No. 721,991. PATENTED MAR. 3, 1903.

W. I. AIMS.

SAFETY AIR LOCK.

APPLICATION FILED DEC. 17, 1902.

NO MODEL. 2 SHEETS—SHEET 1.

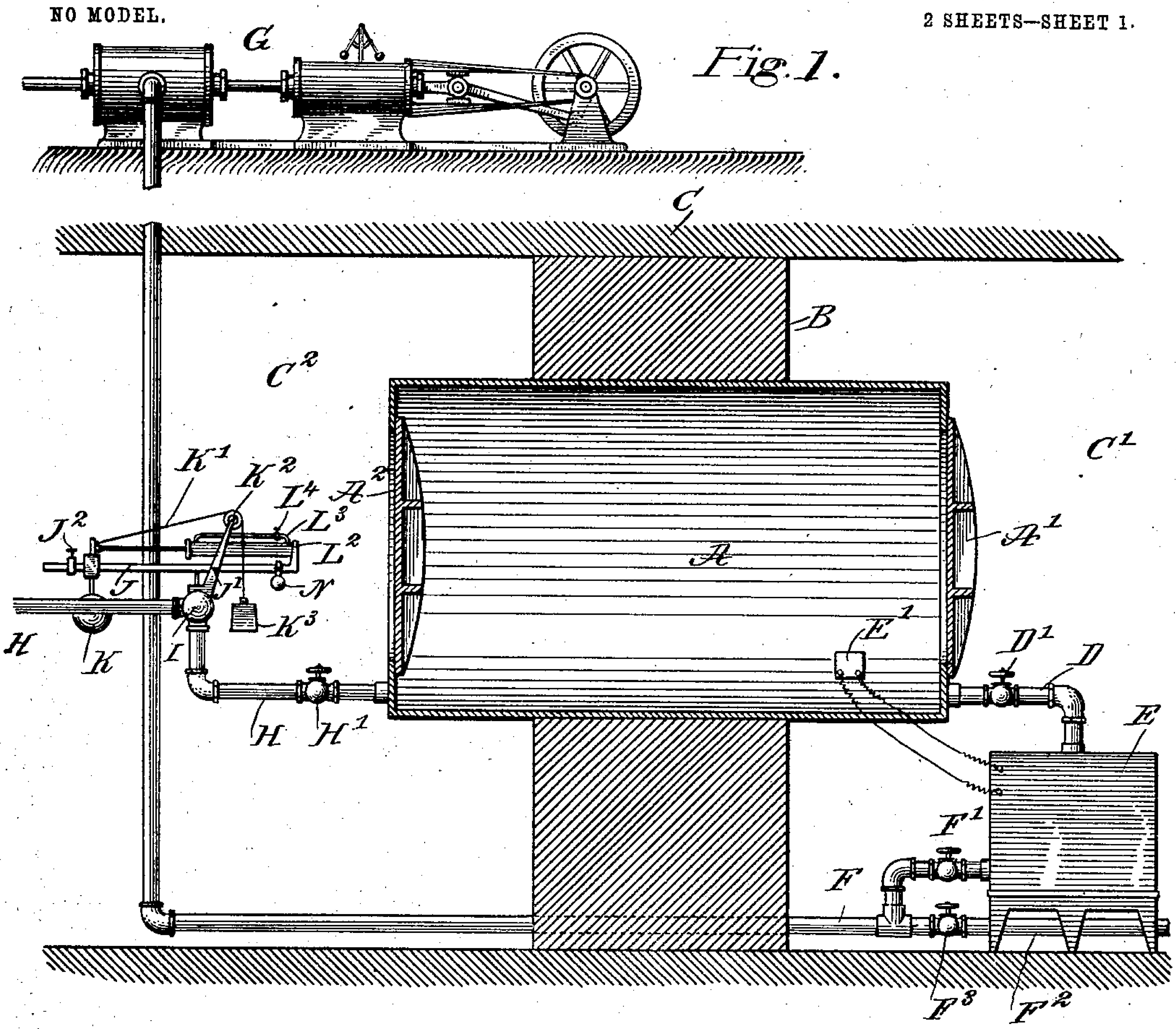

Fig. 1.

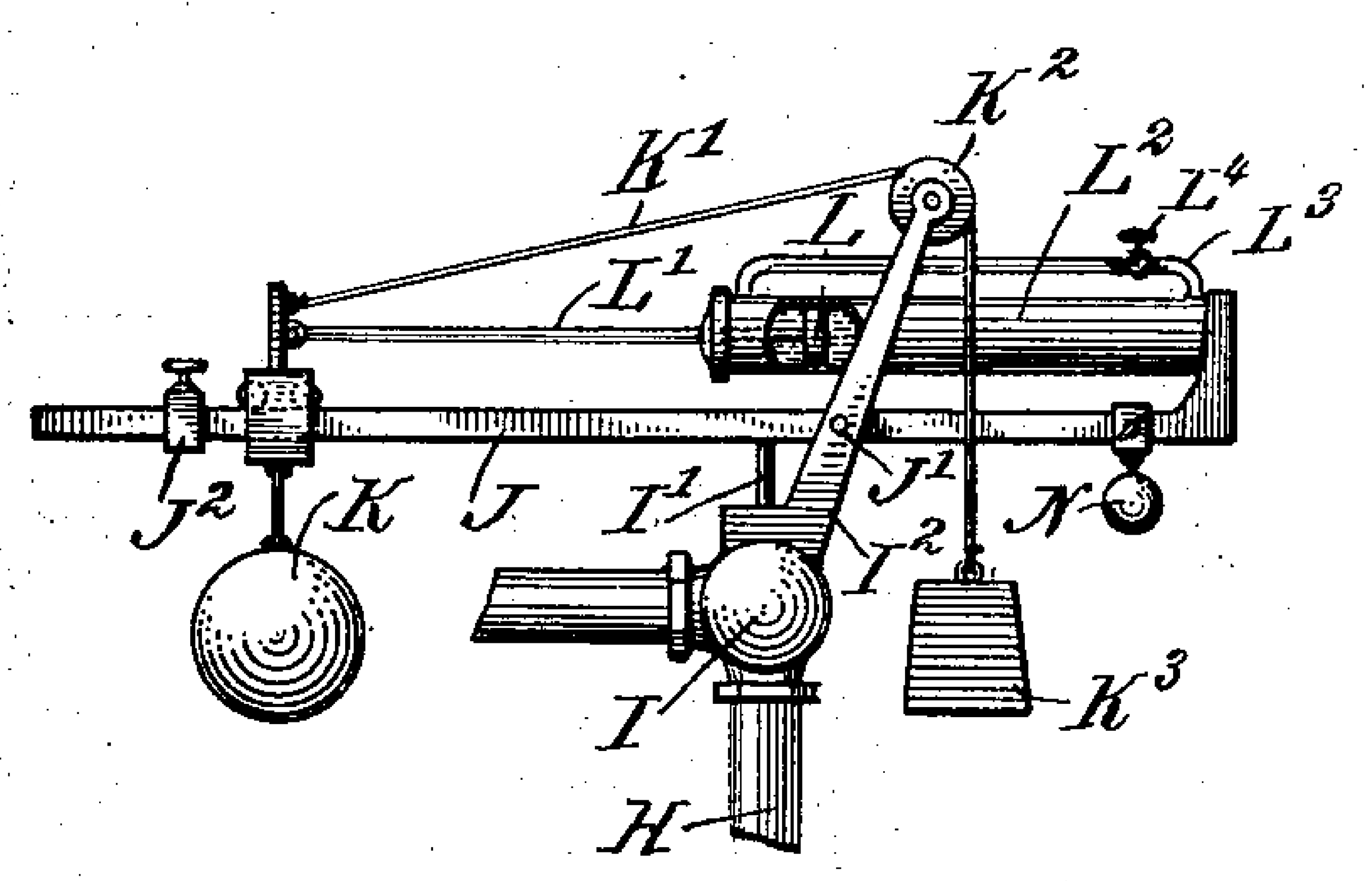

Fig. 2.

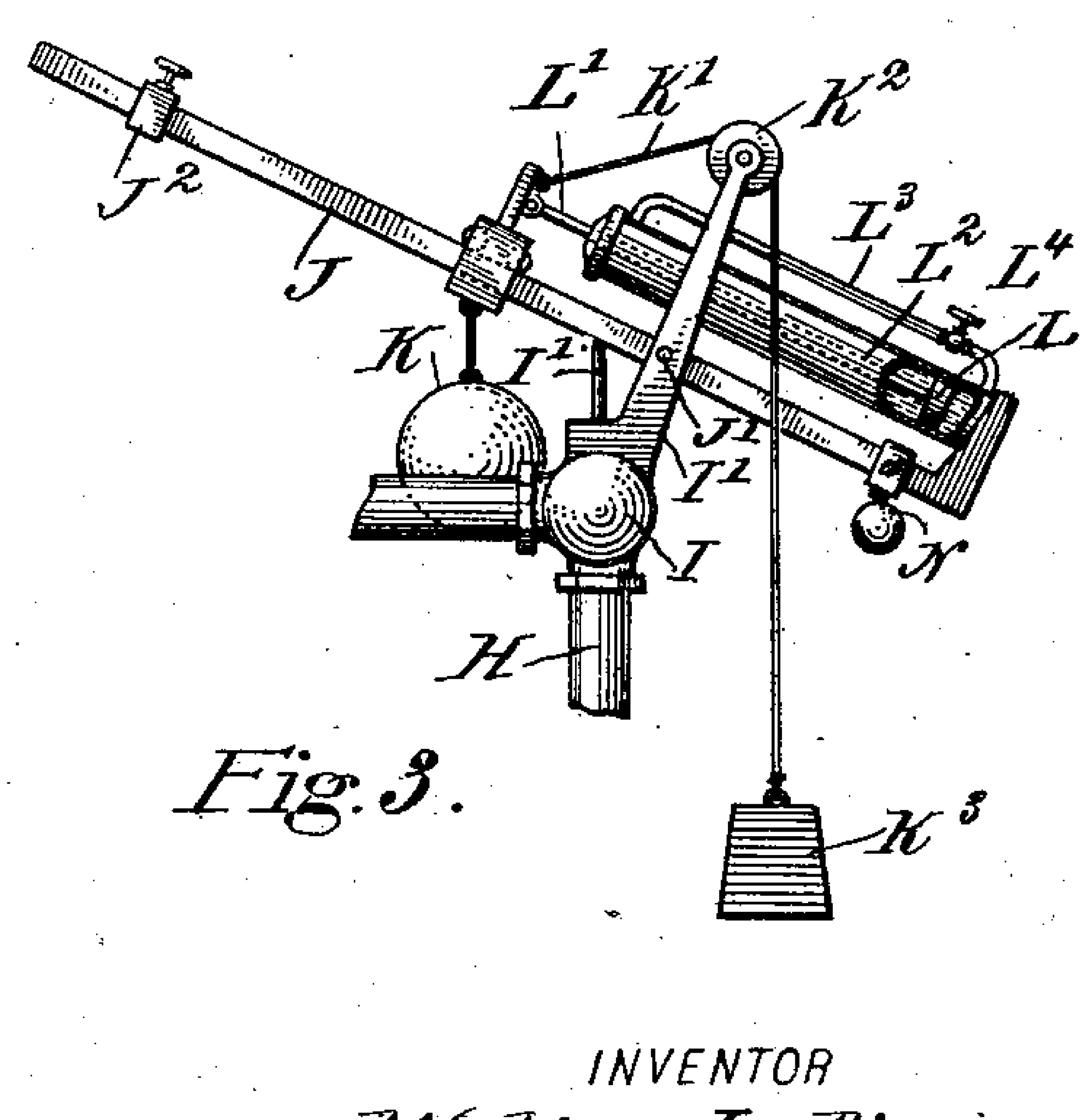

Fig. 3.

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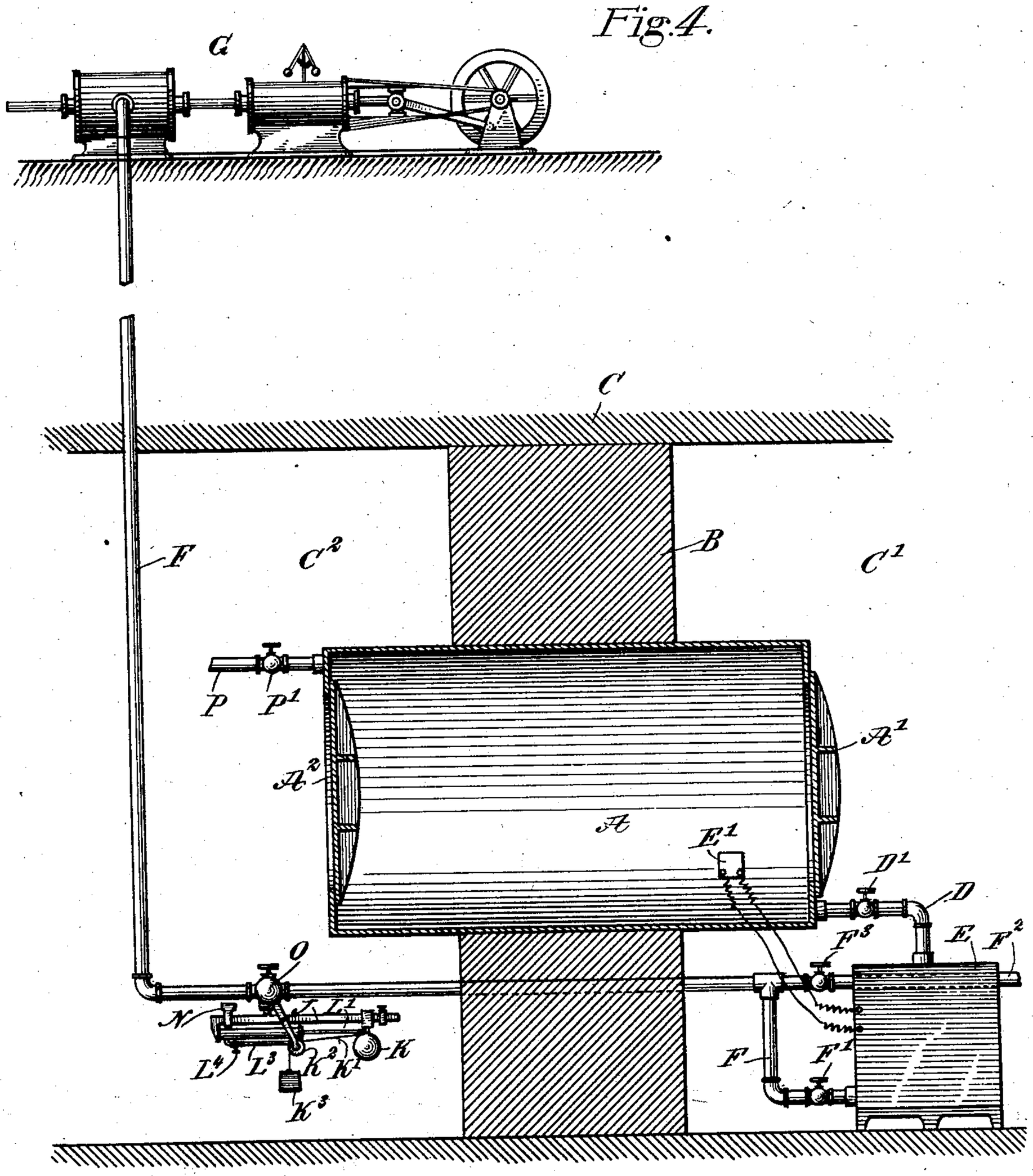
NO MODEL. 2 SHEETS—SHEET 2.

Fig. 4.



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SAFETY AIR-LOCK.

SPECIFICATION forming part of Letters Patent No. 721,991, dated March 3, 1903.

Application filed December 17, 1902. Serial No. 135,494. (No model.)

To all whom it may concern:

Be it known that I, WALTON I. AIMS, a citizen of the United States, and a resident of the city of New York, borough of Manhattan, in the county and State of New York, have invented a new and Improved Safety Air-Lock, of which the following is a full, clear, and exact description.

The invention relates to subaqueous engineering construction for tunnels, foundations, or other structures in water-bearing strata where the compressed-air method of working is employed; and its object is to provide an air-lock arranged to prevent the occurrence of "caisson disease" among the workmen by mechanically regulating the reducing of the air-pressure in the air-lock and while so reducing the pressure by furnishing to the lock a constant supply of pure warm dry air at the same pressure as that in the lock itself.

The invention consists of novel features and parts and combinations of the same, as will be more fully described hereinafter and then pointed out in the claims.

A practical embodiment of the invention is represented in the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the views.

Figure 1 is a sectional side elevation of the improvement. Fig. 2 is an enlarged side elevation, partly in section, of the time-controlled safety-valve for automatically regulating the reduction of the air-pressure in the lock. Fig. 3 is a like view of the same, showing the parts in a different position; and Fig. 4 is a sectional side elevation of a modified form of the improvement.

In subaqueous tunneling or in foundation or other work where operations are carried no in compressed air experience has shown that in high pressures while it is safe for a man to enter the compressed air rapidly a rapid change back into the atmosphere when he comes out is apt to be followed by an attack of caisson disease, bends, or paralysis. Under the present method when the workmen are ready to leave the compressed-air chamber they enter an air-lock, which is simply a large tube with a door at each end closing air-tight.

After the workmen have entered the lock and closed the door a valve is opened, which allows the compressed air in the lock to escape. With the opening of this valve a thick freezing fog immediately forms inside the air-lock, due to the expansion of the air, and it is impossible to keep the men in the lock for any considerable length of time under these conditions.

With my invention, presently to be described in detail, the air-pressure in the lock is regularly and gradually reduced within an exactly-fixed period of time, while the cold foggy condition of the atmosphere within the lock is entirely done away with, the workmen being kept in a pure warm dry atmosphere, enabling them to remain comfortably in the lock for any such length of time as is found most desirable.

An air-lock A, held in the bulkhead B of a tunnel, caisson, shaft, or other subaqueous work C, is provided at one end with a door A′, which when closed disconnects the interior of the lock from a compressed-air chamber C′. The outer end of the lock A is provided with a door A^2, which when closed disconnects the interior of the lock from the chamber C^2, leading to the surface.

The air-lock A is connected by a pipe D, having a valve D′, with an air-heating device E, preferably located in the chamber C′ and in the form of an electric heater controlled by a suitable electric controlling device E′, located within the lock A, so as to be under the control of the workmen while in the lock A to enable them to regulate the temperature of the air entering the lock A by way of the pipe D.

The heater E, through a pipe F, having a valve F′, is connected with an air-compressor G, preferably located above ground or where pure air can be obtained. The air-compressor G is fitted with a suitable governor, so as to run at a constant speed while supplying the lock A with air through the pipes F and D and the heater E. The pressure of the air delivered from the compressor is therefore always the same as that in the lock A.

From the air-lock A leads a discharge-pipe H, having a valve H′ under the control of an attendant outside of the lock and located within the chamber C^2. In this outlet-pipe

H is arranged a safety or reducing valve I, which is time-controlled by a mechanism presently to be described in detail, so that when the door A′ of the lock is closed and the valve H′ opened the air-pressure in the lock A will be gradually reduced until the pressure is finally all released within the time at which the mechanism has been set. The valve I has its stem I′ pressed by a safety-valve lever J, fulcrumed at J′ on a bracket I^2, attached to the valve I. A weight K is mounted to travel on the lever J, and its outward movement is limited by a stop J^2, adjustably secured on the lever J. The weight K is connected with one end of a cord K′, extending over a pulley K^2, journaled in the bracket I^2, and on the depending end of the cord K′ is secured a weight K^3 for drawing the weight K from the stop J^2 inward on the lever J toward the stem I′. Now in order to retard this inward-traveling movement of the weight K the latter is connected with the piston-rod L′ of a piston L, mounted to slide in a cylinder L^2, secured on the lever J, and the said cylinder L^2 is filled with a suitable liquid, and its ends are connected with each other by a by-pass L^3, provided with a valve L^4 under the control of the attendant for regulating the amount of liquid passing from one end of the cylinder to the other in a given time. A weight N is adjustably secured on the lever J to insure the final wide opening of the valve I at the time the weight K nears the end of its innermost position, as indicated in Fig. 3.

The operation is as follows: When the workmen have entered the lock A from the chamber C′, then the door A′ is closed and the attendant in charge of the lock within the chamber C^2 moves the weight K to its outermost position against the stop J^2 and then opens the valve H′, so that the air can escape from the lock A by way of the pipe H and the valve I. The pressure on the stem I′ of the valve I is gradually reduced by the weight K traveling inward on the lever J, owing to the action of the weight K^3; but the inward-traveling movement of the weight K is governed by the liquid in the cylinder L^2, flowing from one end of the cylinder to the other end thereof by way of the by-pass L^3. In this manner an exceedingly-gradual reduction of air-pressure in the lock A takes place. While this is going on, dry heated air at a pressure always the same as that in the lock is constantly supplied to the lock A by way of the pipe D, heater E, and supply-pipe F, connected with the air-compressor G, and consequently a comfortable dry heat with abundant ventilation is maintained within the air-lock, enabling the men to stay in the lock with perfect comfort until the air-pressure therein is completely reduced by the action of the device above described. The door A^2 is then opened and the workmen pass into the chamber C^2 and from the latter up to the surface. In case a plurality of air-locks are used in a tunnel, one spaced from the other, then the pipe F is provided with an extension F^2, having a valve F^3, leading to another heater E, for supplying air to the lock in the next following bulkhead. Any number of such locks can thus be equipped and supplied with warm air from the compressor G.

In the arrangement shown in Fig. 4 a time-controlled valve O, similar to the valve I, is directly arranged in the pipe F, which supplies air to the heater E from the compressor G. The lock A in this case is provided with an outlet-pipe P, having a valve P′, which is opened wide as soon as the workmen are in the lock A and the door A′ is closed. The heated air supplied to the lock A is gradually cut off by the action of the time-controlled reducing-valve O, so that the pressure within the lock A in the same way gradually falls to that of the chamber C^2, after which the door A^2 is opened for the workman to leave the lock A. As the mechanism for controlling the valve O is exactly the same as the one above described for the valve I, further description of the same is not deemed necessary.

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

1. An air-lock having means for regulating the exhaustion of air from the lock, and means for simultaneously supplying heated air to the lock, as set forth.

2. An air-lock having an air-escape, a time-controlled device for the said air-escape, to cause a gradual reduction of pressure in the air-lock, an air-supply for the said air-lock, and heating means for heating the air previous to its entrance into the lock, as set forth.

3. An air-lock having an air-escape, a time-controlled device for the said air-escape, to cause a gradual reduction of pressure in the air-lock, an air-supply for the said air-lock, heating means for heating the air previous to its entrance into the lock, and means within the lock for controlling the said heating means, to regulate the temperature of the heated air passing into the lock, as set forth.

4. An air-lock provided with an air-escape having a valve, and a time-controlled device for the said valve, to cause a gradual reduction of pressure in the air-lock, as set forth.

5. An air-lock having an air-escape, means for supplying heated air to the lock during the escape of air from the lock, and time-controlled means for automatically regulating the pressure of air within the lock during the escape of the air from the lock and the entrance of heated air into the lock, as set forth.

6. An air-lock having an outlet provided with a safety-valve, and a time-controlled device for gradually releasing the safety-valve, as set forth.

7. An air-lock having a valve for controlling the pressure of air in the lock, and a time-controlled device for controlling the said valve, the said device comprising a lever for

holding the valve to its seat, a weight mounted to travel on the said lever, a cylinder held on the lever and having its ends connected by a valved by-pass, and a piston traveling in the said cylinder and connected with the said traveling weight, as set forth.

8. An air-lock having a valve for controlling the pressure of air in the lock, and a time-controlled device for controlling the said valve, the said device comprising a lever for holding the valve to its seat, a weight mounted to travel on the said lever, a cylinder held on the lever and having its ends connected by a valved by-pass, a piston traveling in the said cylinder and connected with the said traveling weight, and a stop on the outer end of the lever, for the said weight, as set forth.

9. An air-lock having a valve for controlling the pressure of air in the lock, and a time-controlled device for controlling the said valve, the said device comprising a lever for holding the valve to its seat, a weight mounted to travel on the said lever, a cylinder held on the lever and having its ends connected by a valved by-pass, a piston traveling in the said cylinder and connected with the said traveling weight, and an adjustable overbalancing-weight on the said lever, as set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

WALTON I. AIMS.

Witnesses:
THEO. G. HOSTER,
EVERARD BOLTON MARSHALL.