(No Model.) 2 Sheets—Sheet 1.

C. LEAVITT.

APPARATUS FOR COMPRESSING AIR AND STORING THE SAME.

No. 320,482. Patented June 23, 1885.

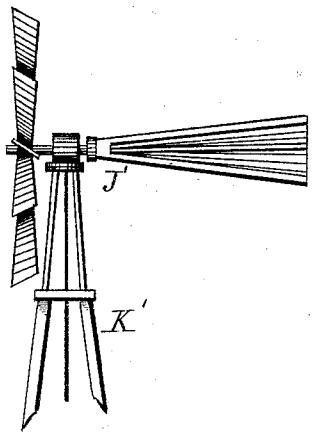

Fig. 1.

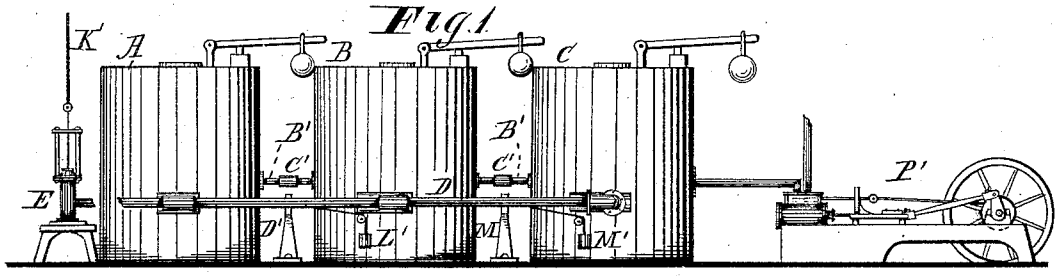

Fig. 3.

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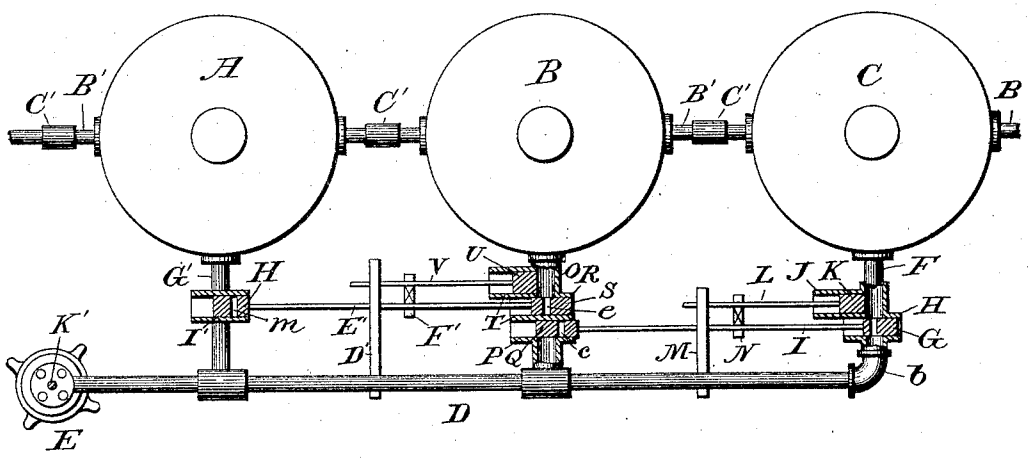
Fig. 2.



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UNITED STATES PATENT OFFICE.

CHARLES LEAVITT, OF CLEVELAND, OHIO.

APPARATUS FOR COMPRESSING AIR AND STORING THE SAME.

SPECIFICATION forming part of Letters Patent No. 320,482, dated June 23, 1885.

Application filed November 24, 1884. (No model.)

To all whom it may concern:

Be it known that I, CHARLES LEAVITT, of Cleveland, Cuyahoga county, and State of Ohio, have invented a certain improved apparatus for the storage of air and compressing the same in an arrangement of tanks or chambers having an open communication one with the other, of which the following is a specification.

The power for compressing the air in tanks, or its equivalent, is obtained from a windmill, and the compressed air stored in said tanks is conducted therefrom to an engine for operating it.

A detailed description of the construction of the apparatus and the operation thereof are as follows, reference being had to the annexed drawings, making a part of this specification.

Figure 1 represents a side elevation of the apparatus. Fig. 2 is a plan view of a detached portion thereof. Fig. 3 is a detached section.

Like letters designate like parts in the drawings.

In Fig. 1, A, B, and C represent a series of tanks or chambers. Three only are shown, but which may be more or less, and of any desirable holding capacity, and hermetical. The several tanks are connected to each other by pipes B′ B′, provided with a valve-chamber, C′, in each of which is a valve, *a*. A detached enlarged view of said chamber and valve is seen in Fig. 3. It is not essential that the valve should be like the one shown in the drawings; but that style of valve is preferred.

D is an air-pipe extending from an air-pump, E, to the several tanks with which the pipe is in communication by side pipes provided with piston-valves constructed and for operation as follows:

In connection with the branch pipe F of said air-pipe D is arranged (in a transverse horizontal relation thereto) a cylinder, G, in which is fitted, so as to work air-tight therein, a piston-valve, H, to which is attached a rod, I; also to said pipe, and in open relation therewith is connected a cylinder, J, having therein fitted a piston-valve, K, to which is attached a rod, L, extending therefrom to a standard or frame, M, in which it is supported and free to slide. The two rods I and L are connected to each other by a link, N, as shown in the drawings.

The pipe D is in communication with the tank B by a branch pipe, O, to which is connected a cylinder, P, having therein a piston-valve, Q, connected to the valve H by the rod I, above alluded to.

R is also a cylinder, with a valve, S, similar to the valves H and Q.

To the said pipe O is also connected a cylinder, T, with a valve, U, therein, similar to the valve K, before described.

To the valve U is attached a rod, V, extending therefrom to the standard or frame D′, in which it is supported and slides. The rod V is connected to the rod E′ of the valve S by a link, F′.

The tank A is also in communication with the air-pipe D by a side pipe, G′, provided with a cylinder, H′, and valve I′. Said valve is similar to the valve Q, and is connected to the valve S by the rod E′. Should there be more tanks than the number herein specified and shown in the drawings, the air-pipe D must necessarily be extended accordingly and its connection with the additional tanks be made by simply duplicating the connections above described as connecting the pipe with the three tanks before described.

The air-pump E, before alluded to, is or may be, like those in ordinary use, a machine too well known to require a description in this place, and with which the pipe D is connected as aforesaid.

Power for working the pump is obtained preferably from the windmill J′, to which the pump is connected by the rod K′ or otherwise. For the purpose specified the windmill may be any one of the approved kind in public use, and therefore needs no special description in this connection.

The operation of the apparatus is substantially as follows: Let it be supposed that the tanks have not any compressed air therein. In this condition the valves I′ and Q are closed against the tanks A B, and the valve H is open to the tank C, as seen in Fig. 2. The air-pump being now operated pumps the air into the tank C, and air continues to be forced therein until a pressure of one hundred to one hundred and twenty or more pounds is obtained to the

square inch. The valve H is then closed by the weight M′, attached to the rod L of the valve K. Said weight is so adjusted as to resist a pressure up to, say, one hundred and twenty pounds. When this pressure is obtained in the tank, the gravity of the weight is overcome by the pressure of the air on the valve K, thereby forcing it in the direction of the arrow. This movement of the valve K takes with it the valve H by its connection with the valve K, the respective valve-rods L and I being attached to each other by the link N. As the valve H moves back, the opening or port *b* passes beyond the bore of the side pipe, F, until the blank of the valve covers said bore, thereby shutting off a further admittance of air into the storage-tank C. This movement and closing of the valve H does at the same time open the valve Q by its being connected therewith by the rod I, which rod pushes the valve Q so far as to bring the port *c* of the valve in open relation with the bore of the side pipe, O, and the port *e* of the valve S. This movement of the valves prevents the air from passing into the storage-tank C, and permits it to pass into the tank B, which, when charged with, say, one hundred and twenty pounds of air-pressure, as was the tank C, then overcomes the gravity of the gage-weight L′, Fig. 1, by the superior pressure of the air upon the valve U, which pushes said valve in the direction of the arrow, taking with it the valve S by its connection therewith, as the respective valve-rods are attached to each other by the link V.

The above said action of the valves S and U prevents a further passage of air into the tank B, as in the former instance relating to the tank C. During the action of the valves S and U, the valve S pushes back the valve I′ by its connection therewith by the rod E′. The valve I′ moves far enough to bring the port *m* of the valve in open relation with the bore of the side pipe, G′, thereby allowing the air from the pipe D to pass into the tank A, in which tank, when charged with the full pressure of air, the air may be confined therein by a stop-cock in the side pipe. It will be obvious from the above that the charging of the several tanks with compressed air is done automatically, and that the pressure of the stored air may be more or less as the weights L′ and M′ are graduated for that purpose by additions to or taking therefrom, as the nature of the case may require.

It will be apparent that any number of storage tanks or cylinders may be used and charged with compressed air by simply duplicating the valves as the number of tanks may require.

To the last tank filled may be attached a safety valve to allow the excess of air above one hundred and twenty pounds or more to escape, so that the mill may be kept running continuously without personal attention or danger of explosion from undue pressure. The practical use of the air stored, as above described, is made by conducting it to the air-engine P′, which for that purpose may be any one of those known to the public, or such modification thereof as may be required for its practical connection with this apparatus, and to be used when the windmill is inoperative for the want of air to drive it. The pneumatic engine P′, Fig. 1, when first started receives its air from the tank C—that is to say, the first one of the whole number of tanks that may be used. As the air commences to be reduced in tank C, the valves *a* in the pipes B′ open, thereby allowing the air to flow freely from one tank to the other and into the tank C, while the air-pump operated by the windmill continues to discharge air into the tank A, which may be the last one of a series of tanks, and thereby keep up the normal pressure of air in the tanks. When the pressure falls below one hundred and twenty pounds, the safety-valve will close and the weight M′ will drop and open the valve H of the tank C, which will then receive the full force of the air-pump. Said tank C will be also re-enforced by the pressure of air from all the other tanks, as the valves *a* will open when the pressure in a tank—that is, on the opening side of the valve—falls below the pressure of air in the tank on the closing port side of the valve, thereby giving to the engine the full force of compressed air in the tanks, and also the direct force of air from the pump.

The engine will run with the same speed and power whether the pressure be either sixty or one hundred and twenty pounds in the tanks, as the engine-governor will control the speed. Under a low pressure of air a large volume is needed to compensate for the lack of compression in the tanks, while its effective force upon the engine will be the same—that is to say, the storage of air in the tanks under a pressure of one hundred and twenty pounds (more or less) is not for the purpose of obtaining that sum of pressure to run the engine, for the engine may not require more than one-fourth or one-half of that force to run it; but whatever the pressure may be needed to run the engine less the one hundred and twenty pounds is stored in the tanks to be utilized for the purpose specified.

I desire it to be understood that I do not confine myself to the exact construction and arrangement of the storage tanks or chambers before described, as the same may be varied in shape and number; nor do I confine myself to the form or shape of the valves, as herein shown and described, as other valves may be used, and instead of valves stop-cocks may be employed and operated in same way as the piston-valves without changing the essential features of my invention, which consists of a number of hermetically-constructed tanks or cylinders in which air is compressed, and using for the compression of the air a windmill for operating the air-pump in connection with the several tanks by an air-pipe provided with valves working automatically

for the admission of air into the storage-tanks. In using a windmill a cheap power is employed for storing the air, thereby accumulating a force which may be held in reserve and utilized when there is not air-current to operate the windmill.

What I claim as my improvement, and desire to secure by Letters Patent, is—

1. In an apparatus for compressing and storing air, an arrangement of hermetically-constructed tanks connected to each other by tubular connections, each of which is provided with a valve in combination therewith, counter-weights L′ M′, air-pump put in communication with said storage-tanks, by an air-pipe, D, and branch pipes, substantially as described, and for the purpose set forth.

2. The combination, with the air-pipe D, branch pipe F, and storage-tank C, of valves H and K, counter-weight M′, arranged to co-operate in relation to and co-ordinately with the valve Q, substantially as described, and for the purpose specified.

3. The combination of the storage-tanks A, B, and C, (more or less in number,) in communication with each other by tubular connections B′, provided with valves for opening and closing said connections, air-pipe D, put in communication with the tanks by branch side pipes, having in connection therewith piston-valves, counter-weight, and air-pump, substantially as described, and for the purposes herein set forth.

In testimony whereof I affix my signature in presence of two witnesses.

CHARLES LEAVITT.

Witnesses:
W. H. BURRIDGE,
J. H. BURRIDGE.