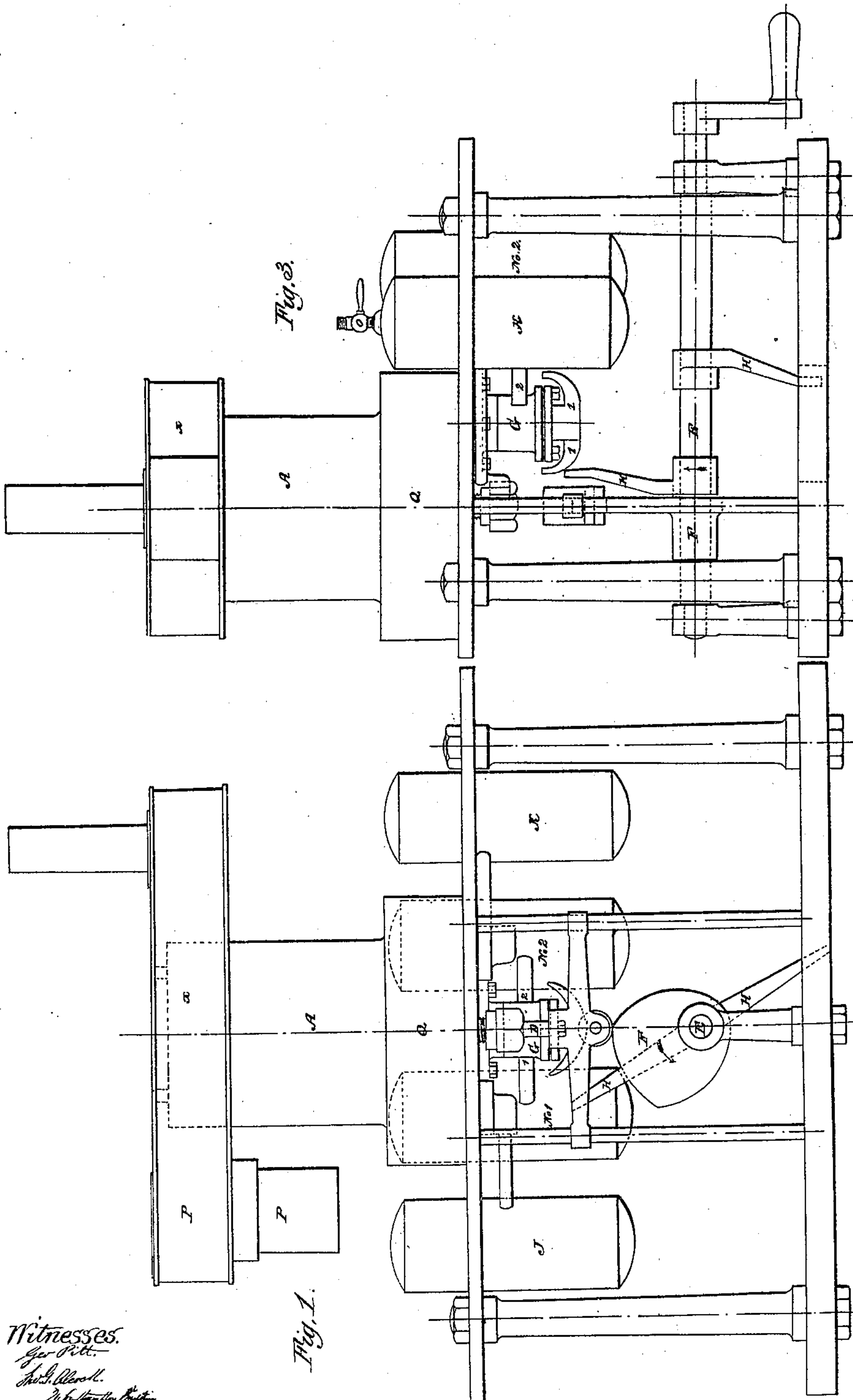


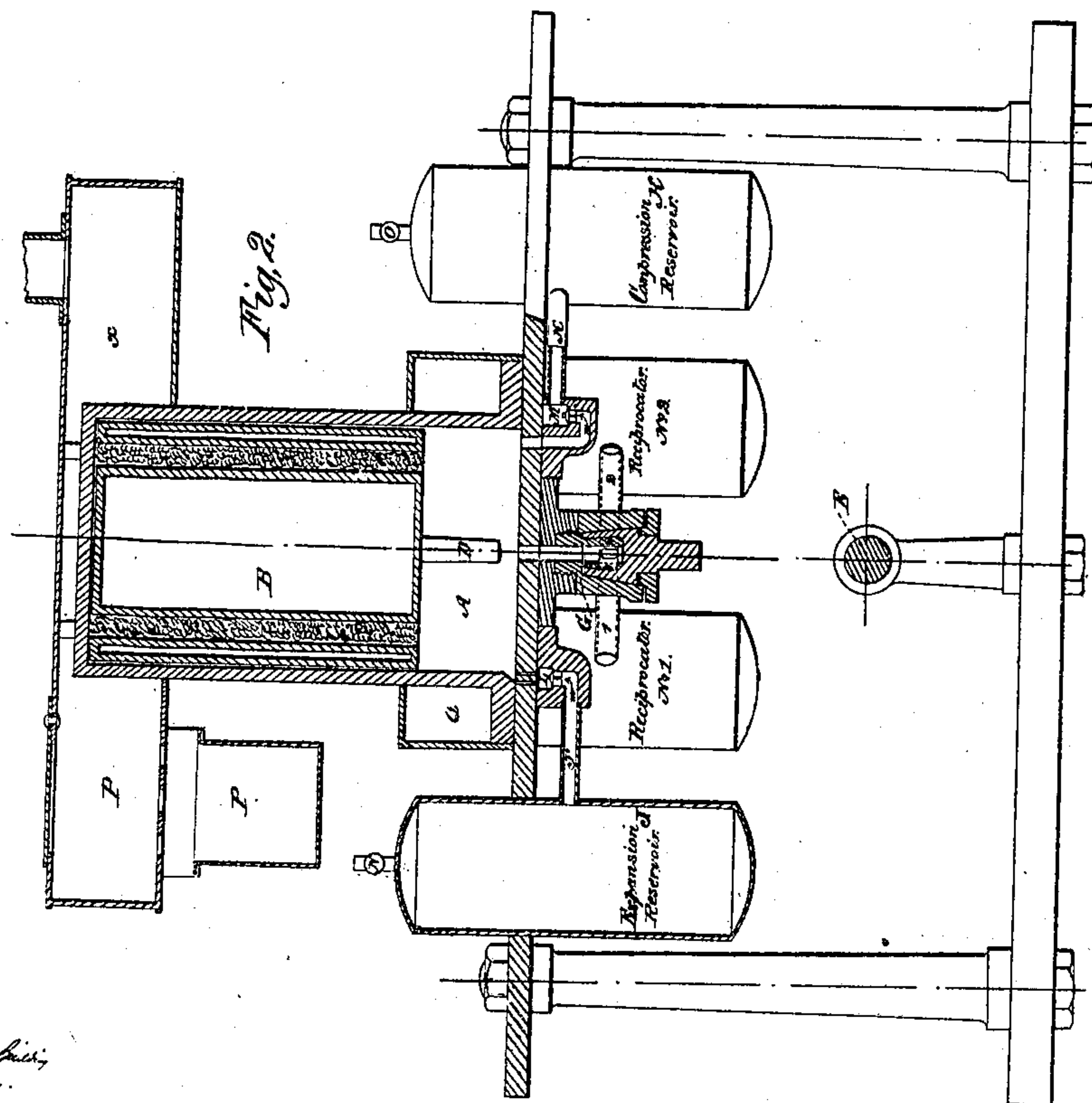
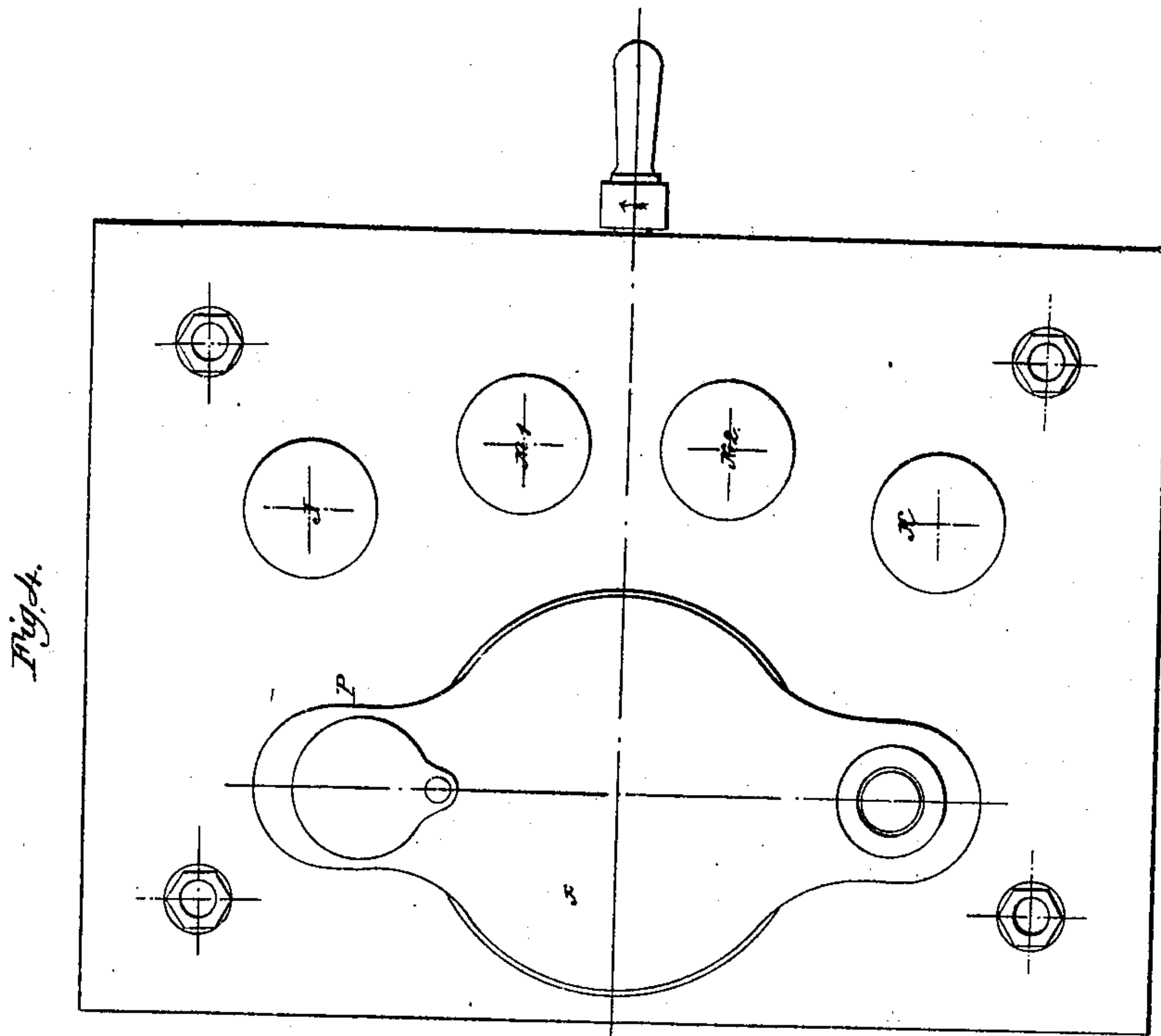
J. JAMESON.
MECHANISM FOR COMPRESSING AND EXPANDING AERIFORM FLUIDS.
No. 30,924. Patented Dec. 18, 1860.



Witnesses.
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John S. Allen.
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UNITED STATES PATENT OFFICE.

JOHN JAMESON, OF GATESHEAD, ENGLAND.

APPARATUS FOR EXPANDING AND COMPRESSING ELASTIC FLUIDS.

Specification of Letters Patent No. 30,924, dated December 18, 1860.

To all whom it may concern:

Be it known that I, JOHN JAMESON, of 10 Catherine Terrace, Gateshead, England, a subject of the Queen of Great Britain, have
5 invented or discovered a new and useful Improvement in Mechanism for Compressing and Expanding Aeriform Fluids; and I, the said JOHN JAMESON, do hereby declare the nature of the said invention and
10 in what manner the same is to be performed to be particularly described and ascertained in and by the following statement thereof.

The invention consists of an improvement
15 in compressing and expanding aeriform fluids by the application of heat in such manner as to effect a high degree of compression or expansion or both, by the application of a moderate degree of heat, and
20 which is effected by a combination of what I call compressing apparatus with reciprocating apparatus as is afterward more particularly described. I employ for the purposes of my invention one or more
25 close vessels (containing portions of the fluid to be compressed or expanded,) so constructed as that heat may be alternately supplied to and abstracted from the greater part of the contained fluid; with provision
30 for economizing a portion of the heat so supplied as is well understood. In conjunction therewith I employ one or more other close vessels (either similarly constructed or simply close vessels), also containing portions of aeriform fluid and connected with the former by a pipe or pipes with provision therein for shutting off the communication when required. The first-
35 mentioned vessel or vessels and mechanism I call for distinction compressing apparatus, and the last mentioned reciprocating apparatus. The functions of the compressing apparatus are to produce frequent change of temperature and thereby increase
40 any diminution of pressure in the elastic fluid contained within such apparatus. With respect to the functions of the reciprocating apparatus, they perform actions in relation to the former or compressing apparatus which I think are best described by
45 the words "borrowing" and "lending" as hereinafter explained.

A variety of methods may be adopted for
50 arranging apparatus to carry out my invention. The advantages which have led me to select for more particular description

the arrangement, shown in the drawing, consist in its possessing in a high degree simplicity combined with efficiency; and in the clear illustration which it affords of the
55 essential peculiarities of my invention in compression or expansion or both combined. I would however have it understood that I do not confine myself to that or any particular form or arrangement of apparatus,
60 seeing that it may be modified or altered in many respects without sacrificing the peculiar advantages obtainable by my invention.

In the drawings, Figure 1 represents an
65 elevation, and Fig. 2 a section, of mechanism according to my invention, Fig. 3 being a side view and Fig. 4 a plan thereof.

The same letters refer to similar parts in
70 all the drawings.

The sectional plane of Fig. 2 is not exactly
75 through the middle of the apparatus, but through those parts which require description.

A is a cylindrical vessel truly bored and
80 containing a plunger or displacer B, turned of a slightly less external diameter than the internal diameter of the cylinder, so as nearly to fit but to move easily therein. The plunger is made hollow for the sake of
85 lightness and (excepting the passages after mentioned) is filled with powdered charcoal (or other bad conductor of heat,) and strongly constructed so that the parts containing the charcoal shall be capable of re-
90 sisting the highest pressure required without permitting the passage of air into them. Such plunger has two passages C, C, made through it each containing ravelings of fine
95 wire between which the air displaced by the movement of the plunger may freely pass either way from end to end of the plunger. The use of the wire is to abstract
100 heat from the hot air during its passage from the hot to the cold end of the cylinder as hereinafter explained, and to restore such heat or a part of it, to the cold air on its
105 passage to the hot end of the cylinder. The plunger is moved by means of the rod D the shaft E, and the heart wheel F, which is so constructed as to cause a pause in the move-
110 ment of the plunger at each end of its stroke. The pause is produced by making segments on the wheel F at its greatest and least radius the arcs of such segments being concentric with the shaft. G is a species of two way cock, the passage in which leads

through the plug thereof, either to one or the other of two passages in the shell or case of the cock or by the movement of the plug to each of the passages in succession.

5 The plug has a rotary motion communicated to it in opposite directions at each end of the stroke of the plunger so that the passages are opened and closed in the order 1, 2, at one end of the stroke, and in the order 10 2, 1 at the other end of the stroke, No. 1 being opened first when the plunger is at the hot end of the cylinder, and No. 2 first when the plunger is at the cold end of the cylinder. This motion is produced by two 15 arms H on the shaft E which are brought, by its continued revolution, into contact with the opposite ends of a cross bar I on the plug. There are also two other close vessels the expansion reservoir marked 20 J and the compression reservoir marked K connected, by pipes J', K', to the cylinder and having, in the pipes, self acting valves L and M; that in the pipe J opening toward the cylinder, and that in the 25 pipe K opening toward the reservoir.

The expansion and compression reservoirs are provided with two small taps, as shown at N and O, which are either opened or closed according to the purpose required 30 to be accomplished. The plug of the cock G is moved during the pause in the stroke of the plunger. The two passages in the shell of the cock G, lead to two close vessels marked 1 and 2, which are the reciprocators, they being in the present instance, 35 simply reservoirs and may in the arrangement described be of any convenient shape and be placed in any convenient position. The cylinder A is heated at its upper end by 40 a flue X, which surrounds its upper part and proceeds from a furnace P, and is cooled at its lower end by a cold water jacket Q. The apparatus is brought into action by the revolution of the shaft which is turned in 45 the direction of the arrow shown in Fig. 3.

In describing the action of the apparatus I will assume that all the vessels contain air at atmospheric pressure, and that the cylinder has been heated at its upper end 50 which the plunger occupies and that the lower end is cool. In this position the movement of the plug of the cock G will (in the first instance) produce little or no effect. Such plug may, in fact, be in any position 55 provided the gear or mechanism before described be arranged to close it last over passage No. 2 before the plunger begins to move. For compression, alone, I open the tap N on the reservoir J, and close the tap O. For 60 expansion alone I open the tap O on reservoir K and close the tap N. In the present instance I will describe the action of the apparatus with the tap N open. The downward movement of the plunger causes the greater 65 portion of the air contained within the cylin-

der to ascend to the heated end and produces an effort of expansion therein, a portion of which effort is expended in compressing a part of the contents of the cylinder into the compression reservoir through the self 70 acting valve M, which allows any excess pressure in the cylinder to pass in the direction of the arrow under valve M but prevents its return. The movement of the plug of the cock G (thereafter) establishes 75 a communication between the cylinder and the reservoir No. 2 whereby an equalization of pressure or nearly so is produced between them by the passage of air from the cylinder to the reservoir which action is that to 80 which I apply the word borrowing. The communication between them is then closed and thereafter that with reservoir No. 1 is opened and closed whereby a similar result is produced, the effect of the stroke being 85 that the compression reservoir will contain a pressure of air greater than atmospheric pressure as will also the reciprocators No. 2 and No. 1 of which No. 1 will contain the 90 least pressure having performed the action of borrowing after No. 2 had borrowed from the cylinder. By continuing the revolution of the shaft the plunger will ascend to the heated end of the cylinder. The air 95 displaced passing through the ravelings of wire in the passages C becomes cooled the wire or part of it becoming at the same time heated, the cooling of the air diminishes the pressure in the cylinder which becomes thus 100 less than atmospheric pressure.

The self acting valve L admits a portion of air from the expansion reservoir restores the pressure in the cylinder to atmospheric pressure or very nearly so: By continuing 105 the motion of the shaft, the arm H will be carried into contact with a cross bar I of the plug of the cock G, and will produce such a movement of the plug as will open and close communication between the reciprocator No. 1 and the cylinder producing 110 thereby equalization of pressure or very nearly so between them, by the passage of air from the reciprocator to the cylinder, which action is that to which I apply the word lending. By the continued movement 115 of the plug a similar action will take place with reciprocator No. 2 which will also lend to the cylinder after which the descent of the plunger will cause an effort of expansion in the cylinder, as before and as before 120 the self acting valve M will permit a portion of that effort to be expended in compressing a part of the contents of the cylinder into the compression reservoir, after which the communications between the reciprocators 125 and the cylinder are again to be opened and closed in the order 2, 1 so as again to produce the action of borrowing and so on. By the continuance, for a few strokes, of the motions described, the differential pressures 130

in the reservoirs become greater and the efficiency of the apparatus is thereby enhanced. By these actions it will be seen that the effect of my invention is to produce compression or expansion of aeriform fluids or both to an extent not alone dependent upon the degree of heat applied but also upon the extent to which the actions of borrowing and lending are employed in conjunction with the apparatus used for compression. By opening the stop cock O on the compression reservoir, and closing that on the expansion reservoir partial vacuum is produced therein, the actions of expanding being quite similar to the actions of compressing—perfect vacuum however is manifestly unattainable by my invention. If both the taps N and O be closed, expansion takes place in the expansion reservoir, and compression in the compression reservoir, a portion of the contents of the one being transferred to the other.

The apparatus may be modified and its efficiency enhanced by constructing the reciprocators similarly to the cylinder and causing them to borrow from the cylinder when the air contained within them is in a cold state and to lend to the cylinder while the air contained in the reciprocator is in a heated state, or the present invention may be employed for enhancing the effect of any combination of compressing apparatus (such as that patented by me on the 15th February 1859) but I think the arrangement first described herein is preferable to other arrangements owing to its simplicity.

It is not necessary to observe any definite relation, as to size, between the reciprocators and the cylinder, but the larger the former are made as compared with the latter the greater is the effect produced. I prefer to make the capacity of each reciprocator at least as great as the available capacity of the cylinder.

If the compressing apparatus employed be a cylinder similar to that described, I vary the proportions between the length of the plunger and cylinder as the size varies. In a very small apparatus the heated and

cold parts of the cylinder necessarily approach nearly together and I therefore use a long plunger as compared with the length of the cylinder; but in a large apparatus the plunger may advantageously be made little more than half the length of the cylinder. In a large apparatus also I prefer to use double slide valves instead of the arrangement shown in the drawing as the wear is more uniform. In any case the passages should be opened and closed quickly and the valves or other mechanism employed should present as little obstacle to the free passage of air either way as is conveniently practicable, other things being equal the greater the number of reciprocators employed in the reduction and enhancing of cylinder pressure the greater is the effect produced.

The air accumulating by the compressive action of the apparatus in the compression reservoir may be employed for any purpose for which compressed air is applicable—as, for instance, like steam in an ordinary high-pressure steam engine, in which it may be used either cold or more or less heated and, although I have only described the action of my invention in compressing and expanding atmospheric air, other aeriform fluids may also be compressed in like manner; by means of my invention as for instance carbureted hydrogen carbonic acid or other gases which are sometimes required under high pressure in chemical manufactories.

Having thus stated the nature of my invention and in what manner the same is to be performed I would have it understood that

What I claim, as my invention, is—

The combination of the apparatus to produce those actions, which I have called borrowing and lending—with the apparatus for performing the functions of what I have called the compressing apparatus substantially as herein described.

JOHN JAMESON.

Witnesses:

GEO. PITT,

JNO. G. ALCOCK.