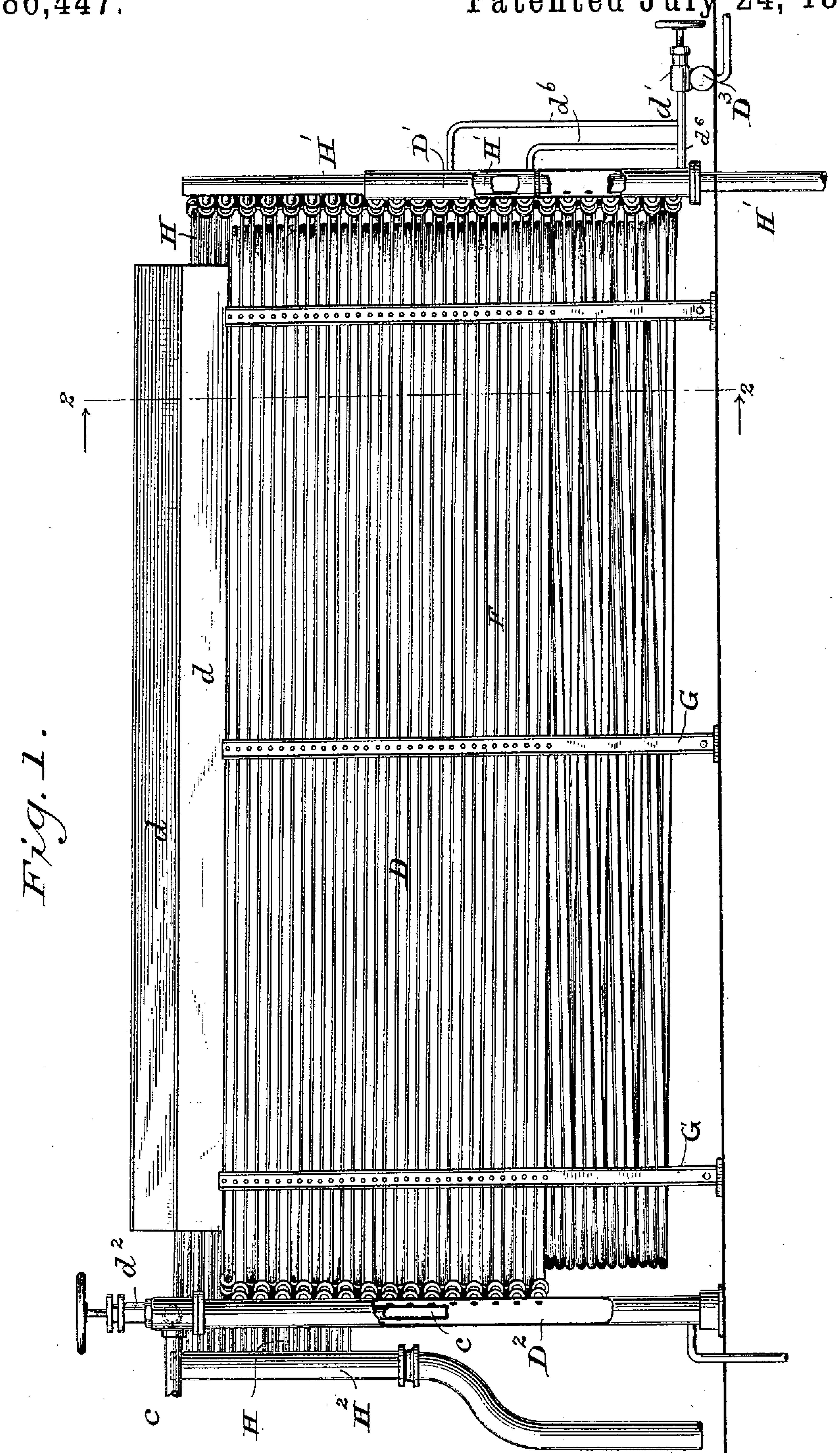
(No Model.) 4 Sheets—Sheet 1.

V. H. BECKER.

CONDENSER.

No. 386,447. Patented July 24, 1888.



Witnesses.
Geo. W. Young.
Arthur Johnson.

Inventor,
Victor H. Becker.
By his Attorney.
Wm. A. Skinkle.

(No Model.) 4 Sheets—Sheet 2.

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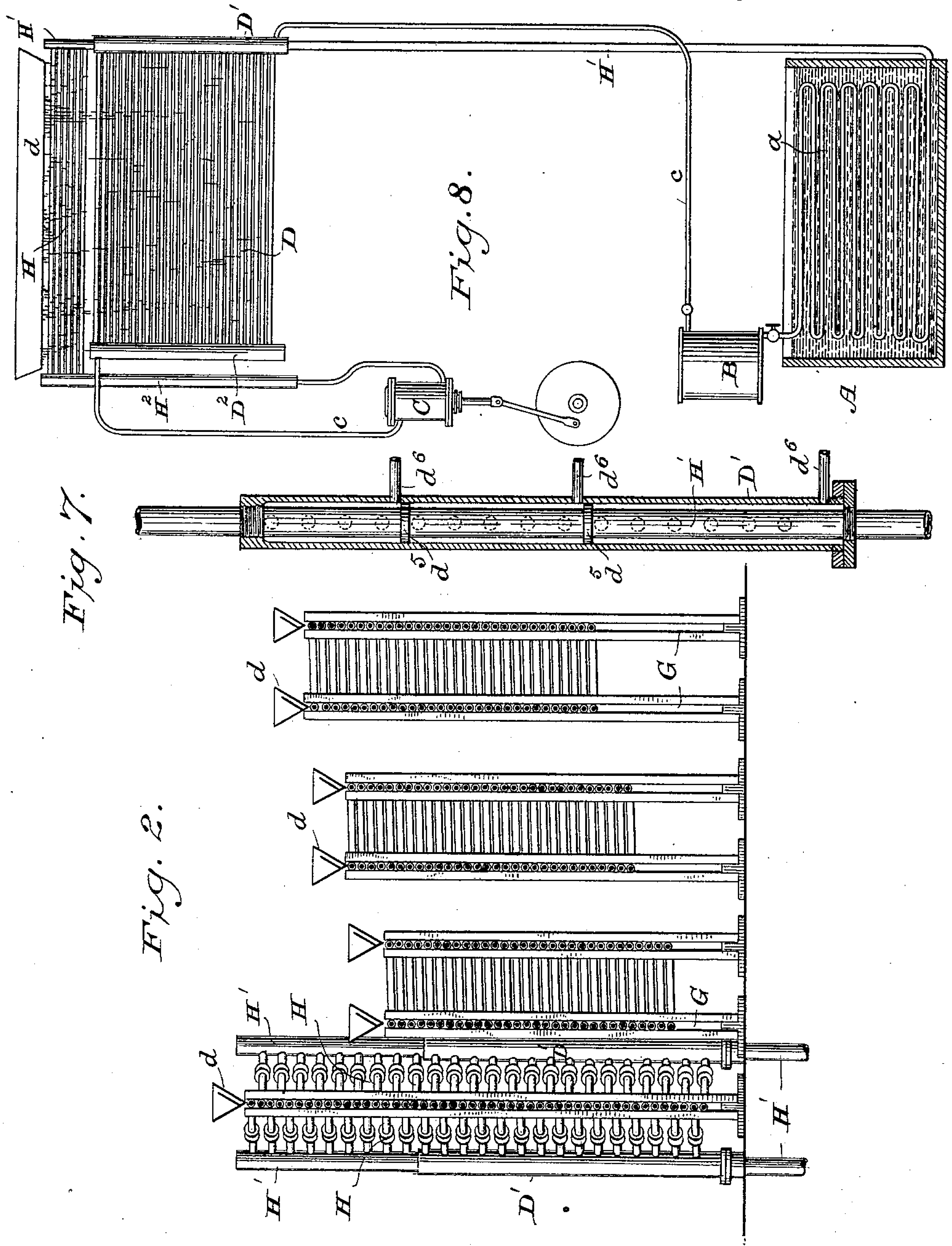

Witnesses:
Geo. W. Young.
Arthur Johnson.

Inventor,
Victor H. Becker.
By his Attorney
Wm. A. Skinkle.

N. PETERS, Photo-Lithographer, Washington, D. C.

(No Model.)

4 Sheets—Sheet 3.

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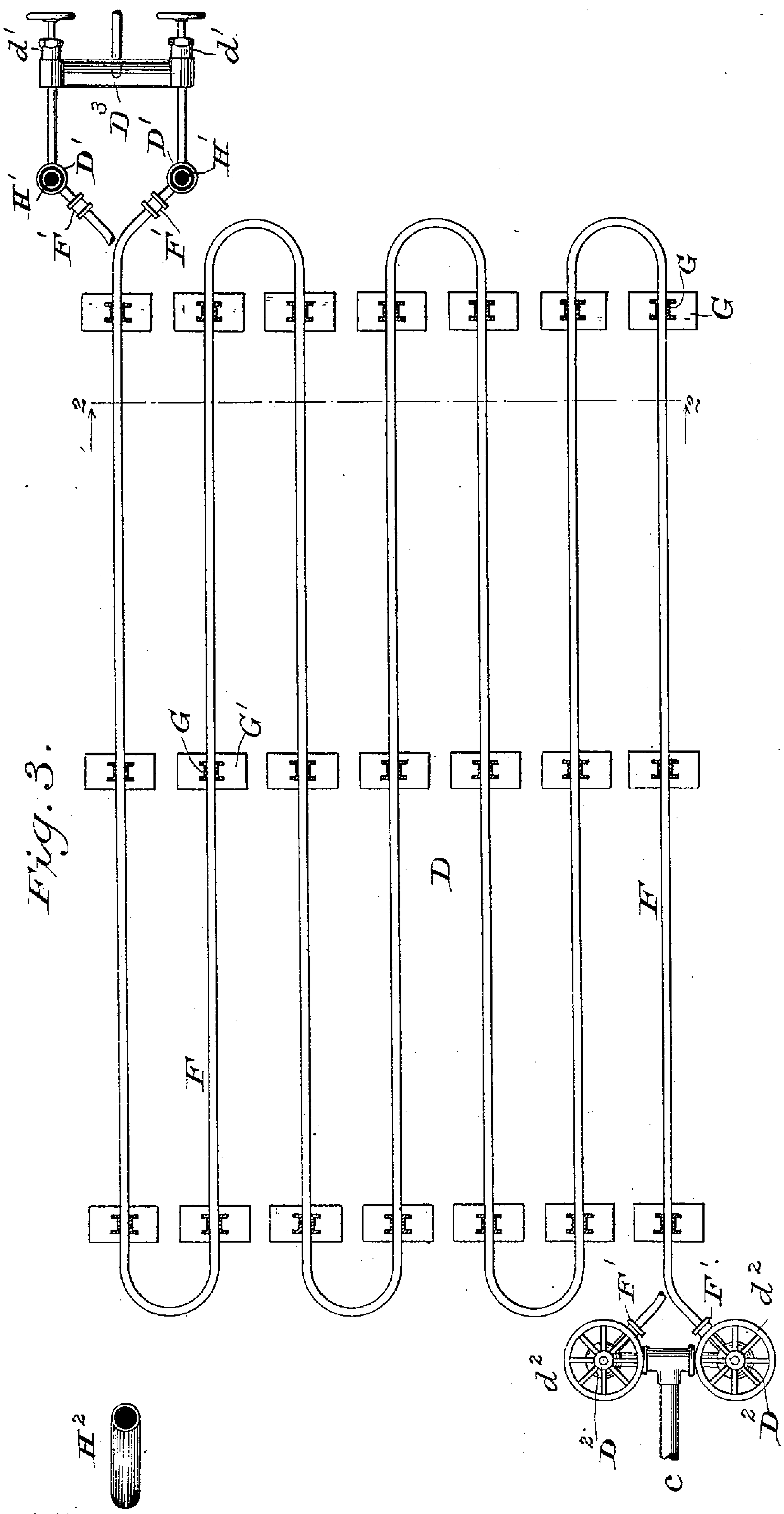

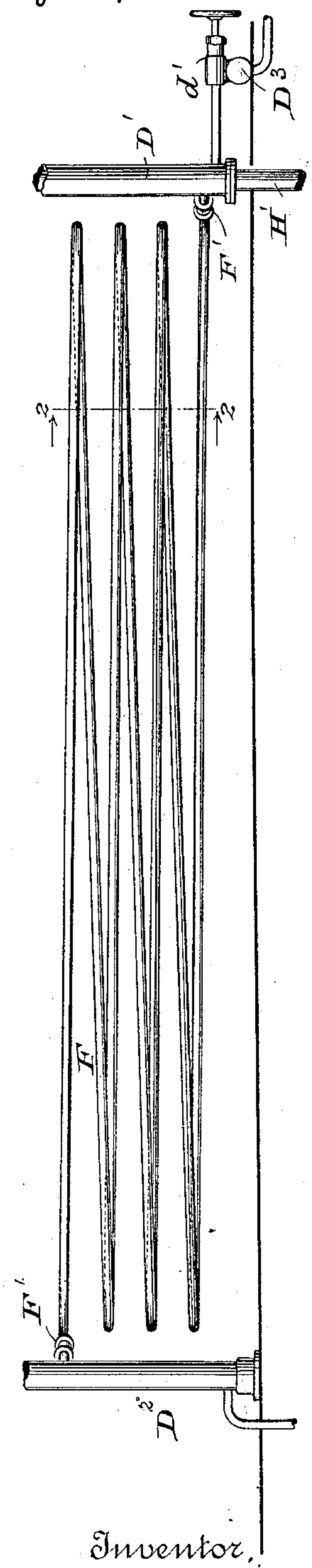

Witnesses,

Geo. W. Young.
Arthur Johnson.

Inventor,
Victor H. Becker.
By his Attorney.
Wm. A. Skinkle.

N. PETERS, Photo-Lithographer, Washington, D. C.

(No Model.) 4 Sheets—Sheet 4.

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Fig. 5.

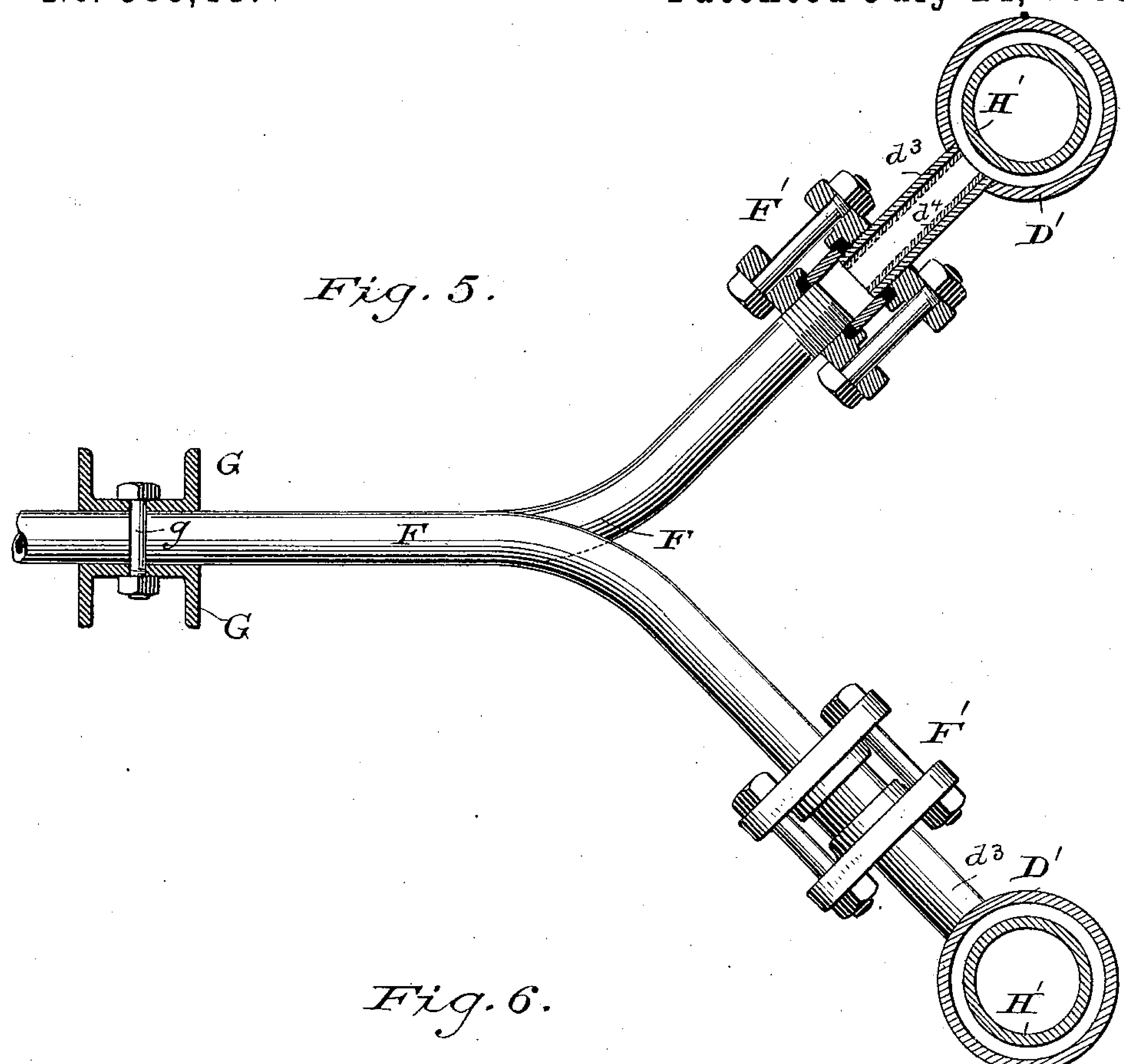
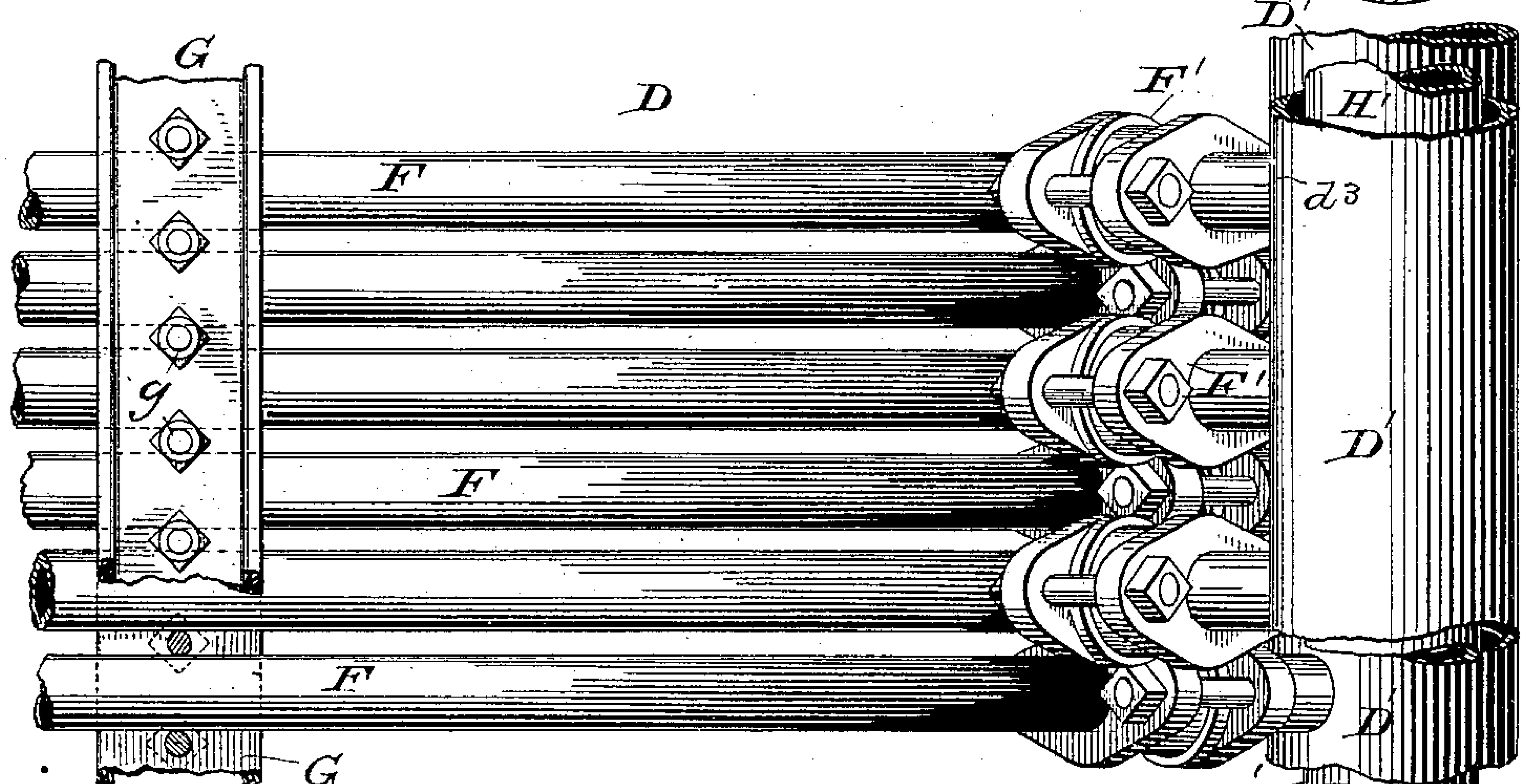


Fig. 6.



Witnesses.

Geo. W. Young.

Arthur Johnson.

Inventor.

Victor H. Becker.

By his Attorney

Wm. A. Skinkle.

UNITED STATES PATENT OFFICE.

VICTOR H. BECKER, OF CHICAGO, ILLINOIS.

CONDENSER.

SPECIFICATION forming part of Letters Patent No. 386,447, dated July 24, 1888.

Application filed January 29, 1887. Serial No. 225,840. (No model.)

To all whom it may concern:

Be it known that I, VICTOR H. BECKER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Condensers; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to pipe-condensers of the class known as "atmospheric" condensers, and is particularly adapted for use in the processes of artificial refrigeration employing anhydrous ammonia or other analogous gases as refrigerants; and it consists in certain improvements in the details of construction and assemblage of the parts, as will hereinafter be fully set forth and claimed.

In the accompanying drawings, which illustrate my improvements, Figure 1 is a side elevation of an atmospheric condenser embodying the features of my invention. Fig. 2 is a vertical transverse section of the same on the line 2 2 of Fig. 1. Fig. 3 is a plan view of a single coil of pipe, any desired number of which may be employed in vertical series in the condenser. Fig. 4 is a side elevation of the same. Fig. 5 is a plan view, on an enlarged scale, of the terminals of the alternating coils, and clearly illustrates their connection to the duplicate headers or manifolds. Fig. 6 is a side elevation of the same. Fig. 7 is a sectional view of one of the ejection-headers. Fig. 8 is a diagrammatic view illustrating the position of my condenser in a refrigerating system adapted to cooling brine-tanks.

The condenser to which my improvements pertain is shown in Fig. 8 as forming part of a cooling system that may be adapted to brewing purposes. In a brine-tank, A, are placed coils of pipe *a* connected at one end to a storage-vessel, B, containing liquid ammonia or other refrigerating agent, which, when released, flows through the coils, and by its rapid expansion into gas produces a low temperature, which cools the brine surrounding them. The expanding gas having done its work in the coils of the brine-tank is drawn from them to a pump, C, by which it is compressed and forced through a pipe, *c*, into the condenser D, where the heat arising from compression is extracted and the gas again becomes liquid, in which form it is forced into the storage-vessel B, from which it started.

Above the condenser-coils are troughs *d*, from which water trickles over the pipes to facilitate condensation. To effect the further cooling of the resultant liquid, I utilize the low temperature of the gas drawn by the pump from the brine-tank coils to reduce below the normal temperature of the supply the water dripping upon the latter end of the coils. The pipe H′, leading from the tank-coils to the pump, passes through the ejection-header D′ of the condenser and at its upper projecting end serves as a manifold for a series of pipes, H, extending above the coils. These pipes are connected to another tube or header, H^2, which leads to the pump, and above them extends a drip-trough, the water from which falls upon the refrigerating-pipes and becomes very cold before coming in contact with the condenser-coils, from which the liquid product of condensation is flowing into the header D′. The condenser shown in the drawings consists of a large number of independent flat "coils" of pipes, F, placed in vertical series and united at their terminals to vertical headers or manifolds D′ D^2.

The extreme tenuity of anhydrous ammonia gas and the high pressure to which it is subjected in the process of condensation cause it to leak through joints that would restrain other fluids or gases of greater density, and this makes it desirable to dispense with joints in the pipes whenever practicable, but where their use is imperative to employ those of a construction best adapted to the peculiar nature of the work to be performed. To this end each coil F of the condenser is composed of a single piece of pipe shaped, as shown in Figs. 3 and 4, to form several straight lengths, which are united by return bends, each terminal of the coil being connected to its respective header D′ or D^2 by couplings or unions F′, as shown in Figs. 5 and 6, or by other suitable devices. These coils have a constant fall or inclination from their inlet to their outlet end, so that at whatever point liquefaction of the gas occurs the product will flow from the coil into the header D′. Above each vertical series of straight lengths of pipe in the condenser is a trough, d, from which a constant supply of cold water trickles in a thin film or stream over the pipes below it, and this water, together with the currents of air circulating around the pipes, extracts from them the heat given off by the compressed gas.

It is desirable to get the pipes in each vertical series close together, in order, first, to get the greatest number within a given space, and, second, to have the water which flows down over their exteriors drip from one pipe to another and without spattering. It has been the practice heretofore in condensers of this kind to use single headers at each end of the condenser, to which the terminals of all the coils were connected by unions such as shown, and under this construction the pipes must be placed far enough apart to allow sufficient space for the unions. In practice with pipes one inch in diameter (one and three-eighths inch external diameter) it is necessary to place them about three and one-half inches apart from center to center. This would leave a clear space between each pipe of two and one-eighth inches, in falling through which the water would spatter, as above stated, to prevent which fins or thin plates of metal were attached along the bottom of each pipe, reaching nearly to the pipe below, down the sides of which the water would gently glide.

In order to get the coils close together for the purpose above set forth, I employ two headers at each end of the condenser, placed on either side of the vertical plane of the pipes, the terminals of which are bent to angles to intersect the headers, the alternate pipes going on the diverging angles. This results in only half of the coils in the condenser being connected to each header, and affords ample room between the correspondingly-diverging terminals for the use of any suitable union connection, and also makes them easily accessible for repairs or renewal at any time.

The two injection-headers D^2 D^2 are connected at their tops to a common feed-pipe, c, from the compression-pump, and each is provided with a controlling-valve, d^2. The two ejection-headers D′ D′ are connected at their lower ends to a common liquid-trap, D^3, from which the liquid passes to the storage tank or receiver, each connection being provided with a valve, d'. As all the alternate coils are connected to the same headers, it will be seen that two distinct parallel systems exist in the condenser from the branch at the injection-headers D^2 to the trap at the ejection-headers D′, and that either may be shut off for repairs or a reduction of capacity without disturbing the other. The several coils comprising the condenser are arranged in vertical series and securely locked together and held in place by standards G at suitable intervals along their length, consisting of a pair of channel-iron bars at each side of a vertical series of pipes, and united by bolts g, which pass between the coils. Each pair of bars comprising a standard is securely bolted at bottom to a base-plate or foot-piece, G′.

Water, at the normal temperature of the supply, drips from all the troughs above the coils; but it is desirable to reduce the temperature of the condensed fluid below the point attainable by this means. To accomplish this I conduct through each of the ejection-headers D′ a tube, H′, connected at its upper projecting end with a series of alternating pipes, H, lying in the vertical plane of the last length of the condenser-coils. These pipes are connected to the vertical tubes in a manner similar to the connection of the coils to the headers, and at their other ends are screwed into a common header or tube, H^2.

The tubes H′ H′ and H^2 are connected to the cooling-coils a of the brine-tank and to the pump C, respectively, and the exhaust-gas is drawn from the former through them. Above the series of pipes H is a drip-trough, d, the water from which falls first upon the tubes through which the exhaust cold gas is drawn and becomes very cold before falling upon the last portion of the condenser-coils in which the gas has become liquefied. The liquid is thus greatly cooled before it runs into the ejection-headers D, where it is still further cooled by contact with the cold-gas tube H therein.

In order to effect an even distribution or division of the gas among the condenser-tubes, I conduct the supply-pipe c down into each injection-header D, as shown in Fig. 1. By this plan the discharge-point of the supply-pipe in the header is brought to a point where a nearly equal pressure will prevail at the orifices of all the coils leading therefrom, some of the gas passing between the supply-pipe and the walls of the header to the coils above the discharge-point. As a further precaution to insure this result, I make the nipples d^3, by which the coils are connected to the inlet-headers, of a smaller diameter than the pipes in the coils, as shown by dotted lines d^4 in Fig. 5, so that the aggregate area of the coil-orifices in the header shall be slightly less than the internal area of the header itself.

The ends of the headers D′ D^2 are closed in to form tight joints around the pipes H′ and c, which are lead into or through them. The water which falls upon the coils is coldest when it meets the upper coils, and gradually becomes warmer as it drips down from one coil to another, and as a result of this it sometimes happens that condensation takes place more rapidly in the upper than in the lower coils, resulting in local variations of pressure in the condenser, which causes a refluxing pulsation in the ejection-headers D′. To correct this I have divided the header into several compartments by partitions d^5, as shown in Fig. 7, and from the bottom of each compartment conduct the liquid to the trap D^3 by separate pipes, d^6, as shown in Figs. 1 and 7.

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

1. A condenser tube or pipe forming a flat

coil, the ends of which are bent at angles to the adjacent portion of the tube, but lie substantially in the plane of the coil, and provided at such diverging ends with unions or couplings, substantially as shown, and hereinbefore set forth.

2. A condenser consisting of a series of flat coils of pipe and having duplicate headers or manifolds at each end, the ends of the pipe being bent at angles to the adjacent portions of the tube, but lying in the plane of the coils, and provided with couplings or unions, by which they are connected to the headers, each alternate pipe or coil being connected to the opposite header, substantially as and for the purpose hereinbefore set forth.

3. The combination of duplicate inlet-headers connected to a common supply-pipe and provided with independent valves and duplicate outlet-headers connected to a common exit-pipe, and also provided with independent valves, with a series of parallel coils of pipe having diverging ends, which connect alternately to one of each pair of headers, thus forming two distinct systems in a condenser, either of which may be shut off without disturbing the other, substantially as set forth.

4. The combination of a series of parallel and substantially flat coils of pipe lying in close proximity and having alternately-diverging ends to provide space for the unions, by which they are connected to the duplicate headers, as shown, with supports or standards at suitable intervals, consisting of bars which embrace the sides of the series of pipes and are united by bolts which pass between the pipes, substantially as hereinbefore set forth.

5. A condenser constructed of coils of pipe alternately united to duplicate headers at each end, as described and shown, and drip-troughs suspended above the several straight portions of the coils, in combination with a series of pipes for cold gas, arranged above the latter portions of the coils and below the last water-trough, said pipes for cold gas being alternately connected at one end to duplicate induction-pipes leading through the outlet-headers of the condensers and at the other end to a single eduction-pipe, substantially as and for the purpose hereinbefore set forth.

6. The combination of the liquid-refrigerant reservoir B, the expansion-coils *a*, the pump C, the condenser D, constructed as shown, the induction-pipe H′ from the expansion-coils passing through the eduction-header of the condenser and connected to a series of cooling-pipes, H, above the latter end of the condenser-coils, and then connected to the pipe H^2, leading to the pump, the ejection-pipe *c* from the pump leading through the condenser to the liquid-refrigerant reservoir, and the drip-trough *d* above the cooling-pipes H, all substantially as and for the purpose set forth.

7. The combination of a series of coils connected at their ends to common inlet and outlet headers, the drip-water troughs suspended above the coils, the partitions which divide the outlet-headers into several compartments, and the fluid-pipes which connect the several compartments with the fluid receiver or trap, substantially as and for the purpose set forth.

In testimony whereof I affix my signature in presence of two witnesses.

VICTOR H. BECKER.

Witnesses:
GEO. W. YOUNG,
ALICE S. WELLS.