(No Model.) 2 Sheets—Sheet 1.

G. R. CULLINGWORTH.

AIR COMPRESSOR.

No. 287,104. Patented Oct. 23, 1883.

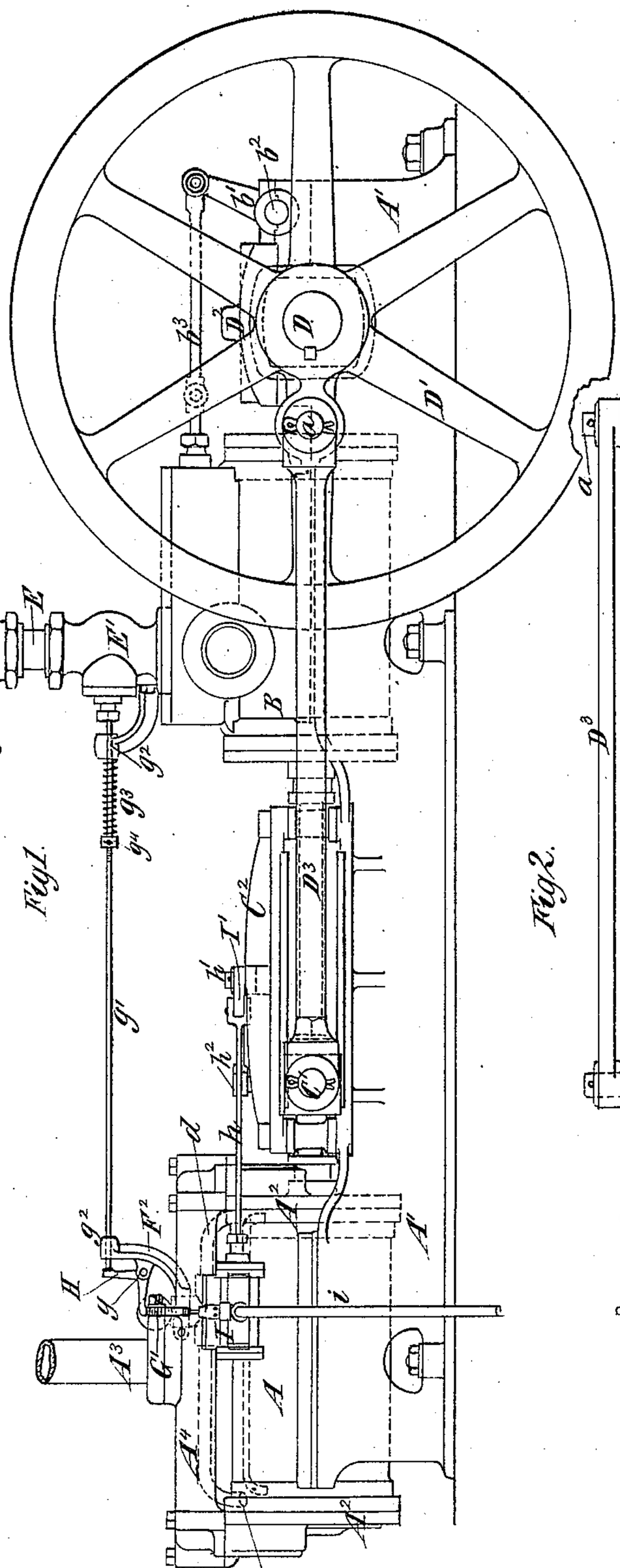

Fig 1.

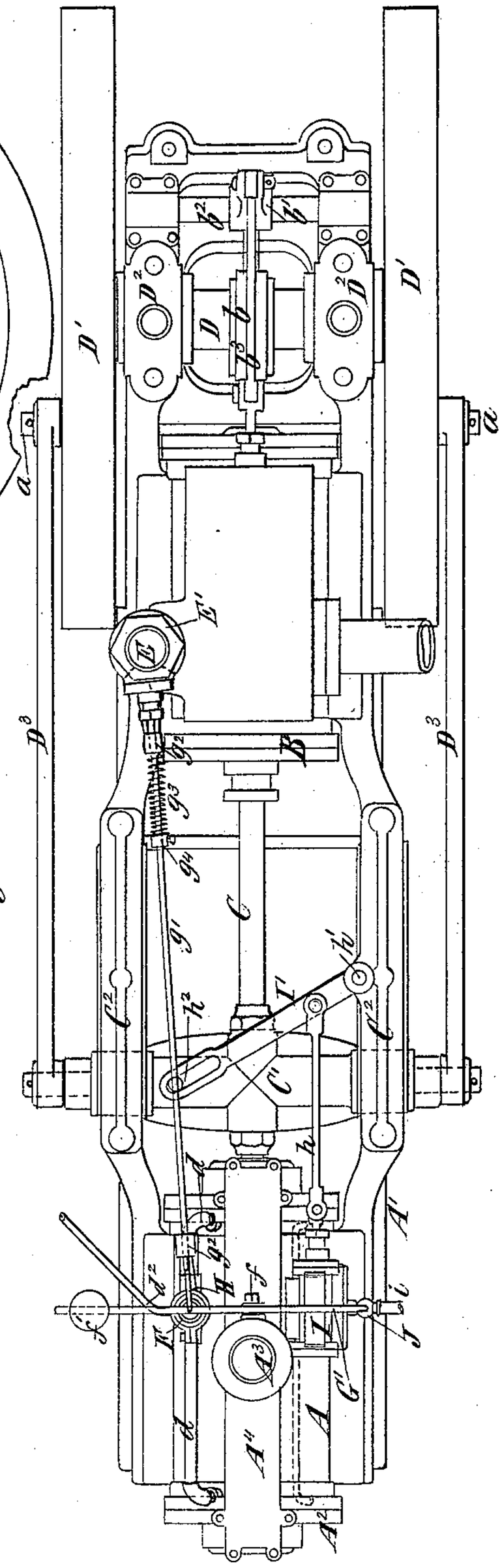

Fig 2.

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(No Model.) 2 Sheets—Sheet 2.

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Fig 5.

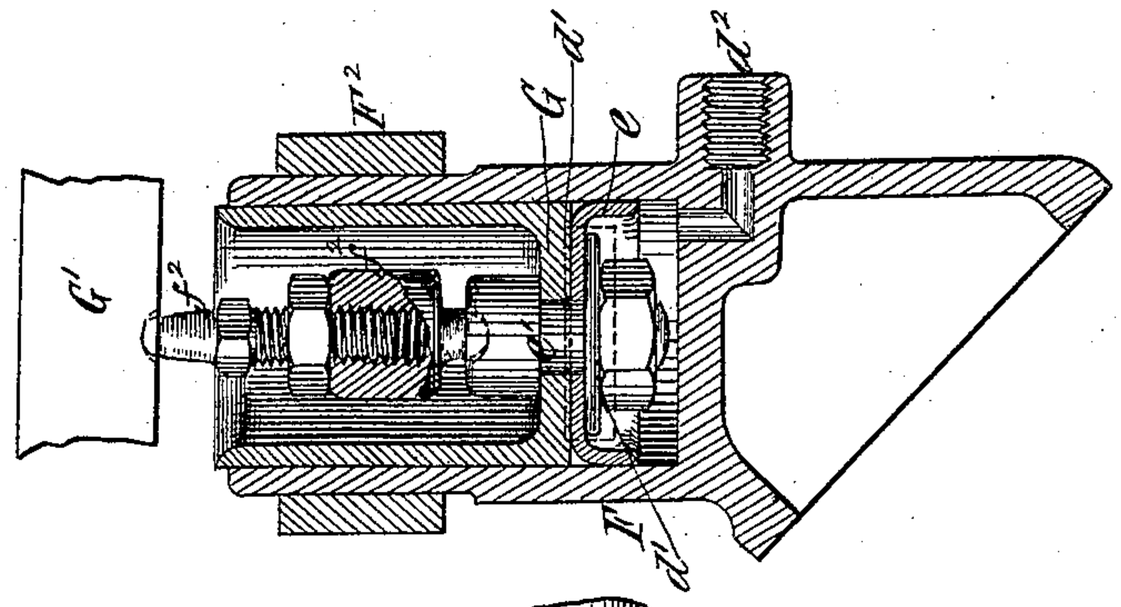


Fig 4.

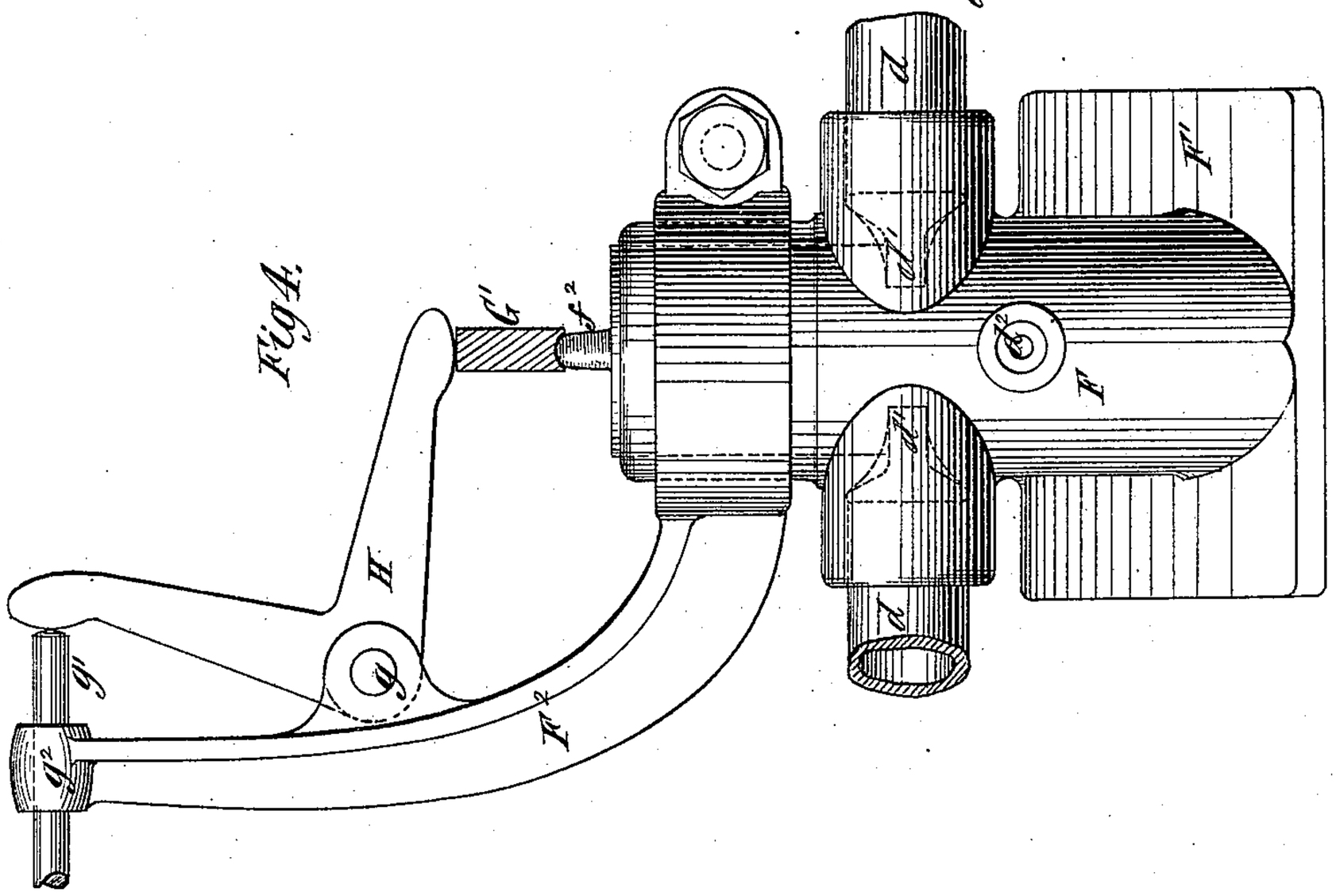


Fig 3.

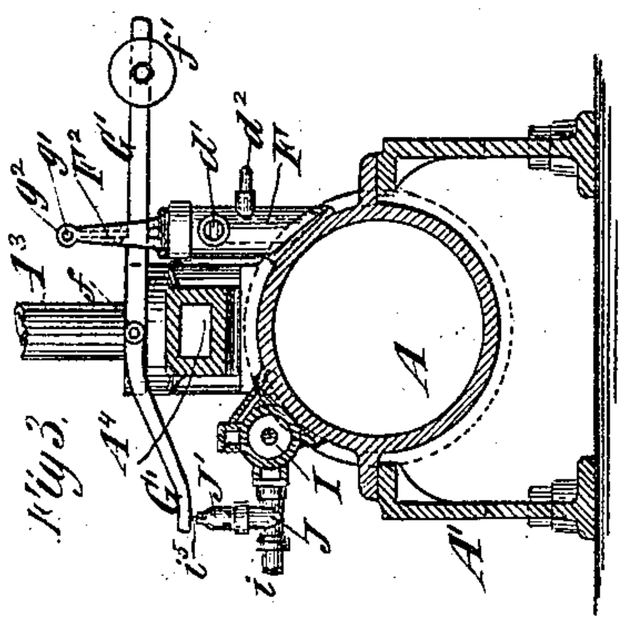
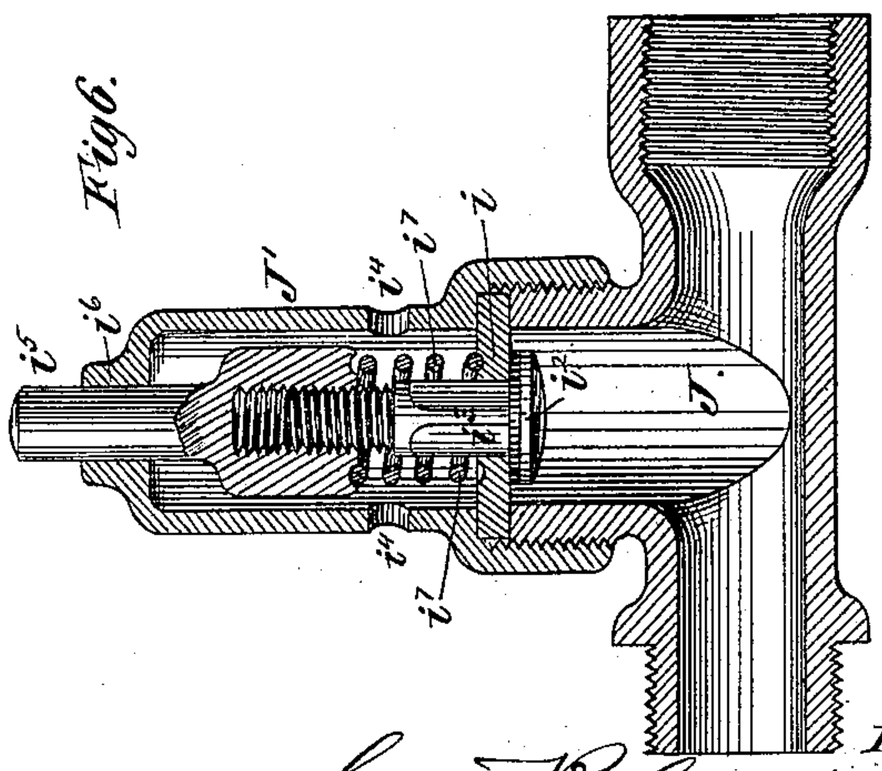


Fig 6.



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UNITED STATES PATENT OFFICE.

GEORGE R. CULLINGWORTH, OF NEW YORK, N. Y.

AIR-COMPRESSOR.

SPECIFICATION forming part of Letters Patent No. 287,104, dated October 23, 1883.

Application filed March 2, 1883. (No model.)

To all whom it may concern:

Be it known that I, GEORGE R. CULLINGWORTH, of the city and county of New York, in the State of New York, have invented a new and useful Improvement in Air-Compressors, of which the following is a specification.

Where air-compressors are employed to pump air into an air-receiver from which a number of machines—as, for instance, a number of rock-drills—are to be supplied with air, it is customary to employ pressure-regulators which are connected with said compressed-air receiver. When, by reason of the stoppage of any of the machines which are supplied with compressed air from the air-receiver, or from any other cause the pressure therein exceeds the maximum pressure desired, the pressure-regulator commonly acts to control the speed of the compressor by acting on the throttle-valve of its actuating-engine, or by placing the cylinder of the compressor in communication with the atmosphere, so that the air will be discharged therefrom without compression.

According to my invention, I control the compression of air by establishing direct communication between the two ends of the compression-cylinder of a double-acting air-compressor, so that the air will be circulated back and forth from one end to the other of the cylinder when the pressure in the receiver exceeds the maximum pressure desired; and my invention, therefore, consists in the combination, with the cylinder of a double-acting air-compressor, of pipes or conduits connecting the two ends thereof, and a pressure-regulator adapted to be operated on by compressed air, and serving to control communication between the ends of said cylinder through said pipes or conduits, so as to allow or prevent the circulation of air from end to end of the cylinder through said pipes or conduits.

The invention also consists in a pressure-regulator of novel construction, combined with the air-compression cylinder, and serving, in addition to its function as a regulator, as the valve whereby communication between the ends of the cylinder is established or cut off. At the same time that the ends of the compression-cylinder are placed in communication, as above described, it is desirable also to check the speed of the engine whereby the compressor is operated, so that there will be no unnecessary consumption of steam; and the invention, therefore, also consists in the combination, with the compression-cylinder and pressure-regulator, capable of operation as above described, of a throttle-valve for the engine, and connections through which the same regulator acts upon the throttle-valve to control the admission of steam to the engine.

In air-compressors the cooling-water is sometimes discharged by a pump directly into the compression-cylinder, and when the air is circulated back and forth, as above described, it is necessary to diminish or stop entirely the discharge from the pump into the cylinder.

To this end the invention consists in the combination, with the compression-cylinder and pressure-regulator, capable of operation as above described, of a pump for cooling water, a valve whereby air may be admitted to the suction of the pump, and connections through which the pressure-regulator may act to open said air-inlet valve to the pump, and thereby stop its action.

The invention also consists in combining a single pressure-regulator with the compression-cylinder, the engine throttle-valve, and the air-inlet valve of the pump, so that when the pressure in the air-receiver exceeds the maximum pressure desired it will operate the regulator, and the latter will simultaneously establish communication between the ends of the compression-cylinder, shift the throttle-valve of the engine, and open the air-valve, to admit air to the suction of the pump for cooling-water.

The invention also consists in various novel details of construction and combinations of parts, which are hereinafter described, and pointed out in the claims.

In the accompanying drawings, Figure 1 is a side elevation of an air-compressor and its operating-engine embodying my invention. Fig. 2 is a plan thereof. Fig. 3 is a transverse section of the compression-cylinder and appurtenances. Fig. 4 is an elevation of the pressure-regulator on a larger scale. Fig. 5 is a central vertical section of said regulator in a plane at right angles to Fig. 4; and Fig.

6 is a sectional view of the air-inlet valve for the water-pump, also on a larger scale.

Similar letters of reference designate corresponding parts in all the figures.

A designates the compression-cylinder, and B designates the steam-cylinder, of the operating-engine. Upon the piston-rod C is secured a cross-head, C′, which is adapted to work in guides C^2. D designates the main shaft, which, as here shown, has a fly-wheel, D′, at each end, and is adapted to turn in bearings D^2. In the fly-wheels are secured crank or wrist pins *a*, which are connected by connecting-rods D^3 with the cross-head C′, and said fly-wheels, therefore, constitute cranks. The cylinders A B are secured to a bed, A′, of any suitable construction. Upon the crank-shaft D is an eccentric, *b*, which, through a lever, *b′*, and rock-shaft b^2, operates the valve-rod b^3 of the engine.

So far as described, the compressor is of ordinary construction, and it and its engine do not in themselves form any part of my invention. Neither do I limit myself to the construction and arrangement of the compressor and operating-engine here shown.

E designates the steam-pipe, through which steam is supplied to the engine, and in said pipe are shown a stop-valve, *c*, and a throttle-valve, E′, which may be of any suitable construction.

I have not shown the valves for the compression-cylinder, as they form no part of my invention, and may be of ordinary construction. They may be located in the heads A^2 of the cylinder A, and the compressed air may be delivered through a discharge-pipe, A^3, leading from an air chest or trunk, A^4, which connects the heads.

I will first describe how communication is established between the two ends of the compression-cylinder A, and the construction of the pressure-regulator, which is shown most clearly in Figs. 4 and 5.

F designates the cylinder or casing of the regulator, which, as here shown, is provided with a base or flange, F′, whereby it is secured on the cylinder A; but it may be attached to any other suitable support. The regulator-cylinder F is connected by pipes or conduits *d d* with opposite ends of the compression-cylinder A, and is provided in opposite sides with ports *d′ d′*, which are shown dotted in Figs. 4 and 5. In the lower end of the cylinder F is an air-inlet, d^2, which is to be connected by a pipe with the compressed-air receiver, (not here shown,) into which air is pumped by the compressor.

In the cylinder F is fitted a piston or plunger, G, which is here shown as provided with a cup-packing, *e*, secured to it by a bolt, *e′*. G′ designates a lever fulcrumed at *f*, as shown in Fig. 3, and provided with an adjustable weight, *f′*. This lever is supported by a rod or stem, f^2, upon the plunger or piston G, as shown in Fig. 5, and the weight *f′*, therefore, loads the plunger or piston and resists its upward movement. The rod or stem f^2 here shown is composed of screw-threaded sections, so that it may be adjusted in length, and its lower end rests in a cavity in the head of the bolt *c′*, while its upper end bears against the under side of the lever G′. In lieu of the lever G′ and its weight *f′*, a weight otherwise applied, or a spring, might be used to load the plunger. It will be understood that by shifting the weight *f′* the load on the plunger or piston will be varied. When in its normal position, the plunger or piston covers the ports *d′;* but when the pressure in the receiver exceeds the maximum pressure desired, and the pressure for which the weight *f′* is set, the air-pressure in the cylinder F raises the plunger or piston G and uncovers the ports *d′*. The two ends of the compression-cylinder are then in communication with each other through the pipes or conduits *d*, and both ends are in communication with the air-receiver, so that the pressure on both sides of the compression-piston is balanced, and the load is taken off the compressor. The plunger or piston G, therefore, not only serves as a part of the pressure-regulator, but also as a valve for controlling the communication between the ends of the cylinder. If desired, the plunger or piston might serve only as a valve, an independent pressure-regulator being employed to move it. In such case the cylinder F would have no air-inlet d^2, and when the ports *d′* are uncovered the ends of the cylinder would be placed in communication without being placed in communication with the receiver. When the load is taken off the compressor, of course less steam is required to work it. I, therefore, connect the regulator plunger or piston by any suitable devices with the throttle-valve E′.

As here shown, the regulator-cylinder F carries a standard, F^2; and H designates a bell-crank lever fulcrumed at *g*, and one arm of which rests upon the lever G′, while the other arm bears against a rod, *g′*, which forms a continuation of the stem of the throttle-valve E′. The rod *g′* is movable in guides g^2—one on the standard F^2 and the other on the shell of the throttle-valve E′. When the regulator-plunger G rises, the bell-crank lever H is moved, and, acting upon the rod *g′*, shifts the throttle-valve and wholly or partly shuts off steam from the engine-cylinder B. When the plunger descends, the rod *g′* is returned by a spring, g^3, applied to the rod, as shown in Figs. 1 and 2, or in any other suitable way. This spring of course increases the load on the regulator-plunger G beyond what is formed by the weight *f′*, and, if desirable, the said spring might be of proper strength to alone form sufficient load on the plunger, and its tension might be varied by adjusting the nut g^4 on the rod *g′*, so as to load the plunger to any desired extent. I may of course connect the regulator-plunger and throttle-valve by any other devices which will cause the same result.

I designates a pump employed for deliver-

ing cooling-water into the compression-cylinder A. It is here shown as arranged at the side of the said cylinder, and its rod *h* is operated by a lever, I′, which is fulcrumed at *h′*, and has a slotted connection, h^2, with the cross-head C′, as best shown in Fig. 2.

I do not here make any claim to the combination of parts for operating the pump, and such combination may be made the subject of a future application for Letters Patent.

The pump I takes its water from a suction-pipe, *i*, and in said pipe is a connection, J, the construction of which is shown in Fig. 6. The connection J has a casing, J′, secured to it by a screw-thread, and between these parts is held a valve-seat, *i′*, to which is fitted an air-inlet valve, i^2, with an upwardly-projecting stem, i^3. The stem i^3 is triangular, or of such other form that when the valve is open air which enters the casing J′ through holes i^4 can pass through the valve-seat *i′* into the suction of the pump.

To the stem i^3 a rod or push-piece, i^5, is adjustably secured by a screw-thread, and the said rod or push-piece fits in a guide, i^6, in the top of the casing J′. The valve i^2 is held to its seat by a spring, i^7, or by a weight suitably applied. The end of the lever G′ bears upon the push-piece i^5, as best shown in Fig. 3, and when the lever is raised by the regulator-plunger G the end which bears on the push-piece i^5 is depressed and opens the air-inlet valve i^2, so as to admit air to the suction of the pump, and so diminish or stop entirely the discharge of water into the compression-cylinder. The cooling-water delivered into the compressor-cylinder by the pump I is discharged from the cylinder, with the compressed air, through the air-discharge valves.

I do not wish to limit myself to the construction or arrangement of the air-inlet valve here shown, nor to the devices through which it is acted upon by the regulator plunger or piston G, for such construction and arrangement and the connecting devices herein described may be greatly varied. By my invention I control by a single pressure-regulator the communication between the ends of the compression-cylinder, the admission of steam to the operating-engine, and the admission of air to the suction of the pump for supplying water to the cylinder. It will also be understood that the regulator plunger or piston itself forms the valve whereby communication between the ends of the compression-cylinder is controlled.

I do not claim, broadly, means for relieving the compressor-cylinder when the air in the reservoir or receiver exceeds the maximum pressure desired, as various means have been proposed for accomplishing this result. It has been proposed to attach to the end of a suction-valve stem at each end of the compressor-cylinder a piston working in a small cylinder, and by means of a regulator to admit air to this small cylinder when the pressure exceeds the maximum pressure desired, so as to hold the suction-valve open, and thus place the compressor-cylinder in direct communication with the atmosphere. It has also been proposed to employ at each end of the cylinder a relief-valve, to which is attached a piston working in a small cylinder, and during the ordinary operation of the compressor said valve would be held closed by the compressed air acting on the piston; but by means of a governor-valve the small cylinder could be placed in communication with the atmosphere and the relief-valve allowed to open, so as to permit the discharge of air from the compressor-cylinder directly to the atmosphere. I am not aware that it has ever before been proposed to place the two ends of the cylinder in direct communication, so that air can circulate from end to end of the cylinder without being discharged therefrom.

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

1. The combination, with the cylinder of a double-acting air-compressor, of pipes or conduits forming direct communication between the ends thereof, and a pressure-regulator adapted to be operated on by compressed air, and serving to control communication between the ends of said cylinder through said pipes or conduits, and to allow or prevent the circulation of air from end to end of the cylinder through said pipes or conduits, substantially as and for the purpose described.

2. The combination, with the cylinder of a double-acting air-compressor, of pipes or conduits forming direct communication between the ends thereof, a regulator-cylinder located between said pipes or conduits, and a piston or plunger fitted in said regulator-cylinder, controlling communication between said pipes or conduits, and capable of being moved by air-pressure to place the ends of the compressor-cylinder in direct and uninterrupted communication, and to thus allow air to be circulated from end to end of the cylinder through said pipes or conduits, substantially as described.

3. The combination, with the cylinder of a double-acting air-compressor and pipes or conduits leading from opposite ends thereof, of the regulator-cylinder F, provided with ports *d′ d′*, and with an air-inlet, d^2, and the regulator plunger or piston G, adapted to cover the said ports, and thus cut off communication between the ends of the compressor-cylinder through said pipes or conduits, and capable of being moved by the pressure of air directly upon it, so as to uncover the said ports, and thus place the ends of said cylinder in direct communication through said pipes or conduits, substantially as described.

4. The combination, with a double-acting air-compressor, an engine for operating the same, and a throttle-valve controlling the admission of steam to the engine, of pipes or conduits for establishing direct communication between the ends of the compressor-cylinder, and a pressure-regulator and connec-

tions serving to control communication between the ends of said cylinder through said pipes or conduits, and to shift or control said throttle-valve, substantially as and for the purpose described.

5. The combination, with a double-acting air-compressor, its operating-engine, and the throttle-valve of said engine, of the pipes or conduits *d d*, the regulator-cylinder F, provided with ports *d' d'*, and with an air-inlet, *d²*, the regulator plunger or piston G, serving by its movement to place the ports *d' d'* in communication, and thereby to establish direct communication between the ends of the cylinder through the pipes or conduits *d d*, and connections through which said plunger or piston acts upon said throttle-valve, substantially as and for the purpose described.

6. The combination, with the cylinder of a double-acting air-compressor and a pump for supplying cooling-water thereto, of pipes or conduits connecting the ends of said cylinder, a valve whereby the suction of said pump may be placed in communication with the atmosphere, a pressure-regulator for controlling communication between the ends of said cylinder through said pipes or conduits, and connections whereby said regulator may open said valve to admit air to the said pump, substantially as and for the purpose described.

7. The combination, with the cylinder of a double-acting air-compressor, a pump for supplying cooling-water thereto, and a valve whereby the suction of said pump may be placed in communication with the atmosphere, of the regulator-cylinder F, provided with ports *d' d'*, which are in communication with opposite ends of the compressor-cylinder, and also provided with the air-inlet *d²*, the plunger or piston G, and connections through which said piston or plunger may open said valve to admit air to the suction of the said pump, substantially as described.

8. The combination, with the double-acting compressor-cylinder A and water-pump I, of the pipes or conduits *d d*, the regulator-cylinder F, with which they communicate, the regulator plunger or piston G, the pump-connection J, the air-valve *i²*, and the lever G', operated by said plunger or piston and operating said air-valve, substantially as described.

9. The combination, with the cylinder of a double-acting air-compressor, its operating-engine, a throttle-valve for controlling the admission of steam to the engine, a pump for supplying cooling-water to the compressor-cylinder, and an air-valve for said pump, of a pressure-regulator adapted to be operated by compressed air, and serving by its operation to establish communication between the ends of the compressor-cylinder, to close or partly close the throttle-valve of the engine, and to open said air-valve to admit air to the suction of said pump, substantially as and for the purpose described.

10. The combination, with the compression-cylinder A, the engine-cylinder B, the throttle-valve E', the water-pump I, and its air-inlet valve *i²*, of the regulator-cylinder F, the regulator plunger or piston G, the lever G', through which said plunger or piston acts upon said air-inlet valve, and the bell-crank lever H, and rod *g'*, through which said plunger or piston acts upon said throttle-valve, all substantially as described.

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