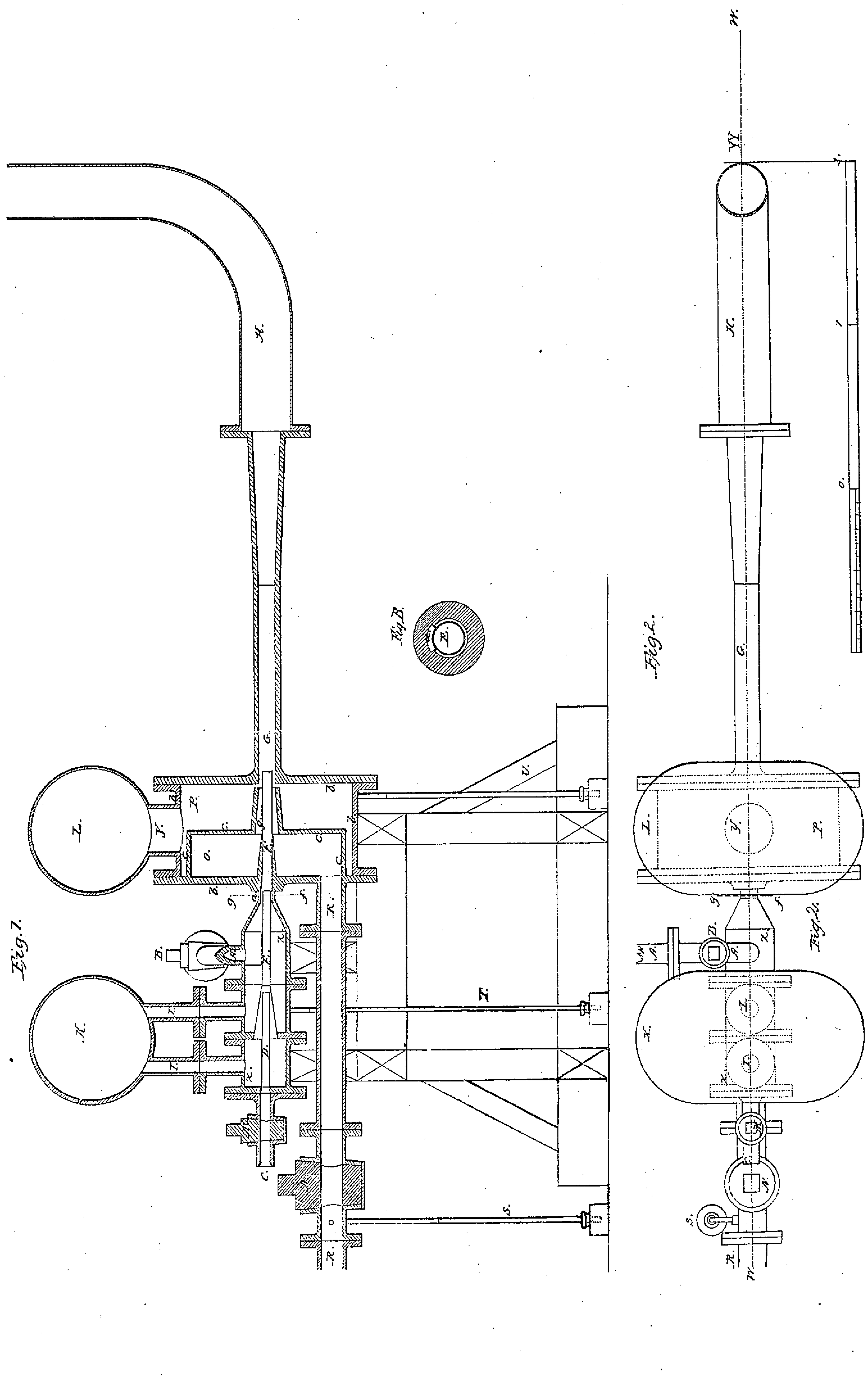
4 Sheets—Sheet 1.

P. RAVARD.

APPARATUS FOR PRODUCING A VACUUM FOR RAISING WATER, &c.

No. 1,903. Patented Dec. 17, 1840.



4 Sheets—Sheet 2.

P. RAVARD.

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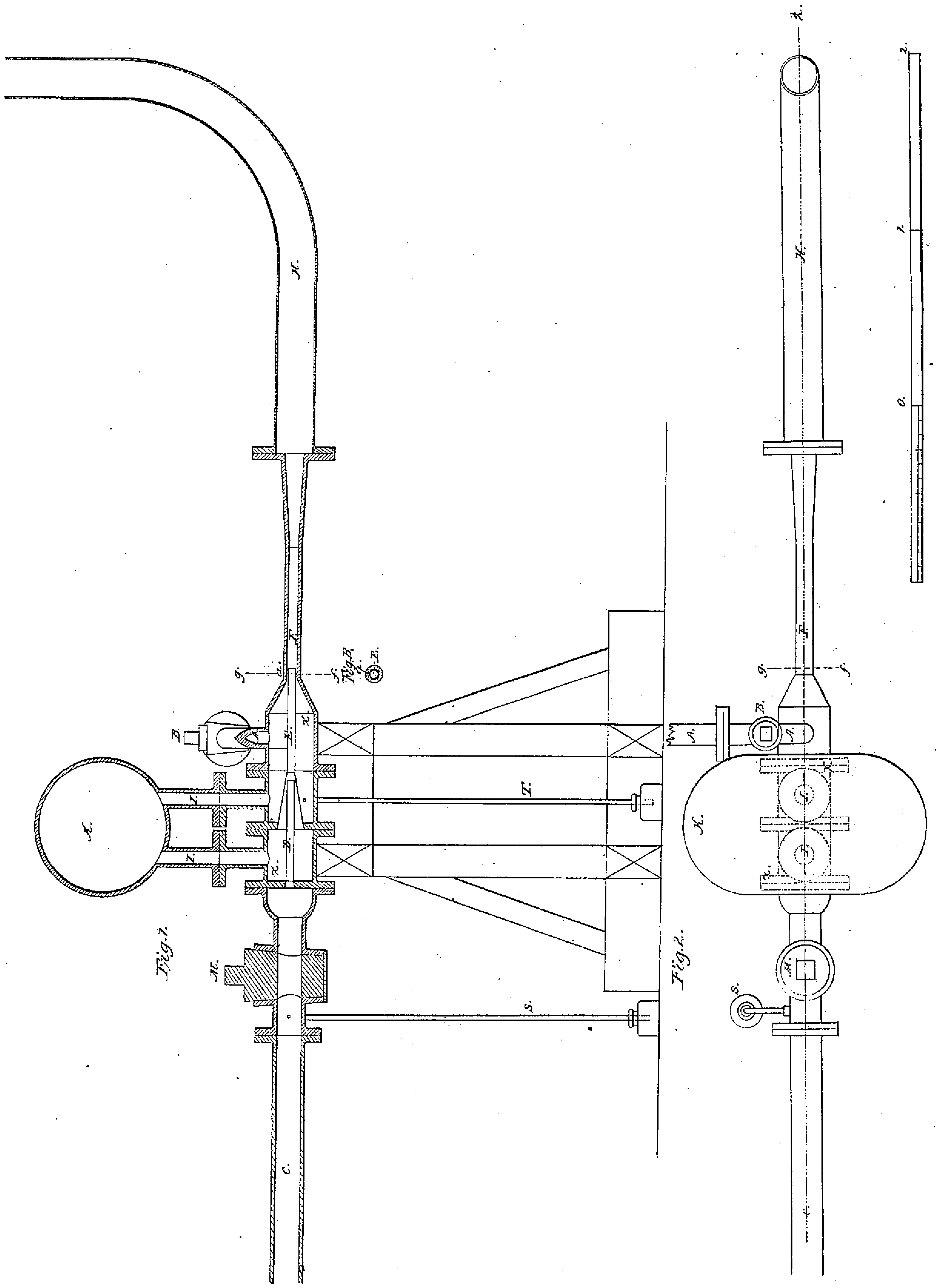

4 Sheets—Sheet 3.

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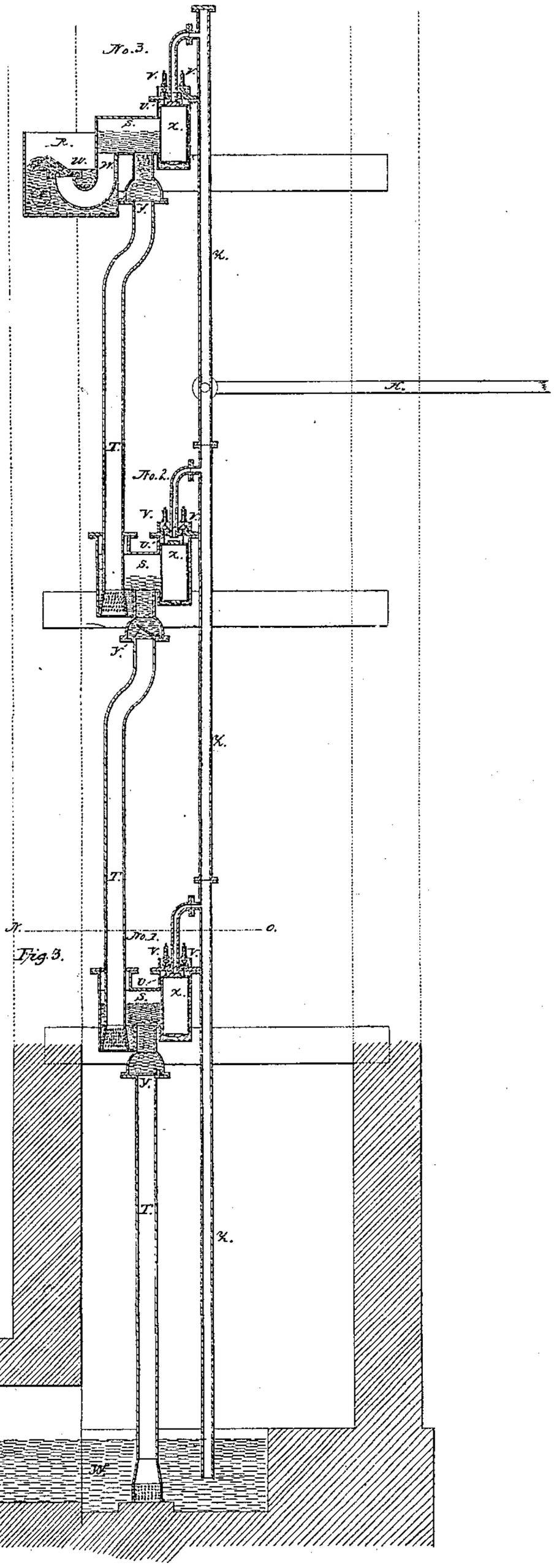


Fig. 3.

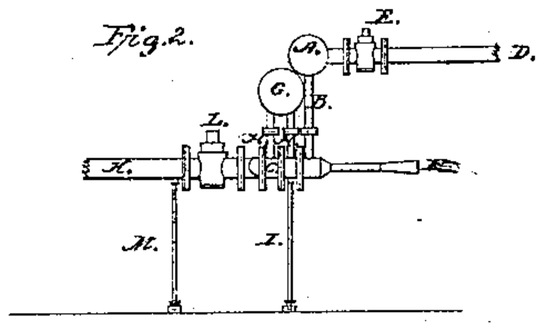


Fig. 2.

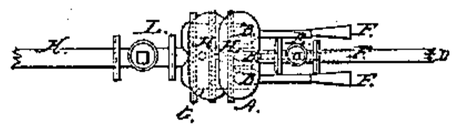


Fig. 1.

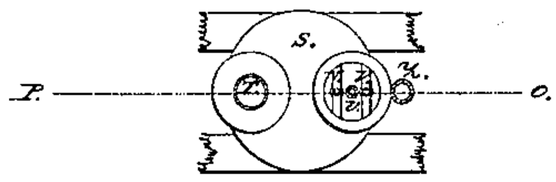
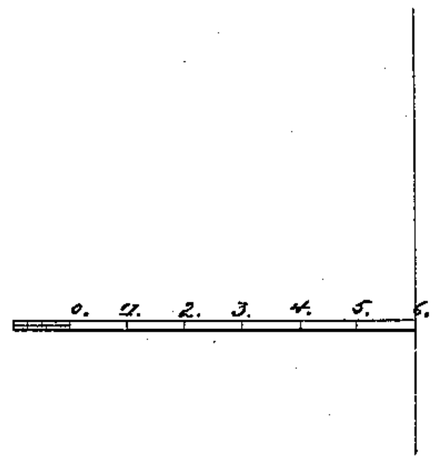


Fig. 4.



4 Sheets—Sheet 4.

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Fig. 3.

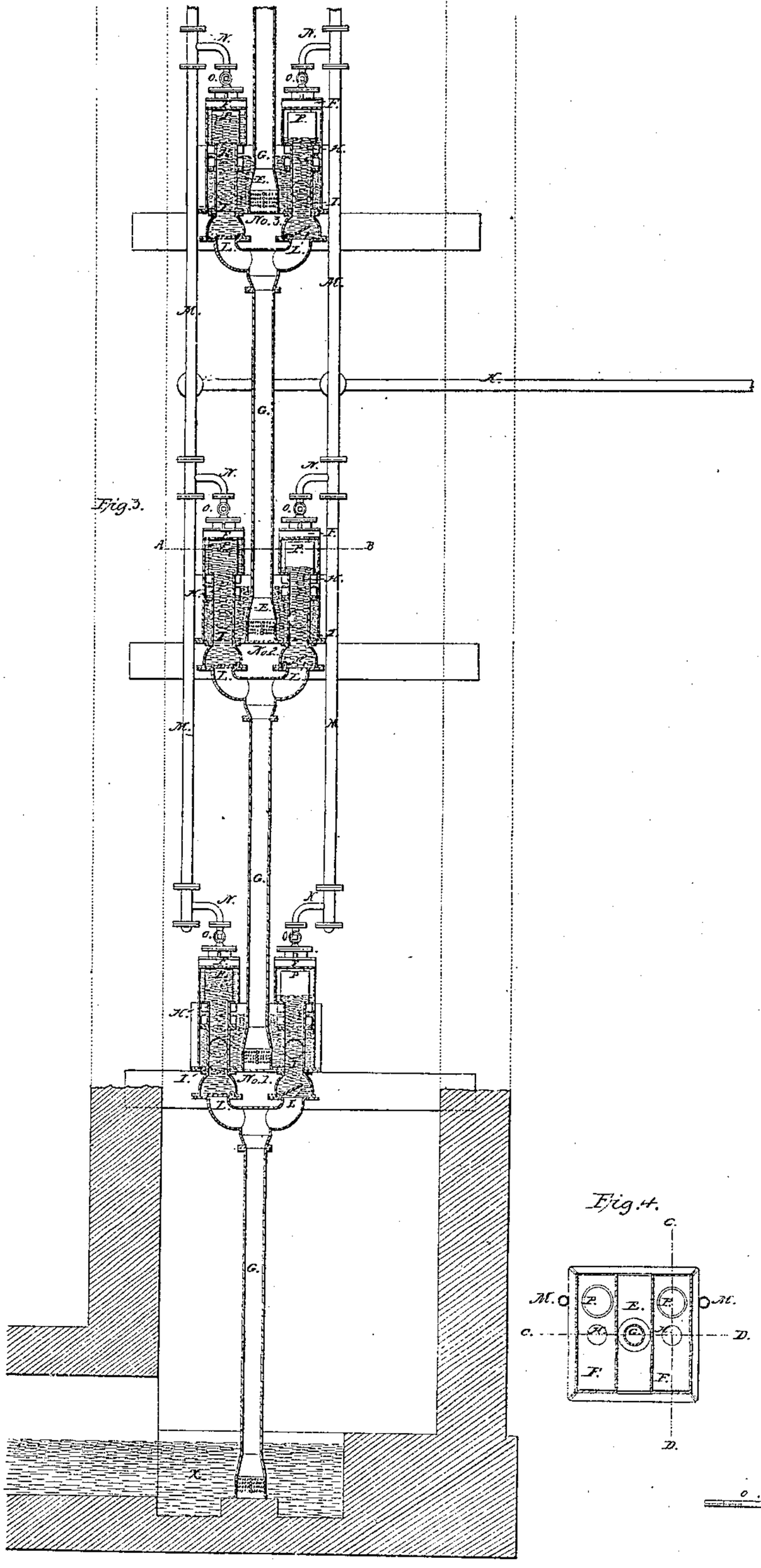


Fig. 2.

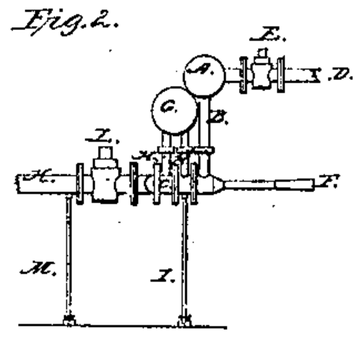


Fig. 1.

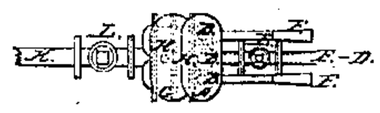
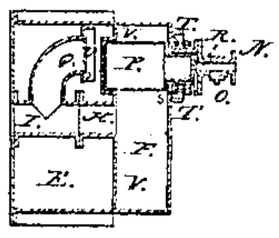


Fig. 4.

Fig. 5.



0 . 1. 2. 3. 4. 5. 6.

UNITED STATES PATENT OFFICE.

PIERRE RAVARD, OF PARIS, FRANCE.

IMPROVEMENT IN APPARATUS FOR PRODUCING A VACUUM FOR RAISING WATER, &c.

Specification forming part of Letters Patent No. **1,903**, dated December 17, 1840.

To all whom it may concern:

Be it known that I, PIERRE RAVARD, a citizen of France, residing in Paris, in the Kingdom of France, have invented a new and useful Apparatus Applicable to the Purpose of Raising Water from Wells and other Reservoirs, which I denominate the "Aeolipile Hydraulic Apparatus;" and I do hereby declare that the following is a full and exact description thereof.

It is a well-known fact that when steam is allowed to escape rapidly through a small orifice into the atmosphere it carries with it a considerable portion of the surrounding air, and that the instrument denominated the "aeolipile" has been from this circumstance proposed to be applied to the blowing of air into forges and furnaces. The same principle is also applied in the locomotive steam-engine to create a partial vacuum in the furnace by projecting a jet of waste steam up the chimney, which carries with it a large portion of air, thereby effecting the object desired. In my apparatus for raising water I apply this same principle to the producing of a partial vacuum in suitable receivers or reservoirs, into which water is then to be forced from the well or other reservoir by the pressure of the atmosphere. To effect this purpose I connect a tube or system of tubes from the receptacle or receptacles, reservoir or reservoirs, into which the water is to be raised, with another part of my apparatus, into which highly-elastic steam is to be admitted, and from which it is to be allowed to escape in such manner as to carry with it a portion of the air from the receptacles or reservoirs, sufficient to produce the required degree of exhaustion.

The apparatus may be so constructed and its operation so regulated as to vary the extent of this exhaustion; but, according to my experience, the best and most economical procedure for the raising of water is that by which the density of the air in the receptacles or reservoirs is so diminished as to be equal to three-fifths of the ordinary density of the atmosphere.

In the accompanying drawings, I have represented the manner in which I construct the apparatus invented by me and applied to the above-named purpose. These drawings consist of four sheets, and are numbered 1, 2, 3, and 4, respectively,

Figure 1 in drawing No. 1 is a vertical projection, in section, of that part of the apparatus by which the exhaustion of air is to be produced, the part in which the elevating of the water is to take place being represented on the drawings Nos. 3 and 4. Fig. 2 on drawing No. 1 is a horizontal projection of the apparatus shown in Fig. 1, and in these two figures corresponding parts are designated by the same letters of reference.

The line Y Z in Fig. 2 is that of the sectional view, Fig. 1.

A is a pipe or tube, which leads from a boiler, in which the steam used is to be generated, into the exhausting apparatus, which it enters at A′, Fig. 1.

B is a cork, to allow, arrest, and regulate the passage of steam.

C is a pipe or tube, by which the exhausting apparatus is connected with that intended for the raising of water.

X X is a cylindrical or other formed vessel, within which is contained the principal part of the apparatus concerned in producing the exhaustion. This cylinder is composed of several parts, which are connected together by means of flanges in the ordinary way, as shown in the drawings.

D and E are tubes, through which air is to escape from the receptacles, reservoirs, and the air-vessels, which parts are to be presently described.

F is a tube, into which the steam from the boiler is to be projected by its own elastic force, and through which it is to carry the air entering through the tubes D and E.

H is a tube for leading the escape steam and the accompanying air into the atmosphere in any required direction. The steam which enters into the fore part of the cylinder X X through the steam-tube at A′ passes thence through a small orifice into the tube F. This orifice is at the point *a*, and an end view of it is shown at Fig. B, in which also is seen the mouth of the tube E. This Fig. B represents a cross-section of the apparatus in the line *f g*, Fig. 1, and in drawing No. 2 a similar cross-section is shown, and is there represented of the ordinary size in the acting instrument. The following proportions I deem the best in this part, having found them to answer well in practice: The inner diameter of the tube E I make one-fourteenth greater than that of D.

and the area of the cross-section of the ajutage *a* for the emission of steam equal to one-tenth of that of the tube E.

The foregoing proportions, as well as others herein given, may be varied according to circumstances, one of the most important of which is the degree of the pressure of the steam in the boiler, which I prefer to be equal to that of five atmospheres, and have made my calculations accordingly. Where the pressure is greater or less than this, it will be proper to diminish or to enlarge the ajutage of steam in accordance therewith.

K is an air-vessel, between which and the cylinder X X there is a free communication by means of the tubes I I, and this air-vessel is, in consequence of this connection, subjected to the same degree of exhaustion with the tube C and the receivers or reservoirs with which it is connected, and by its capacity it serves to equalize this exhaustion.

S and T are manometers of the ordinary construction, the rise of the mercury in which will at once indicate the degree in which the air is rarefied in the cylinder X and in the tube C. The cock M regulates the communication between the exhausting part of the apparatus and that in which the raising of water is to be effected.

In drawing No. 2 I have given another modification of the above-described exhausting apparatus, in which two air-vessels are employed, together with a cylindrical or other formed vessel of considerable capacity, so constructed and connected as to operate concurrently with the air-vessels in regulating the exhaustion. Fig. 1 on this sheet is a vertical projection in section of this apparatus in the line W Y Y of Fig. 2, which is a horizontal projection of the same. In each of these figures the same letters of reference are used to designate the corresponding parts. The similarity of this arrangement to that first described will render it unnecessary to do more in the present instance than to point out the variations therefrom which are therein proposed.

A is the pipe or tube for the admission of steam from a steam-boiler; B, a cock to regulate its admission; X X, a cylinder similar to that so marked in drawing No. 1; C, a tube leading into this cylinder, and through which air, if desired, may be admitted from the atmosphere, its admission being arrested or regulated by means of the cock M. The tubes D and E are the same with those in No. 1, but in this modification of the apparatus the tube E and the steam-ajutage *a* discharge into a tube, F, which is inclosed within, and passes through the center of a cylindrical body, O P, the tube F opening into that marked G, which leads into H, the office of which is the same with that so designated in No. 1.

Fig. B is a sectional view of the steam-ajutage *a*, and of the opening of the tube E, represented of the size employed by me in the acting machine. *b b* is the case of the cylinder or drum O P. The air-vessel K is combined with the apparatus in the same way with that in drawing No. 1.

L is the additional air-vessel, which stands on the top of the cylinder or drum O P, and communicates with it by means of the tube or neck Y, and may be considered as making one with the portion P of said cylinder.

R R is a tube or pipe corresponding in its use with that marked C in drawing No. 1; but instead of leading from the water-elevating apparatus into the rear of the cylinder X X it leads into the portion O of the cylinder or drum O P. The portion O of this cylinder, into which the tube R R opens, constitutes a distinct chamber separated from the portion P by an interior cylindrical case, *c c*, but communicating with it by means of the conical tube Q through the air from it and from the tube R R is to pass into the tube G, being urged by the force of the steam-ajutage acting through the tube F. This action produces also the exhaustion of air from the portion P of the cylinder or drum and from the air-vessel L. There is a cock, N, in the tube R, and manometers at S, T, and U, the purposes of which have been previously explained.

The light shading in the tubes of the exhausting apparatus indicates those parts through which steam passes.

In drawing No. 3, Figs. 1 and 2 show on a reduced scale the exhausting apparatus represented on drawing No. 1, Fig. 1 being a horizontal, and Fig. 2 a vertical projection, of it. The corresponding parts in these two figures are designated by the same letters of reference, and these figures are given for the purpose of recapitulating the design of the principal parts, and to furnish some additional observations before describing the hydraulic machine represented in Fig. 3 of this drawing.

A A is a distributing-receiver of steam, from which descend three pipes, B B, which may serve to feed three steam-adjutages and their corresponding tubes, F F, all proceeding from the same box or steam-receptacle, C C, attached to the pipe K, which corresponds with that marked C in drawing No. 1.

D is the pipe leading from the steam-generator to supply the receiver A A, a cock, E, being employed to regulate and govern the supply.

F F are the tubes through which the air and steam are to escape; G G, the air-vessels; H H, pipes establishing a communication between the air-vessels and the steam-box C C. The pipe K is that which connects the exhausting with the hydraulic apparatus, and L a cock therein intended to open or close this communication.

I is the manometer for indicating the degree of rarefaction in the exhausting apparatus, and M that for indicating the degree of rarefaction in the pipe K. I will here remark that the degree of rarefaction indicated by the monometer I is always less than that shown by the monometer M as existing in the interior of the exhausting apparatus, and that

this is not changed by the supply of air which passes through the apparatus.

The foregoing figures serve to exemplify the manner in which two, three, or more steam-ajutages, with their appropriate appendages, may be applied to and employed in the same apparatus. The inner parts of this apparatus having been fully described in the explanation of drawing No. 1 need not be repeated.

The Hydraulic Machine.—Fig. 3 in drawing No. 3 represents a vertical projection of my hydraulic machine which is calculated to raise water to any height required by means of the rarefaction and pressure of air, the air being rarefied by the action of the within-described exhausting apparatus. This vertical projection is a section made in the line C D of Fig. 4, which is a horizontal projection, according with the line A B in Fig. 3. Fig. 5 represents a vertical projection of a part of this apparatus, being a section in the line C′ D′ of Fig. 4. In Figs. 3, 4, and 5 the same parts, although shown under different aspects, are designated by the same letters of reference.

X, Fig. 3, represents the well or main reservoir from which water is to be raised; G G, raising-mains or ascending pipes through which it is to rise from the main reservoir into the reservoir E, No. 1, in the first story or lift, and from this last reservoir to the next, (E, No. 2,) and so on successively until it has attained the required elevation, the whole elevation being divided into separate lifts or stories, three of which are shown in the drawings, and these I have denominated and numbered the first, second, and third stories. The water does not pass directly from the ascending pipes G G into the reservoirs E, but into receivers F F, which in each story consist of two air-tight quadrangular boxes having the openings into them closed by means of valves or cocks, and operating in a way to be presently described. Each of the pipes G is divided at its upper end into two branches, H. H, leading, respectively, into the two receivers F F, which in each of the stories stand above the reservoirs E, into which the water received by them is to descend by its own gravity when air is admitted into the receivers. The branches of the pipes G are each furnished with a valve, L, opening upward within a chamber or enlargement of the branch tubes prepared for that purpose. From each of the branch pipes H H there proceeds a curved branch pipe, Q, in the manner shown distinctly in the section, Fig. 5. These curved pipes extend up nearly to the top of the reservoir E, and are closed by a valve, U. The entrance from H into these tubes is shown at I I, Figs. 3 and 5.

P P are floats contained within the receivers F F. These floats are so graduated in weight as to rise to the top of the receivers when these are nearly filled with water—say up to the point *s*, Fig. 5—and when so raised they are brought into contact with the tails of two valves, T T, which they raise from their seats, and thus allow an influx of air into the receiver. They, when thus raised, also close the orifice R of the tube N, Fig. 5. At other times these floats rest upon the bottoms of the receivers V V, in which a recess or excavation may be made to receive and keep them in place, as shown in the drawings. Each of the stories constituting the upper part of each lift is similarly constructed.

I now proceed to describe the manner in which the exhausting apparatus is connected with and made to actuate the hydraulic portion of the machinery. K is a pipe or tube leading from the exhausting apparatus into tubes M M, which latter are connected with each of the receivers by means of the tubes N N, one of the orifices through which is shown at R, Fig. 5, which orifice is closed by the float P at the same time that it opens the valves T T. To each of the connecting-tubes N there is a cock, O, which must be opened when the exhausting apparatus is to set upon its corresponding receiver.

In drawing No. 4 I have represented another modification of my hydraulic apparatus, which, although it varies in form from the foregoing, is identical with it in principle; but, having sufficiently described one modification of this apparatus, and also shown the construction of the exhausting or rarefying apparatus. I will now explain their combined action, and afterward proceed to the explanation of the drawing No. 4. The steam in the generator being at a pressure of five atmospheres, and the two cocks B and M, drawing No. 1, being closed, if the cock B is opened, the steam will then enter the apparatus, and escape by the steam-ajutage *a*, carrying with it a portion of air sufficient to rarefy to the required degree that in the cylinder X X in the air-vessel K, and to produce a rise of the mercury in the manometer T to the height of about twenty-one inches above the level of its basin, where it will remain. The cock M is then to be opened, and the air in the receivers of the hydraulic apparatus escapes with great rapidity, and that without lessening the degree of rarefaction in the cylinder X X or the air-vessel K, with which it communicates, as will be evinced by an actual rise instead of a depression of the mercury in the manometer T. Were not fresh air admitted into the tube C by the passing of air into the receivers of the hydraulic apparatus, the mercury would rise to the same height in the manometer S as in that marked T. The height indicated in the manometer S is about twelve inches, at which it will continue during the discharge of the air admitted in the operation of the hydraulic apparatus, and which is sufficient for the proposed application thereof to the raising of water.

When the hydraulic apparatus is to be put in action, the cocks O O of the tubes N are to be all closed, excepting one of those of the stage No. 1. The air in the receiver F corresponding to this cock will become rarefied, as

also will that contained in the branch H and the raising-main G, communicating with it. The pressure of the atmosphere on the surface of the water contained in the reservoir X will then cause it to rise through G to open the valve L and to fill the receiver F. This causes the float within said receiver to rise and to open the valves T T, as above explained. Air being thus admitted, the valve L will be closed, and the water contained in the receiver will pass by its own gravity through the pipe Q, will raise the valve U, Fig. 5, and flow into the reservoir E. The second cock of the same story is to be opened as the water in the first receiver begins to descend, and this second receiver will in like manner be filled with water. Thus while one of the receivers is being emptied the other is being filled, and so on alternately. As each of the stories or lifts is similarly constructed, the same proceeding is to be pursued until the whole machine is in full operation, the reservoirs E E bearing the same relation to the story next above it as the reservoir X does to the first story. When the water has been thus raised to the desired height, it may be conducted off to any required place through an opening in the side of the uppermost reservoir. From the reservoir of the first story, or from either of the others, the water may be let out upon a water-wheel for the purpose of driving machinery, and a portion of the power thus obtained may be made to operate a supply-pump to feed the steam-generator. By this arrangement the power of the steam will be applied in the most simple and effective manner to any purpose to which it may be adapted. A small portion of the water which is raised may be used for working the supply-pump when it is not desired to propel a large wheel.

Drawing No. 4.—In this drawing Figs. 1 and 2 are the same in all respects with Figs. 1 and 2 in drawing No 3, and do not therefore require to be further noticed, the main design of this drawing (No. 4) being to afford an example of the manner in which the hydraulic apparatus already described may be modified. Fig. 3 is a vertical projection of the hydraulic apparatus in accordance with a section thereof made in the line P Q of Fig. 4, which is a horizontal projection of story No. 1, Fig. 3, according with the line N O of that figure. In this apparatus, as in that of drawing No. 3, the height to which the water is to be raised is divided into stories at equal distances from each other, and each of these stories consists in part of a reservoir, into and from which the water is to be raised, and of a float which is operated upon, and operates in a manner similar to those in drawing No. 3; but there is not a reservoir and receiver distinct from each other, as in the apparatus represented in that drawing, but the reservoir itself is made an air-tight vessel, and is adapted to the production of the whole effect produced by the receiver and reservoir in the hydraulic apparatus first described.

Y Y is the well or main reservoir from which the water is to be raised. T T are the raising-mains or ascending pipes; S S, the reservoirs of the respective stories into which the water is to rise through the ascending pipes. The ascending-pipes are each furnished with a valve, Y, opening upward in an enlargement or chamber, as in the instrument formerly described.

Z is the pipe through which the air exhausted from the reservoirs is to pass to the exhausting apparatus, with which it is connected by the pipe K. From the pipe Z pipes proceed which open into the reservoirs immediately above the floats, as shown at U U. Small valves V V for the admission of air are situated and operate like those marked T T in drawing No. 3. X X are the floats, which by rising open these valves and close the orifices U, through which the air is discharged from the reservoirs. The reservoirs S S have no other openings into them than those of the raising mains, the orifice U, and the air-valves V V. In this figure the pipe Z is represented as extending down and opening into the water in the well or main reservoir Y Y, and this is done for the purpose of allowing of the discharge of any water which may accidentally pass through the tubes U U into it. When this hydraulic apparatus is put into operation by its connection with the exhausting apparatus, as fully described under the first modification of the hydraulic machine, the exhaustion produced in the pipe Z will cause the water to rise into the reservoir S of story No. 1 through the ascending pipe T, and this water will force the float X up against the orifice U, which it will close, while it will raise the valves V V by pressing against their tails. The air being admitted through the seats of these valves will press upon the surface of the water in the first receiver, and will force it up into the receiver of the second story, in which the air is in a state of rarefaction. Within this the same operation will take place as that just described, the water being in like manner forced up from it into the reservoir of the third story. While this is being effected, the reservoir of the first story will be refilled, the float having descended, the valves V V closed, and the air having again become exhausted within it, and thus the operation will go on alternately throughout the series of reservoirs so long as the exhausting-machine is kept in action, the air-valves of stories Nos. 1 and 3 being raised at the same time by their floats, while the valves of No. 2 and its float resume their first position. In the reservoir of the upper story, No. 3, there is inserted a curved pipe, W, furnished with a valve, *w*, through which the water may pass into the distributing-receiver R in the same manner in which it passes from one of the receivers into one of the reservoirs in the first-described hydraulic ap-

paratus. The circle Æ represents the entrance into a tube of distribution for carrying the water wherever it may be wanted.

I have thus shown various modifications of my apparatus, and it will be obvious to every competent machinist that many other changes may be made in the respective parts, while the general construction and the principle upon which it operates will still remain the same. Thus, for example, in the exhausting apparatus represented in drawing No. 1 and elsewhere the pipe D may be omitted, and that marked E alone retained, although by their concurrent action a better result is obtained than with a single pipe.

Having fully described the nature of my apparatus and shown the manner in which the same operate, what I claim therein as constituting my invention, and desire to secure by Letters Patent, is—

1. The manner in which I have constructed and combined the various parts of the apparatus for effecting the rarefaction of air by the rapid emission of steam from a steam-generator, reference being had to drawing No. 1 for a general exemplification of this combination, which consists, mainly, in the cylinder X, its contained tube or tubes for the efflux of air, the air-vessel connected therewith, and the manometers or gages for indicating the degree of exhaustion. I do not claim either of these parts taken separately as of my invention; but I do claim the so arranging and combining them, substantially as herein set forth, as to adapt them to the purpose of producing and indicating the degree of exhaustion in my hydraulic apparatus.

2. The arrangement and combination of the receivers and reservoirs, as described in the first modification thereof, or of the reservoirs alone, as described in the second modification thereof, with the floats, air-valves, and tubes for the exhaustion of air situated immediately above the floats, as described, so as to co-operate with each other in the manner and to produce the effects, as herein set forth, and these I claim, together with such modifications thereof as are analogous in construction and mode of operation, and which in consequence thereof produce a like effect.

P. RAVARD.

Witnesses:
DETTHITONY,
A. FOURNIER.