(No Model.) 3 Sheets—Sheet 1.

# ADOLPH FABER DU FAUR.

## HYDRAULIC AIR COMPRESSOR.

No. 561,160. Patented June 2, 1896.

Fig. 3.

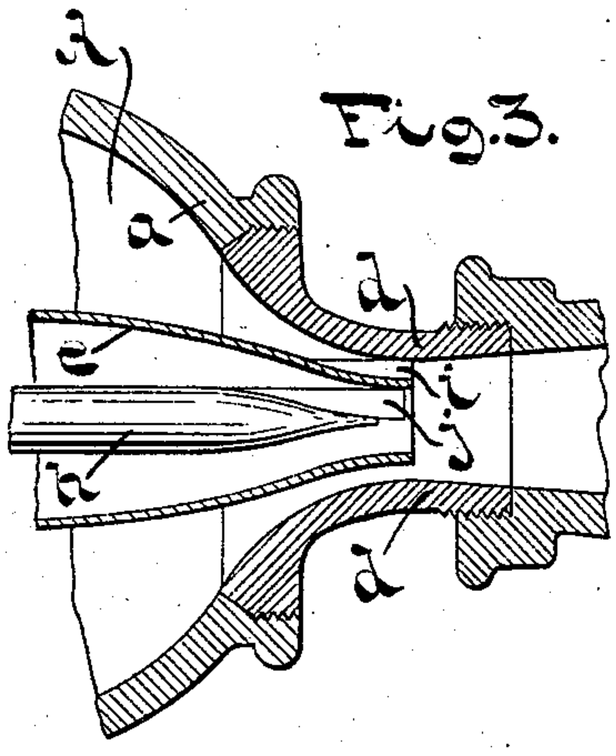



Fig. 1.

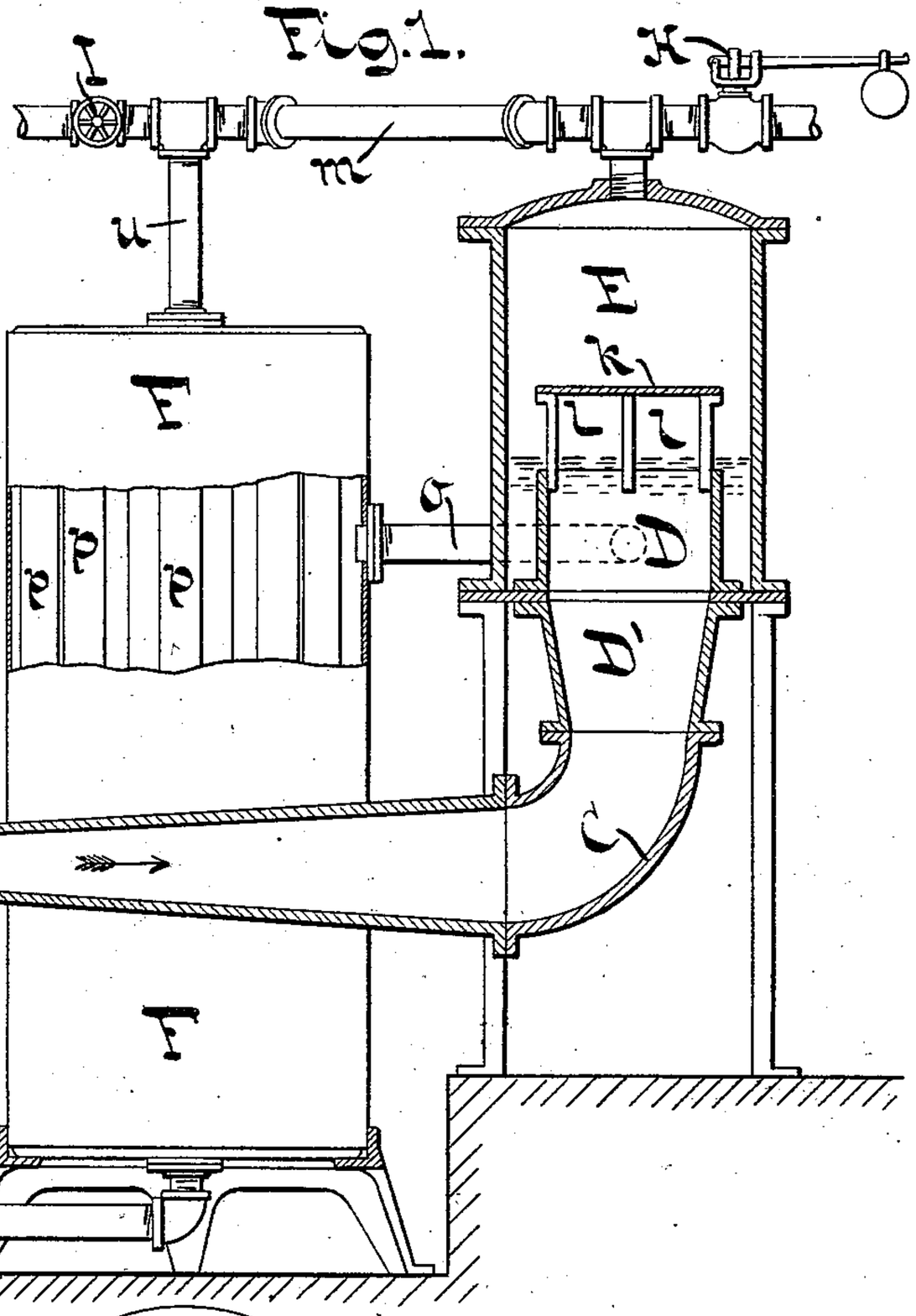
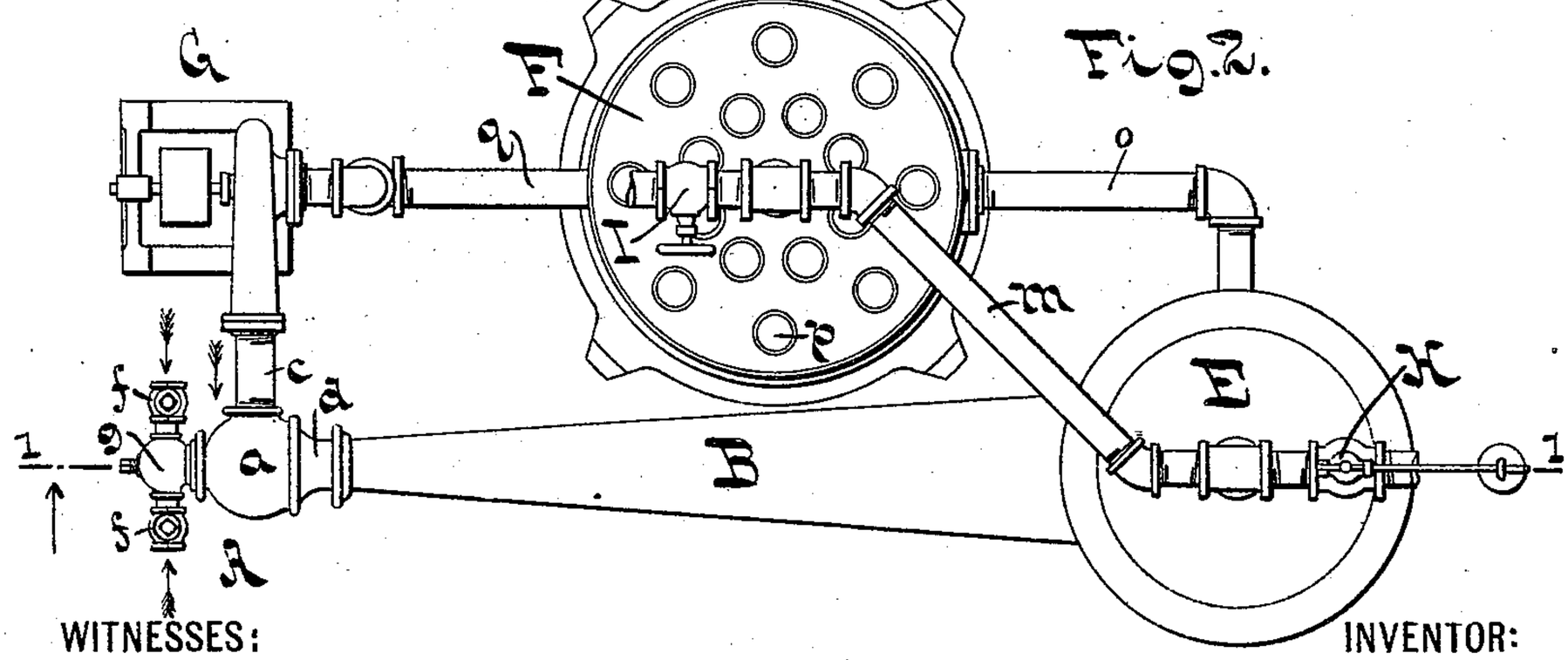



Fig. 2.

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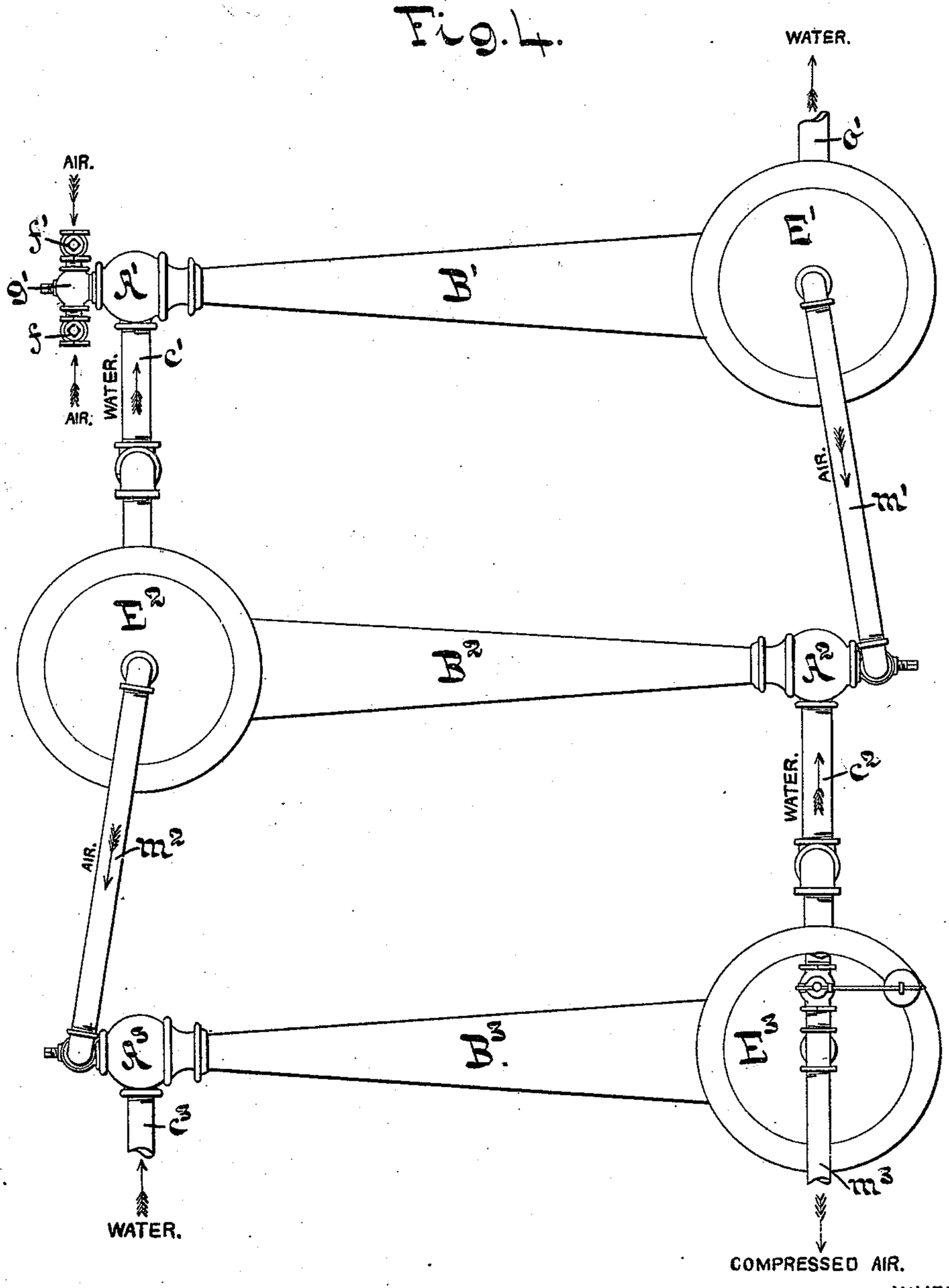
(No Model.) 3 Sheets—Sheet 2.

# ADOLPH FABER DU FAUR.

## HYDRAULIC AIR COMPRESSOR.

No. 561,160. Patented June 2, 1896.

Fig. 4.

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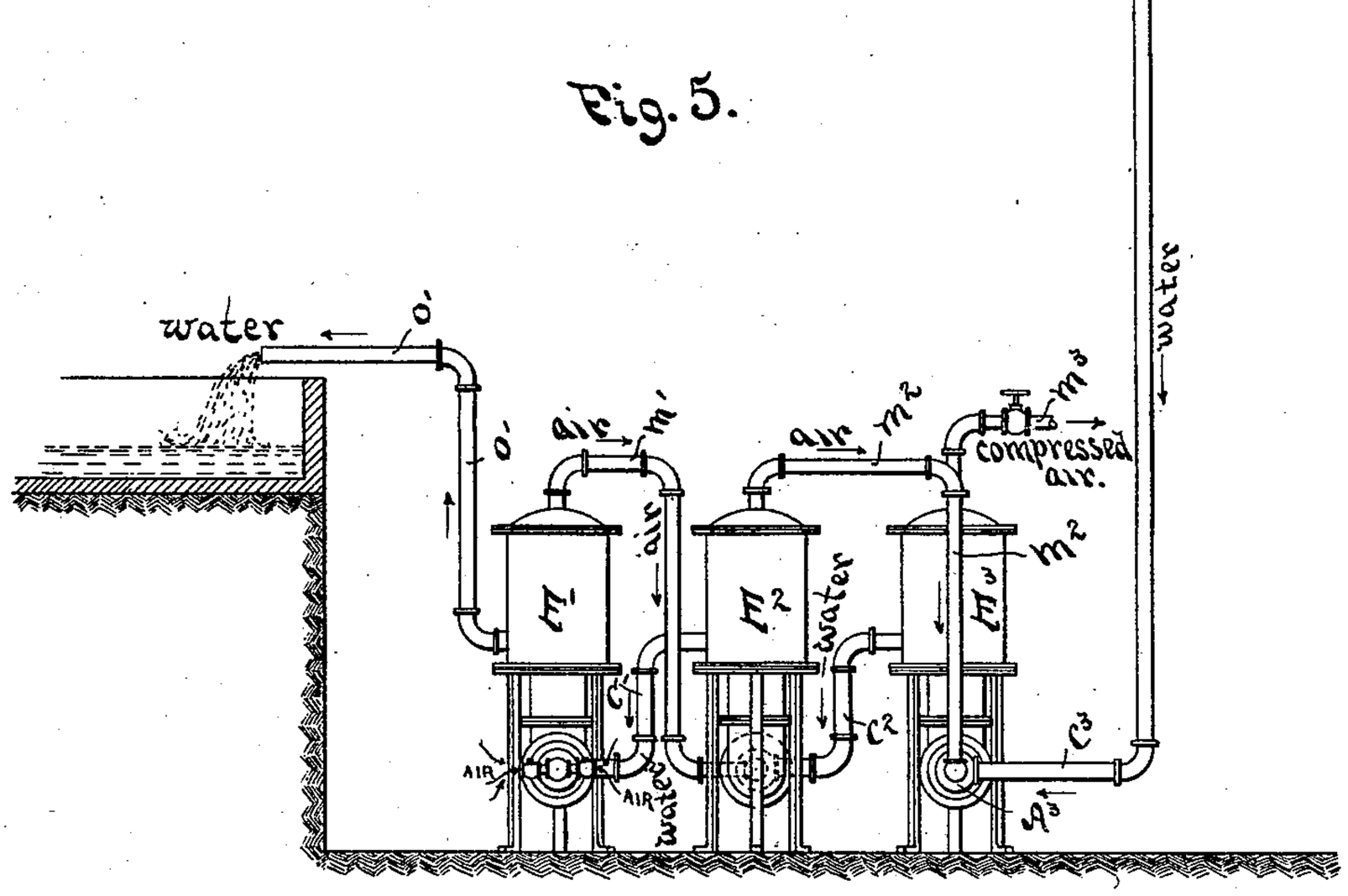
(No Model.) 3 Sheets—Sheet 3.

# ADOLPH FABER DU FAUR.

## HYDRAULIC AIR COMPRESSOR.

No. 561,160. Patented June 2, 1896.

Fig. 5.

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# UNITED STATES PATENT OFFICE.

ADOLPH FABER DU FAUR, OF NEWARK, NEW JERSEY.

## HYDRAULIC AIR-COMPRESSOR.

SPECIFICATION forming part of Letters Patent No. 561,160, dated June 2, 1896.

Application filed November 20, 1893. Serial No. 491,414. (No model.)

*To all whom it may concern:*

Be it known that I, ADOLPH FABER DU FAUR, a citizen of the United States of America, and a resident of Newark, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Hydraulic Air-Compressors, of which the following is a specification.

My invention refers to improvements in hydraulic air-compressors of the class called "tromp," (*wassertrommel gebläse.*) In such apparatus air is drawn into the upper part of a vertical tube of uniform area through side holes or through a central tube by means of a stream of water and is carried down with the water into a box or chamber, from which air and water are separately carried off. By this arrangement the full available head of water is not brought into action in the jet apparatus—on the contrary, but a small part of it—the efficiency of the apparatus is very low, and but a comparatively low air-pressure is obtained.

The object of my invention is to increase the efficiency of hydraulic air-compressors of this class and to supply highly-compressed air. For this purpose it consists, essentially, in the arrangement and construction of parts, which I shall hereinafter fully describe, for bringing the full available head of water into action in the jet apparatus and for using the exhaust-water by returning it to a compressor, either to one of a series, or when but one jet apparatus is used to the same by first passing it through a pump which reëstablishes the original pressure. By bringing the full available head of water into action in the jet apparatus, by discharging into a separator against a superincumbent column of water and air, and by passing the waste under the pressure of the compressed air to the injector the air can be very highly compressed without loss of efficiency.

In the accompanying drawings, Figure 1 is a sectional elevation of a complete apparatus, the section being taken on the line 1 1, Fig. 2. Fig. 2 is a plan view of Fig. 1. Fig. 3 is a sectional detail view of part of the injector. Fig. 4 is a plan view of a series of water-jet compressors. Fig. 5 is a diagrammatic elevation of Fig. 4 on a reduced scale.

Similar letters designate corresponding parts.

In Figs. 1, 2, and 3 the letter A designates a jet apparatus, consisting of a globe *a*, with lateral inlet *b* for water under pressure from supply-pipe *c*, a mouthpiece *d*, screwed into the globe, and an air-inlet pipe adjustably screwed into the opposite end of the globe *a* and projecting into the mouthpiece *d* to about the narrowest part of the same, leaving an annular space between the inside of the piece *d* and the outside of the inner end of the air-supply pipe *e*, through which space the water is forced. To the outer end of the air-supply pipe *e* is secured a globe *g* with two check-valves *f*, through which air directly from the atmosphere, or from a blower, enters the globe *g* and pipe *e*. A single check-valve, however, may be used. *h* is a rod screwed into the globe *g* and projecting with its inner tapering end into the air-pipe *e* and serving for the regulation of the opening of the air-pipe. To prevent whirls in the mouthpiece *d*, short fins *i* and *j* may be attached to the inner ends of the air-pipe and of rod *h*, as indicated in Fig. 3.

B is a tapering pipe attached to and forming the continuation of the mouthpiece *d*, with which it may be made in one piece, if desired. To the wide end of the pipe B is attached an elbow C and to the latter a short pipe D′.

E is a closed vessel, which I call a "separator," into which projects upwardly a pipe D connected with pipe D′.

*k* is a deflecting-plate supported by legs *l* upon the pipe D.

F is a receiver and cooler for water and air, its top being connected with the top of the separator by pipes *m n* and fittings, while the lower part of the separator is connected to the cooler F by a pipe *o*.

*p p* are pipes connected to and passing through the upper and lower heads of the cooler F, and through which air or cold water passes for cooling the water.

G is a centrifugal pump, the suction end of which is connected with the lower part of the cooler F by pipes *q*, while the discharge is connected with the supply-pipe *c* of the globe A.

H is a safety-valve, and I a valve placed

in the discharge-pipe for drawing off compressed air.

The cooler F may be omitted or the separator and cooler may be made in one. Instead of a centrifugal water-pump any kind of pressure-pump may be used for taking up the exhaust-water and delivering it under increased pressure into the jet apparatus. The cooler F (shown in the drawings) is designed principally for cooling the circulating water. It consists of a shell communicating with the vessel E by means of a pipe *o* and with the pump by means of a pipe *q*. The top of the shell is connected with the air-pipe *m* by a branch *u* to establish equal pressure upon the water in E and in F. Cooling-pipes *p* pass through the vessel from top to bottom, none however at the center, where the pipes *u* and *q* connect at top and bottom, respectively. The water is thus brought in contact with the large surfaces of the shell and of the pipes *p*, so that its temperature cannot rise above a certain maximum, depending on the surface of contact and the temperature as well as the kind and quantity of the cooling medium, which latter, in the example shown, is atmospheric air. When it is desired to cool the compressed air also, the current of air may likewise be passed through the same or through a separate cooler.

Before starting, the apparatus is filled with the necessary volume of water. The pump G receives the waste water from the separator or from the cooler substantially under the pressure of the compressed air in the separator and delivers it to the globe A under a pressure sufficiently high for doing the work of compressing the required volume of air. The water from the globe A passes into the mouthpiece *d* with a high velocity and low pressure and draws in air through the pipe *e*, the velocity of the mixed air and water on the way to the separator is gradually decreased, and the pressure correspondingly increased. The water carried off by the compressed air in the form of vapor must from time to time be replaced.

For very high pressures of air and particularly for compressing air by water-power I use several hydraulic air-jet compressors connected in series, as shown in Figs. 4 and 5, where $A' A^2 A^3$ are jet apparatus, $B' B^2 B^3$ the tapering pipes, and $E' E^2 E^3$ separators. The water under high pressure from any source—such as the penstock *w*, Fig. 5—enters the globe $A^3$ through pipe $c^3$, while atmospheric air enters the globe A′ through valves $f'$ and globe $g'$. Water from separator $E^3$ passes through pipe $c^2$ into jet apparatus $A^2$ and from separator $E^2$ through pipe $c'$ into the first jet apparatus A′, and then goes either to waste under a comparatively low pressure from separator E′ or is pumped back into globe $A^3$. The air travels through the system in an opposite direction, entering into the first jet apparatus A′. After the first compression it is carried by pipe $m'$ from the separator E′ into the second jet apparatus $A^2$. After second compression it passes from the separator $E^2$ into the globe $A^3$ and is finally carried by the water entering through pipe $c^3$ into the separator $E^3$, from which it is drawn off through pipe $m^3$. Thus any desirable number of jet apparatus $A' A^2 A^n$, conical pipes $B' B^2 B^n$, and separators $E' E^2 E^n$ may be connected in series, the water under pressure entering the jet apparatus $A^n$, passing from $E^n$ to $A^{n'}$, and so on, and being finally discharged from the separator A′ or thence returned through a pump to $A^n$, while the air from the atmosphere enters A′, passes from E′ into $A^2$, from $A^2$ into $A^3$, and so on, and is discharged from $E^n$ under high pressure. By this means water under very large head may be used to supply air under high pressure without appreciable loss of power, the waste water passing off under a very much smaller pressure than that due to the final air-pressure. By this arrangement in series, in connection with a circulating-pump, much smaller velocities of air and water are required in the several injectors than would be required in a single one.

The apparatus in Figs. 4 and 5 also shows the combination, with a jet apparatus, of a supply-pipe for air under pressure, and such pipes like $m'$ and $m^2$ may supply air to the jet, Figs. 1 to 3, from any suitable source, such as a fan-blower.

I do not claim as my invention hydraulic apparatus in which air alone is passed through a centrifugal apparatus against water-pressure or where air and water together are passed through a centrifugal apparatus.

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

1. In a hydraulic air-compressor, the combination of a water-jet apparatus provided with an inlet for air and a supply-pipe for water under pressure; a contracted mouthpiece where air and water meet; a gradually-expanding pipe connected to the said mouthpiece at its narrow end; a separator connected to the wide end of the expanding pipe and arranged to cause the mixed air and water to pass into it against gravity; a discharge-pipe for the exhaust-water connected to a jet apparatus, and a discharge-opening in the upper part of the separator for the compressed air, substantially as and for the purpose specified.

2. In a hydraulic air-compressor, the combination of a water-jet apparatus provided with an inlet for air and a supply-pipe for water under pressure; a contracted mouthpiece where air and water meet; a gradually-expanding pipe connected to the said mouthpiece at its narrow end; a separator connected to the wide end of the expanding pipe and arranged to cause the mixed air and water to pass into it against gravity, and discharge-openings for the exhaust-water and for the compressed air, substantially as and for the purpose specified.

3. A hydraulic air-compressor, consisting of

a series of water-jet apparatus A′, A² Aⁿ, a series of separators E′, E² Eⁿ connected with the former by gradually-expanding pipes B′, B² Bⁿ, an inlet for water under high pressure into the jet apparatus Aⁿ, water connections from separator Eⁿ to jet apparatus Aⁿ′ and so on finally from E² to A′; a discharge-pipe for the exhaust-water from E′, an air-supply pipe for the jet apparatus A′, pipes connecting the air-space of the separator E′ with the jet apparatus A², E² with A³, and finally separator Eⁿ′ with jet apparatus Aⁿ, and an outlet for the compressed air at the separator Eⁿ, substantially as and for the purpose specified.

4. A hydraulic air-compressor consisting of a series of water-jet apparatus A′, A² Aⁿ, a series of separators E′, E² Eⁿ connected with the former by gradually-expanding pipes B′, B² Bⁿ, water connections from the separator Eⁿ to jet apparatus Aⁿ′ and so on finally from E² to A′; pipes connecting the air-space of the separator E′ with the jet apparatus A², E² with A³ and finally separator Eⁿ′ with jet apparatus Aⁿ, an outlet for compressed air at the separator Eⁿ, and a water-pump having its suction end in connection with the separator E′ and its discharge end with the jet apparatus Aⁿ, substantially as and for the purpose specified.

5. A hydraulic air-compressor consisting of a series of water-jet apparatus A′, A² Aⁿ, a series of separators E′, E² Eⁿ connected with the former by gradually-expanding pipes B′, B² Bⁿ, water connections from the separator Eⁿ to jet apparatus Aⁿ′ and so on finally from E² to A′; pipes connecting the air-space of the separator E′ with the jet apparatus A², E² with A³ and finally separator Eⁿ′ with jet apparatus Aⁿ, an outlet for compressed air on the separator Eⁿ, a cooling apparatus connected with the separator, and a water-pump having its suction end in connection with the cooling apparatus and its discharge end with the jet apparatus Aⁿ, substantially as and for the purpose specified.

6. A hydraulic air-compressor, consisting of a jet apparatus with an inlet for air and a supply for water under pressure; a gradually-expanding pipe connected at its narrow end to the jet apparatus; a separator located above the jet apparatus and connected to the wide end of the expanding pipe, and a water-pump having its suction connected to the separator and its discharge end to the supply-pipe of the jet apparatus, substantially as and for the purpose specified.

7. In a hydraulic air-compressor the combination of a water-jet apparatus provided with an inlet for air and a supply-pipe for water under pressure, a contracted mouthpiece where air and water meet, a separator, a gradually-expanding pipe connected to the said mouthpiece with its narrow end and to the separator with its wide end, a cooler connected with the separator, and a water-pump having its suction end in connection with the cooler and its discharge end with the water-supply pipe of the jet apparatus, substantially as and for the purpose specified.

In testimony that I claim the foregoing as my invention I have signed my name, in presence of two witnesses, this 18th day of November, 1893.

ADOLPH FABER DU FAUR.

Witnesses:
KLAS H. TERNSTEDT,
JAS. KING DUFFY.