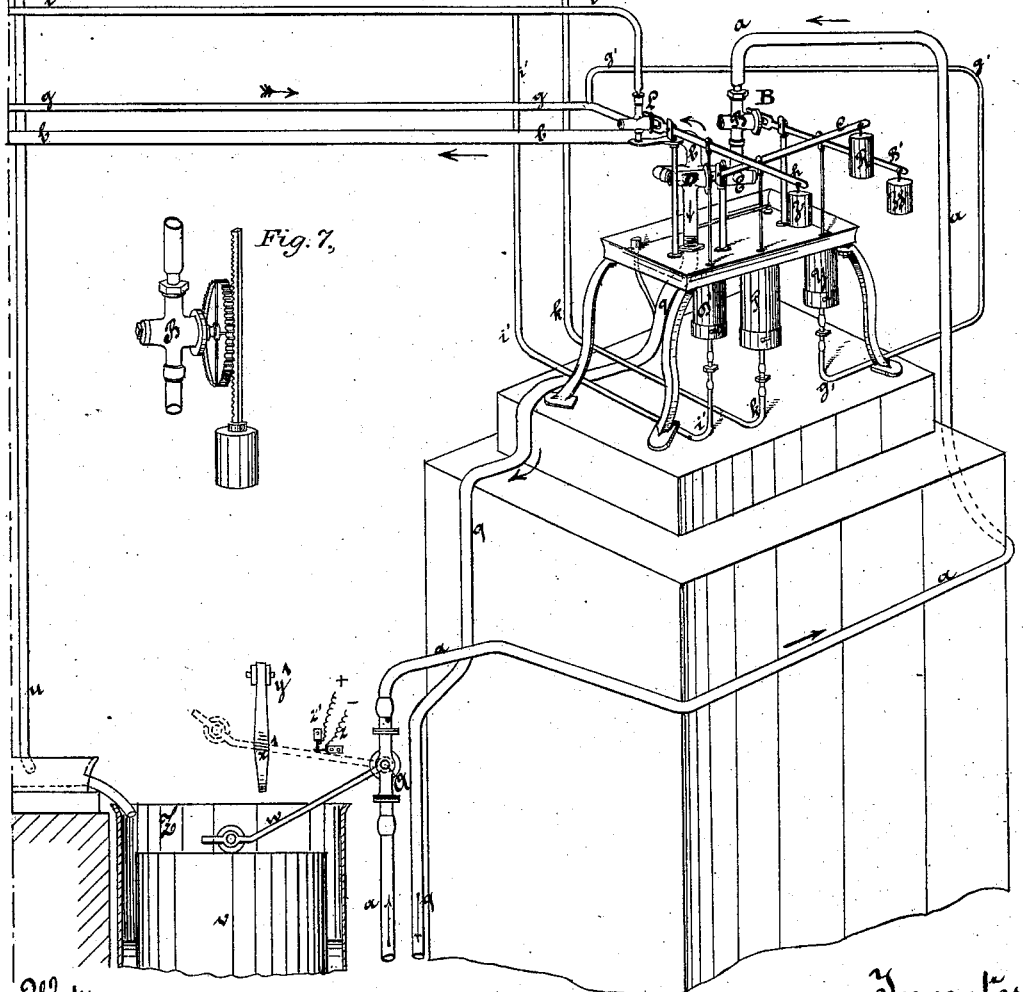

Fig. 7.

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Fig. 3.

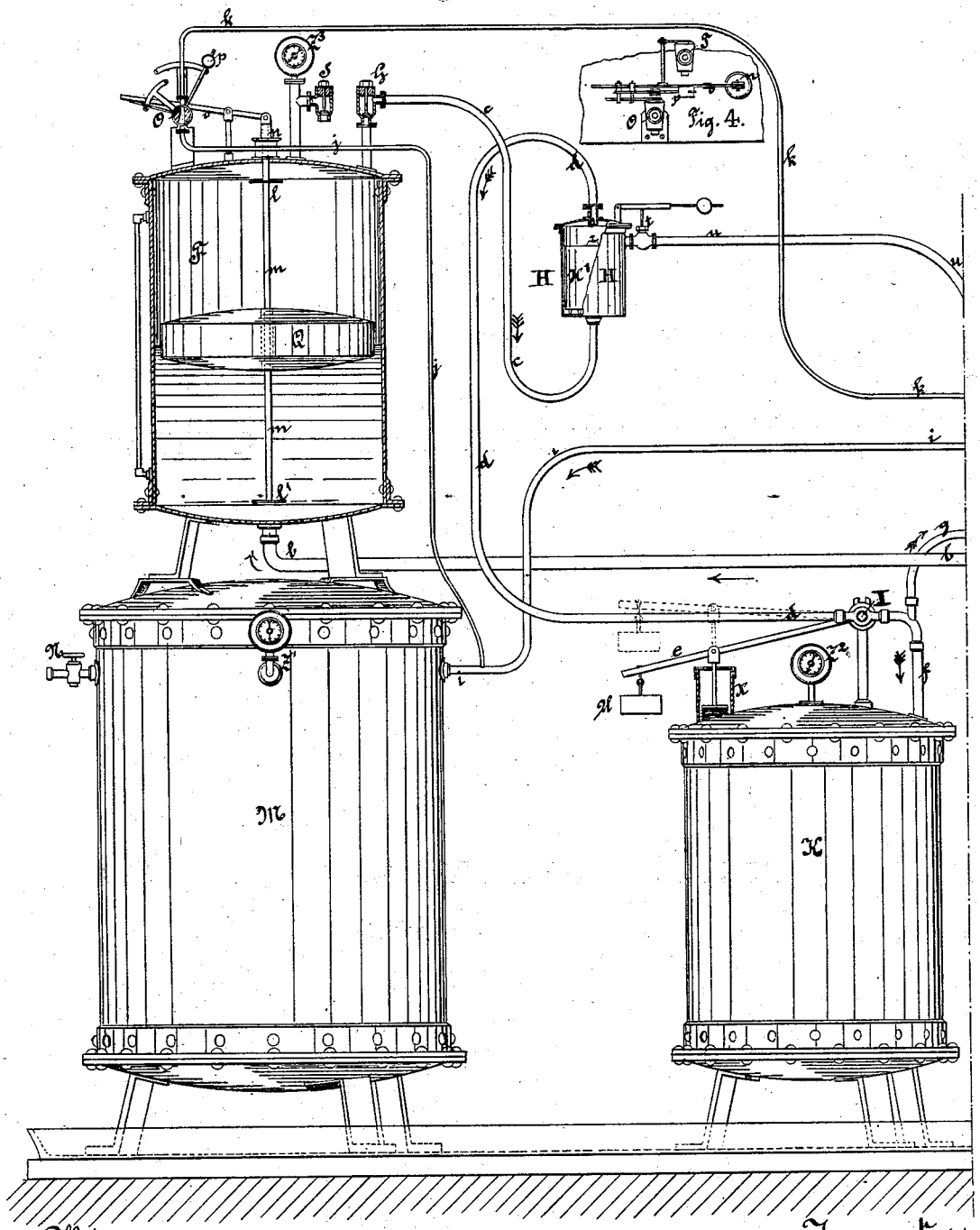

Fig. 4.

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Fig. 5,

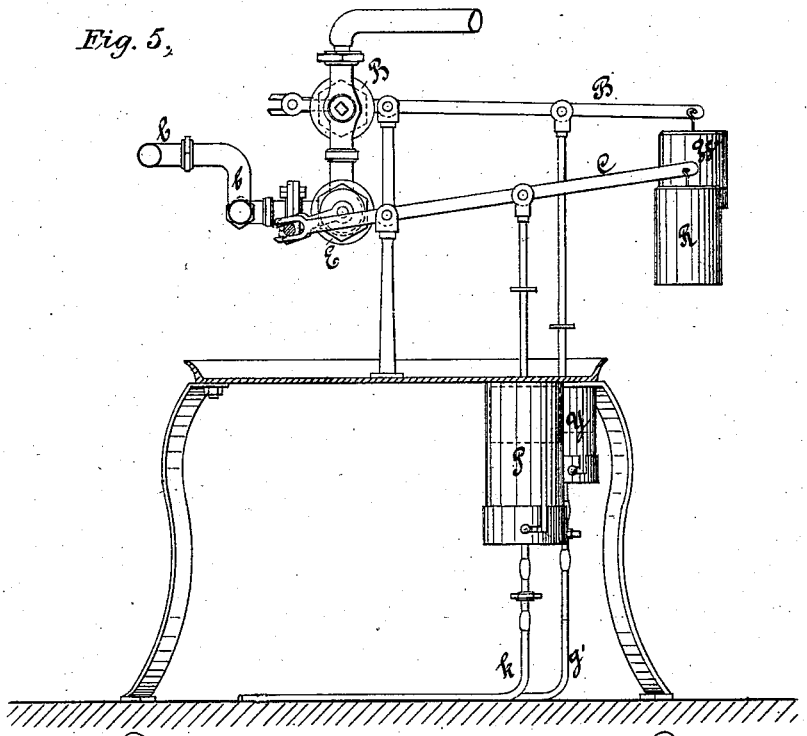

Fig. 6,

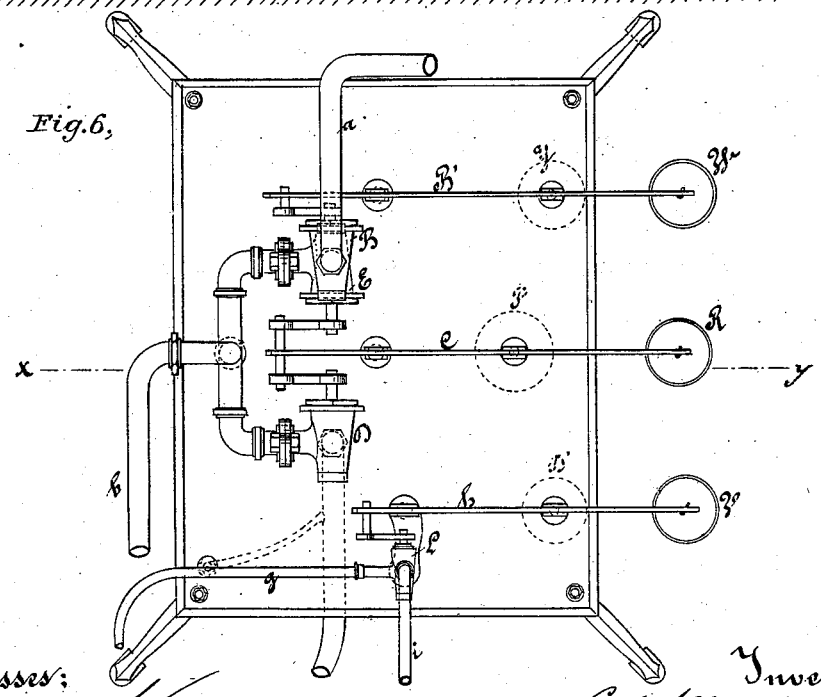

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Fig. 8,

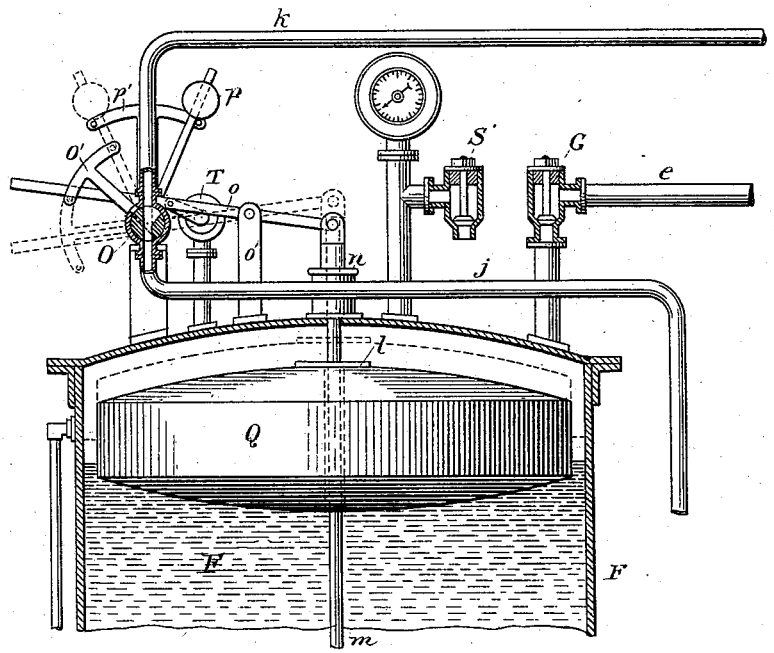
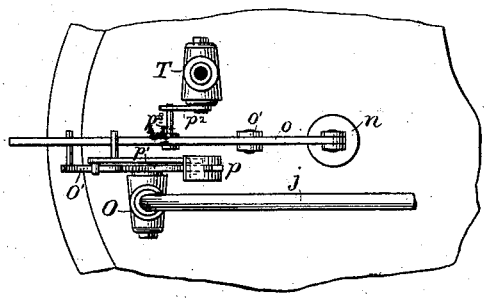


Fig. 9,



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UNITED STATES PATENT OFFICE.

CARL A. MAYRHOFER, OF PARIS, FRANCE.

HYDRAULIC AIR-COMPRESSOR.

SPECIFICATION forming part of Letters Patent No. 261,560, dated July 25, 1882.

Application filed November 25, 1881. (No model.) Patented in France June 18, 1881; in Belgium June 25, 1881; in Germany October 4, 1881; in England October 10, 1881, and in Austria-Hungary October 29, 1881.

To all whom it may concern:

Be it known that I, CARL ALBERT MAYRHOFER, electric engineer, resident at Paris, in the French Republic, have invented certain new and useful Improvements in Hydraulic Air-Compressors, of which the following is a specification.

This invention has reference to an improved hydraulic air-compressor with automatic reversing-gear; and the invention consists of the combination of a low-pressure reservoir and a high-pressure reservoir with a water-reservoir and a reversing-gear that is operated by compressed air, in connection with a three-way cock of the water-reservoir, so as to interrupt or establish the water-supply to the same.

The apparatus is further provided with automatically-working safety devices for preventing the entrance of water into the air-reservoir by shutting off the water-supply entirely from the apparatus, as will be more fully set forth hereinafter.

In the accompanying drawings, to which reference is made, Figure 1 represents a diagram showing the general arrangement of my improved hydraulic air-compressor. Fig. 2, Sheet 1, represents a part of the apparatus on a larger scale, showing the automatic reversing-gear and the automatic alarm indicating when the water is entirely shut off. Fig. 3, Sheet 2, represents the remaining part of the apparatus, also on a larger scale and partly in section. Fig. 4 represents a detail plan view of the three-way cock of the water-reservoir; and Figs. 5 and 6, Sheet 3, represent respectively a vertical transverse section of the automatic reversing-gear on line *x y*, Fig. 6, and a plan view of the same. Fig. 7 represents a substitute device for automatically opening and closing the cocks; Fig. 8, an enlarged sectional view of a portion of the chamber F, showing the arrangement of the pipes connected thereto, the vents, valves, and valve-operating mechanism. Fig. 9 is an enlarged view of the parts shown in Fig. 4.

Similar letters of reference indicate corresponding parts.

My improved hydraulic air-compressor consists essentially of five main parts—to wit, a low-pressure reservoir, M, a high-pressure reservoir, K, a water-reservoir, F, supported above the low-pressure reservoir M, a safety device for preventing the entrance of water into the connecting-pipes of the apparatus, and an automatically-operated pneumatic reversing-gear. (Shown in Figs. 2, 5, and 6.) To the latter water is admitted under pressure through a stop-cock, A, and pipe *a*, Fig. 2, and through the cock B of the reversing-gear into the system of connecting-pipes of the apparatus.

Close to the entrance-cock B are arranged two cocks, E and D, to which a weighted lever, C, is connected in such a manner that the lever keeps always one of the cocks open and the other closed.

If the position of the lever C be up, as shown in Figs. 2 and 5, the cock E is opened and the cock D closed. The water consequently is allowed to pass through the cock E and the tube *b*, which latter connects with the bottom of the water-reservoir F, Fig. 3.

The air contained in the water-reservoir F is compressed by the rising of the water, and passes through the valve G and the pipe *c* to the safety apparatus H. (Shown in Fig. 3.)

The safety apparatus H is of cylindrical shape, and has at its interior a float, H′, which rests on small feet. The air which is forced in through the pipe *c* passes around the float, and then through the tube *d* to the cock I of the high-pressure reservoir K, Fig. 3, and when the same is in open position, which is the case when the lever *e* is down, through the cock I and pipe *f* into the reservoir K. Simultaneously the air passes through the pipe *g* to the cock L of the reversing-gear, (shown in Fig. 2,) which cock is also in open position when its lever *h* is in a downwardly-inclined position, and from the same through the connecting-pipe *i* into the working low-pressure reservoir M, Fig. 3. The course of the water (indicated by plain arrows) is therefore as follows: A, *a*, B, E, *b* to the water-reservoir F, while the course of the compressed air (indicated by winged arrows) is as follows: G, *c*, H, *d*, I, *f*, K, *g*, L, and *i* to the working-reservoir M.

The low-pressure reservoir M is provided with a discharge-cock, N, for the working air, also with a pressure-gage, Z′, the water-reservoir F and high-pressure reservoir K having respectively the pressure-gages Z^3 and Z^2.

Upon the top of the water-reservoir F, Figs.

3 and 8, is arranged a three-way cock, O, to which leads a small branch pipe, *j*, from the tube *i* of the low-pressure reservoir M. The position of the three-way cock O during the time when the water-reservoir is supplied with water is such that the compressed air enters from *i* to *j* through the three-way cock O and through the small pipe *k* to the cylinder P of the lever C of the reversing-gear, Fig. 2, whereby the latter is raised and the cock E retained in open position, and the discharge-cock D is retained simultaneously in a closed position.

As soon as the float Q of the water-reservoir F, Figs. 3 and 8, has arrived at its uppermost position, it lifts a rod, *m*, by bearing on the fixed upper disk, *l*, of the same. The rod *m* passes through the stuffing-box *n* of the top of the reservoir F, and is connected at its upper end to the inner end of the horizontal lever *o*, which is pivoted at *o'* to a standard fixed to the top of the chamber F. Attached to the cock O is a T-shaped arm, O', and a weighted lever, *p*. An arc-shaped guide-strap, *p'*, attached to a fixed standard and provided with stop-pins at each end, serves to guide the movement of the weighted or balancing lever *p*. The T-shaped arm is provided with laterally-projecting pins, against which the lever *o* acts to turn the valve O. When the parts are in the positions shown in Figs. 3 and 8 and the float Q is raised the outer end of the lever *o* presses against the lower pin of the arm O' and turns the valve O sufficiently to cause the weighted lever *p* to pass the center of the arc-shaped guide-strap *p'*, and the weight upon said lever *p* causes it to drop to the other end of the strap, and the axial turning of the cock O is accomplished. By the changed position of the latter the admission of air from the small air-pipe *j* is shut off and the air in the cylinder P, Fig. 2, allowed to escape to the atmosphere, so that the lever C is lowered by its weight R, and consequently the cock E closed and the cock D opened. This change in the position of the cocks E and D allows the water to pass from the reservoir F through tube *b*, cock D, and tube *q* to the outside of the apparatus, where it may be utilized for any other purpose, it having accomplished its work in the apparatus.

During the passing off of the water from the reservoir F air is admitted thereto through the vent S, Fig. 3, and the vent T, Fig. 4, the latter being opened by the arm *p'*, attached to the lever *p*, so as to be thrown into open position.

The vent S consists of a check-valve which is raised from its seat by the outside pressure of the atmosphere when the water is drawn off.

The vent T consists of a cock which is connected by a crank-arm, p^2, and pin p^3 to the lever *o*, whereby said lever operates to open or close the vents simultaneously with the turning of the cock O.

When all the water has run out of the reservoir the float Q has arrived at its lowermost position and presses upon a second plate, *l'*, at the lower end of the rod *m*, and forces by its weight the rod *m* downward, causing thereby the reversing of the levers *o* and *p* and the simultaneous change of position of the three-way cock O. The connection between the pipes *i*, *j*, and *k* and the cylinder P of Fig. 2 is thereby established again, the lever C raised, the supply-cock E opened, and the discharge-cock D closed. The apparatus begins now its play again in the same manner as before described.

It may be remarked, in this connection, that instead of the two cocks E and D a single three-way cock may be used. In case of very high pressure it may also be advisable to substitute, in place of the weighted levers for opening and closing the cocks, pinions and weighted racks, as shown in Fig. 7.

The weight U of lever *e* (shown in Fig. 3) and the weights V and W of levers *h* and B' (shown in Fig. 2) have the object to equalize the pressure of the air to such a degree that a certain fixed pressure may be reached, and also the friction of the cocks be overcome. If, for instance, it is desired to store up air in the high-pressure reservoir K at a pressure of two atmospheres, (provided that the pressure of the water is higher,) the weight U of the lever *e* must be heavy enough to resist this pressure and hold the balance of the bellows or piston of the cylinder X. If a larger pressure should be reached, the lever *e* is raised, the cock I closed, and consequently every further supply of air shut off.

A similar operation takes place with the cock L, Fig. 2. The weight V is arranged for a small pressure only, and is lifted by the air conducted through the small pipe *i'* into the cylinder D' as soon as the desired pressure is obtained, whereby any further passage of air from the pipe *g* to the pipe *i* and to the working-reservoir M is prevented. The lever C of the reversing-gear is either in its lowermost or its uppermost position, according to the position of the reversing-levers of the three-way cock O of the water-reservoir F. The cock B of the reversing-gear is closed by the lever B' when the pressure in the high-pressure reservoir K reaches its maximum, as in that case the air, conducted through the small pipe *g'* to the cylinder Y, overcomes the resistance of the weight W.

The reversing-gear is shown in detail in Figs. 5 and 6, and shows more fully the different parts, which do not so clearly appear in the perspective view of the reversing-gear in Fig. 2.

The safety apparatus H, Fig. 3, has the object to prevent the entrance of water into the pipe *d* whenever, by accident or otherwise, the reversing of the three-way cock O should not be accomplished, and consequently water be admitted into the tube *c*. In this case the float H' is raised and the mouth of the tube *d* closed by the cone *r* at the top of the float H'. At the same time the safety-valve *t* is opened and the water allowed to escape through the pipe *u* to the water-collecting pan at the bottom of the apparatus, from which it passes into

the open tank Z of Fig. 2, where it raises the float *b* and lifts the lever *w* of the supply-cock A, so as to close the same and prevent the further supply of water. The lever *w* is retained by a nose or catch, *x'*, on the latch *y'*, so as to prevent it from being lowered. The latch *y'* is pivoted to the end of an arm which may project from the wall or from a suitable supporting-standard.

The safety apparatus will also be thrown into operation if water should leave the apparatus at any other point, as the different parts are arranged at different heights above each other and shed all the water into the tank Z. The moment the supply-cock A is closed by the raising of the lever *w* an electrical contact, *z z'*, is formed, and thereby an alarm given, after which the lever *w* has to be released from its catch *x'* before the apparatus can be made to resume its functions.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. A hydraulic air-compressor consisting of a water-reservoir, a low-pressure air-reservoir, a high-pressure air-reservoir, a safety device to prevent the water from entering into the system of air-pipes, a pneumatic reversing-gear, and connecting water and air pipes, substantially as set forth.

2. In a hydraulic air-compressor, the combination of the water-reservoir F, having a float, Q, connecting-rod *m*, and lever *o*, with a three-way cock, O, connecting-pipe K, cylinder P, and lever C, whereby the automatic opening or closing of the cocks E and D is accomplished, substantially as specified.

3. The combination of the water-reservoir F, the low-pressure air-reservoir M, the high-pressure air-reservoir K, air-pipes *c* and *d*, connecting the water-reservoir F and high-pressure reservoir K, cock L, air-pipes *f* and *g*, connecting the high-pressure reservoir with cock L, air-pipe *i*, connecting cock L with the low-pressure reservoir M, cylinder D, air-pipe *i'*, connecting pipe *i* with cylinder D', and the weighted lever *h*, all substantially as described.

4. In a hydraulic air-compressor, the combination of the water-reservoir F, high and low pressure air-reservoirs M and K, connecting air-pipes *c d g g'*, cylinder Y, and weighted lever B', whereby cock B is automatically closed in case of too high a pressure in reservoir K, substantially as set forth.

5. In a hydraulic air-compressor, the combination, with the water-reservoir F and the high and low pressure air-reservoirs K and M, of the safety device H H' and connecting air-pipes *c d g i* and water-discharge pipe *u*, substantially as described.

6. In a hydraulic air-compressor, the combination of the water-supply cock A, having a lever, *w*, with float *v*, latch *y'*, having nose *x'*, and electric contacts *z z'*, substantially as set forth.

In testimony that I claim the foregoing as my invention I have signed my name, in presence of two witnesses, this 14th day of September, 1881.

C. A. MAYRHOFER.

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CHANTEMESSE.