No. 635,955. Patented Oct. 31, 1899.

A. CAMPBELL.

CONDENSING COIL FOR REFRIGERATING MACHINES.

(Application filed Jan. 27, 1899.)

(No Model.) 4 Sheets—Sheet 1.

Fig. 2.

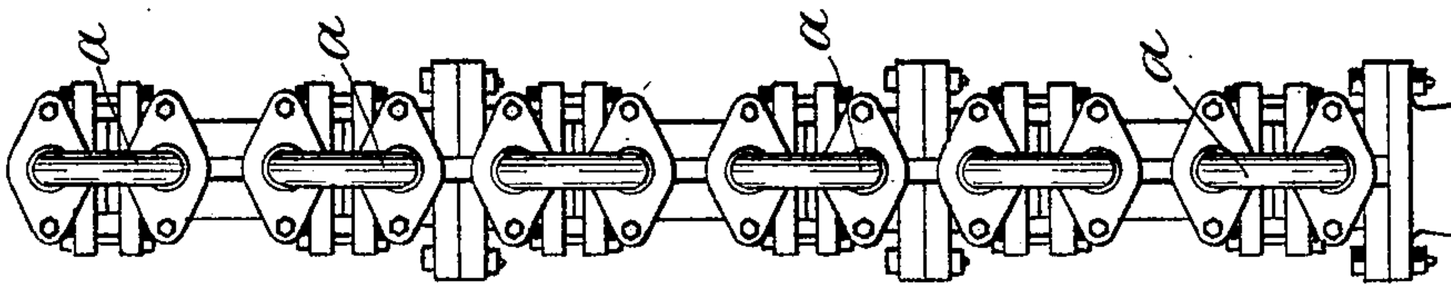

Fig. 1.

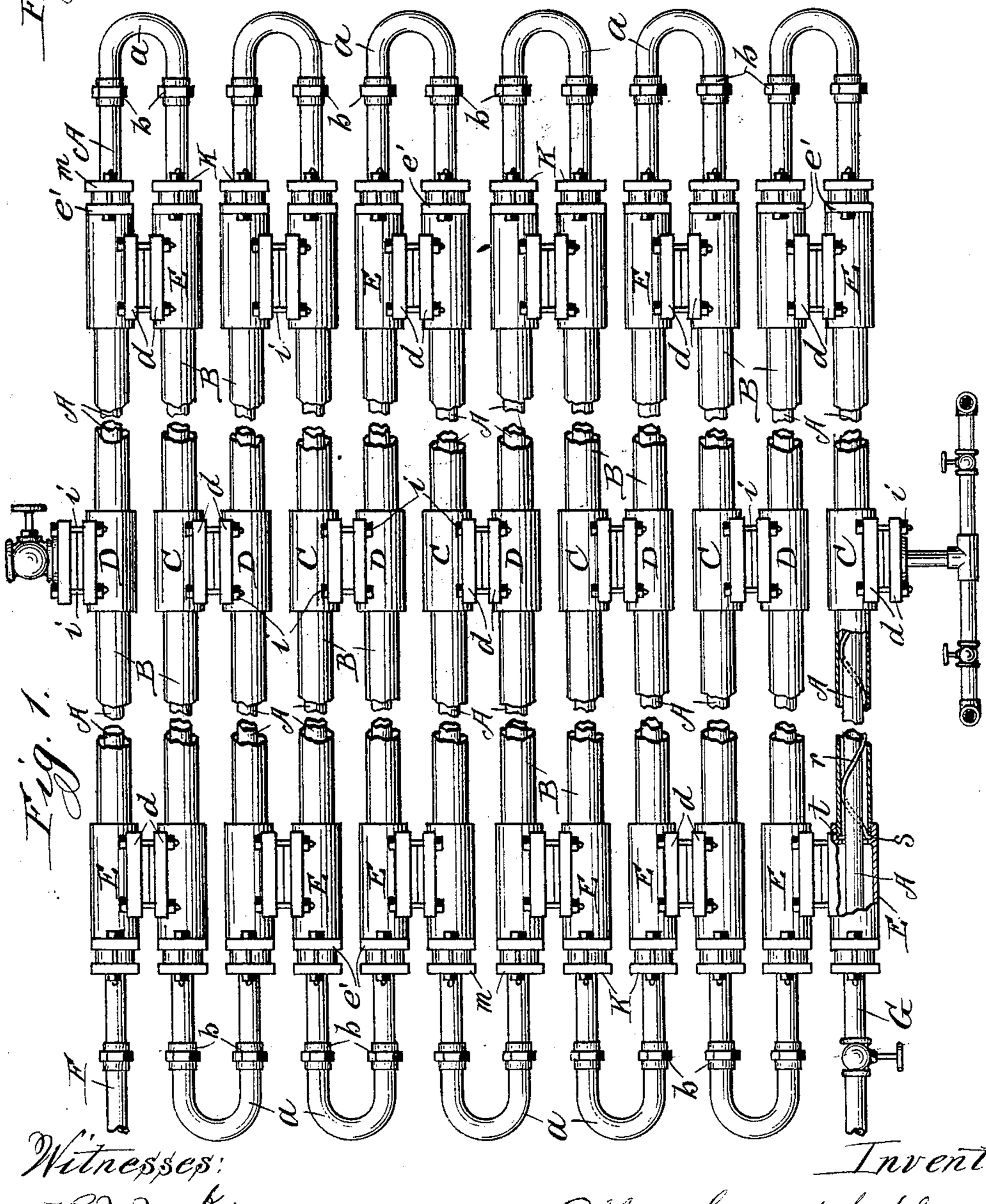

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Fig. 3.

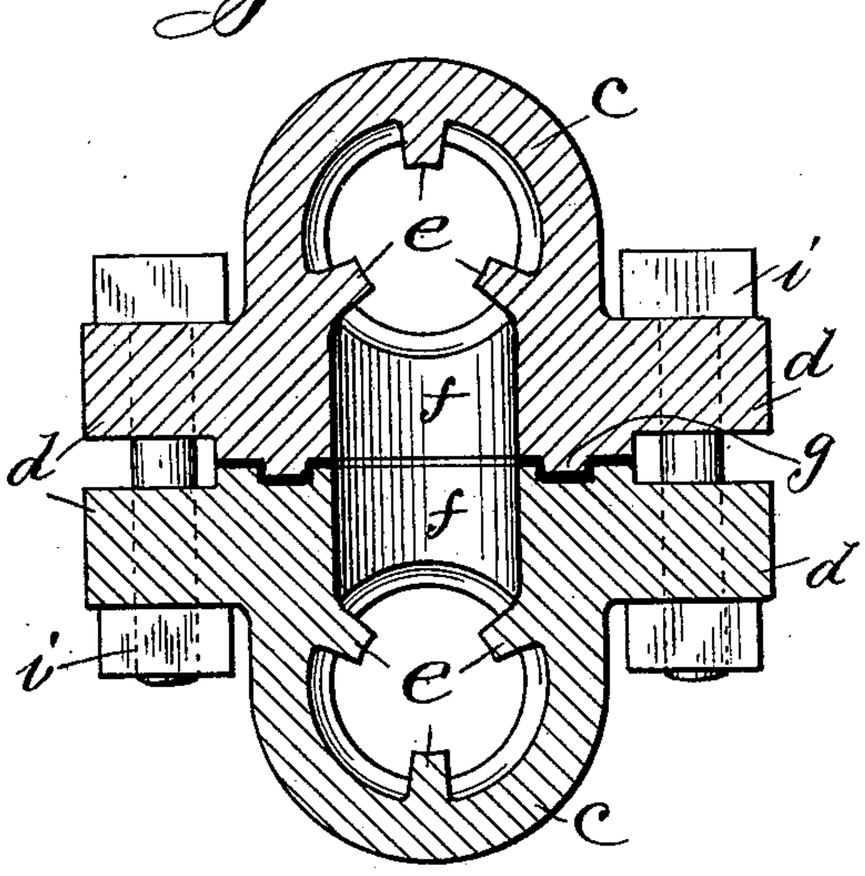


Fig. 4.

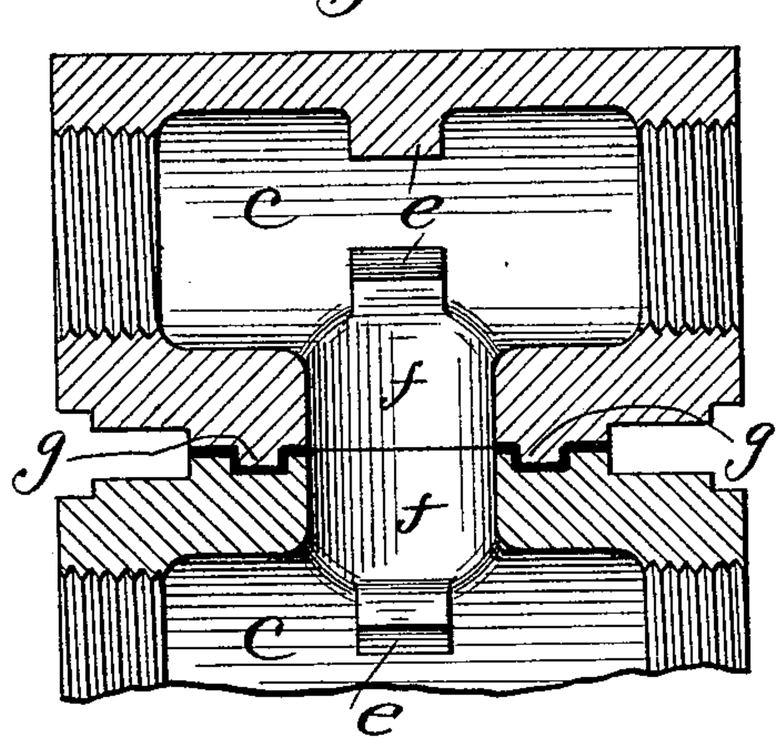


Fig. 5.

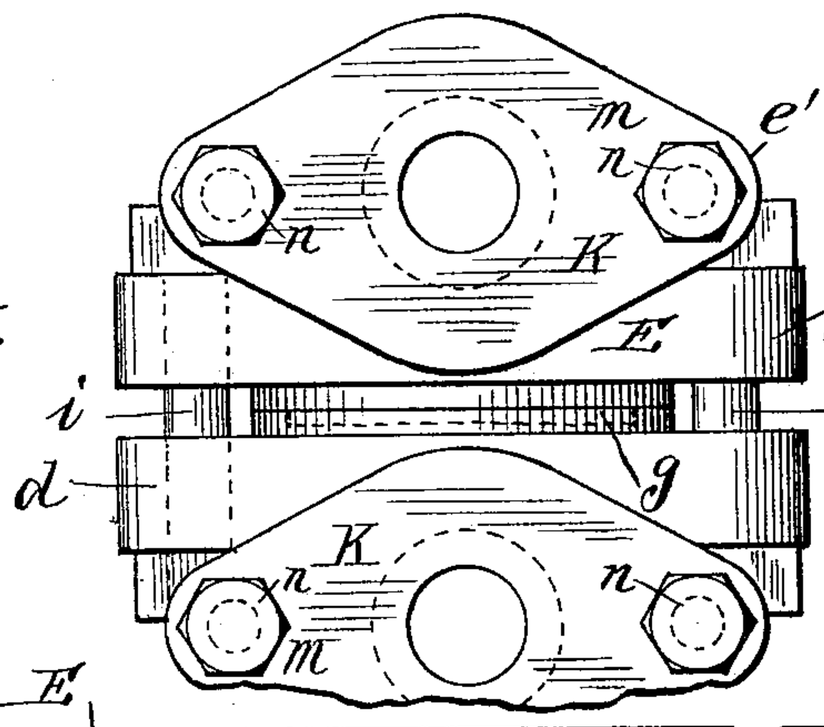
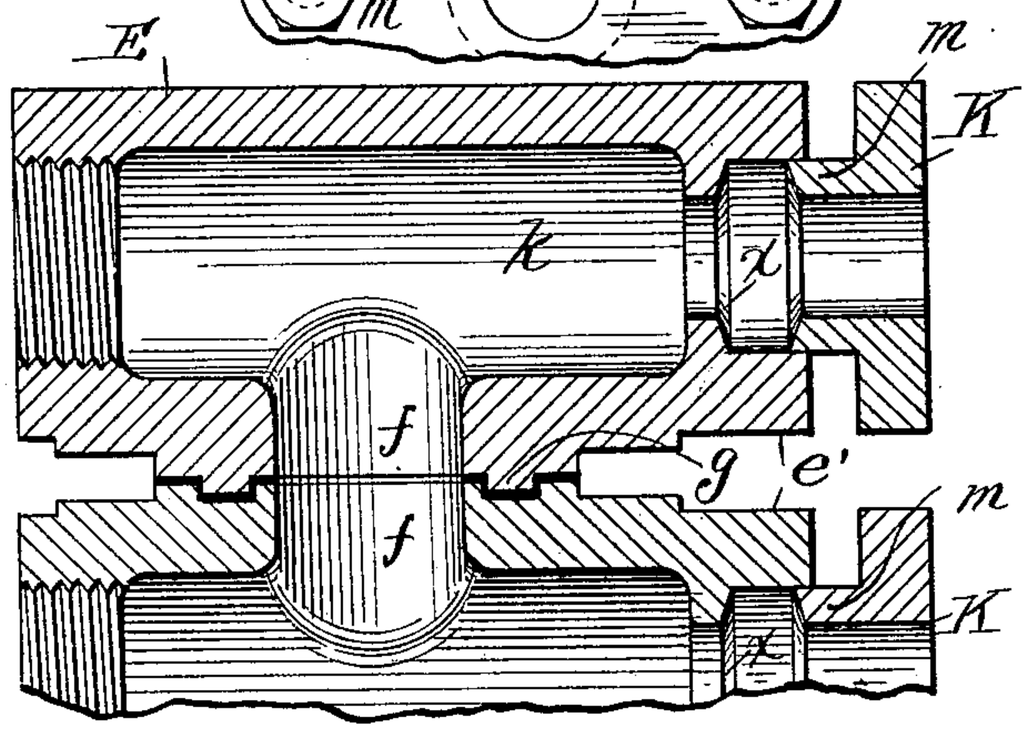


Fig. 6.



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(No Model.) 4 Sheets—Sheet 3.

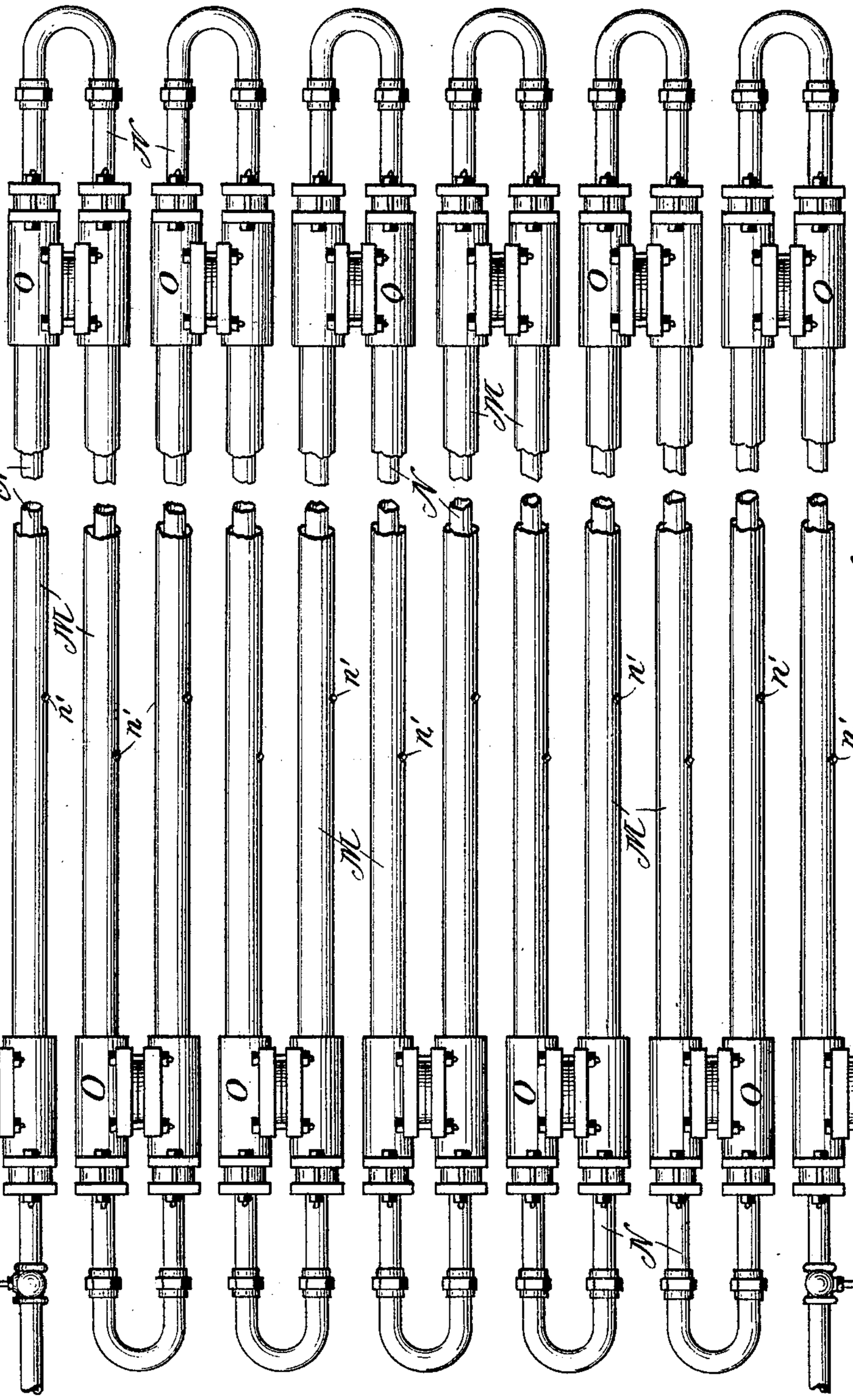

Fig. 7.

Fig. 8.

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(No Model.) 4 Sheets—Sheet 4.

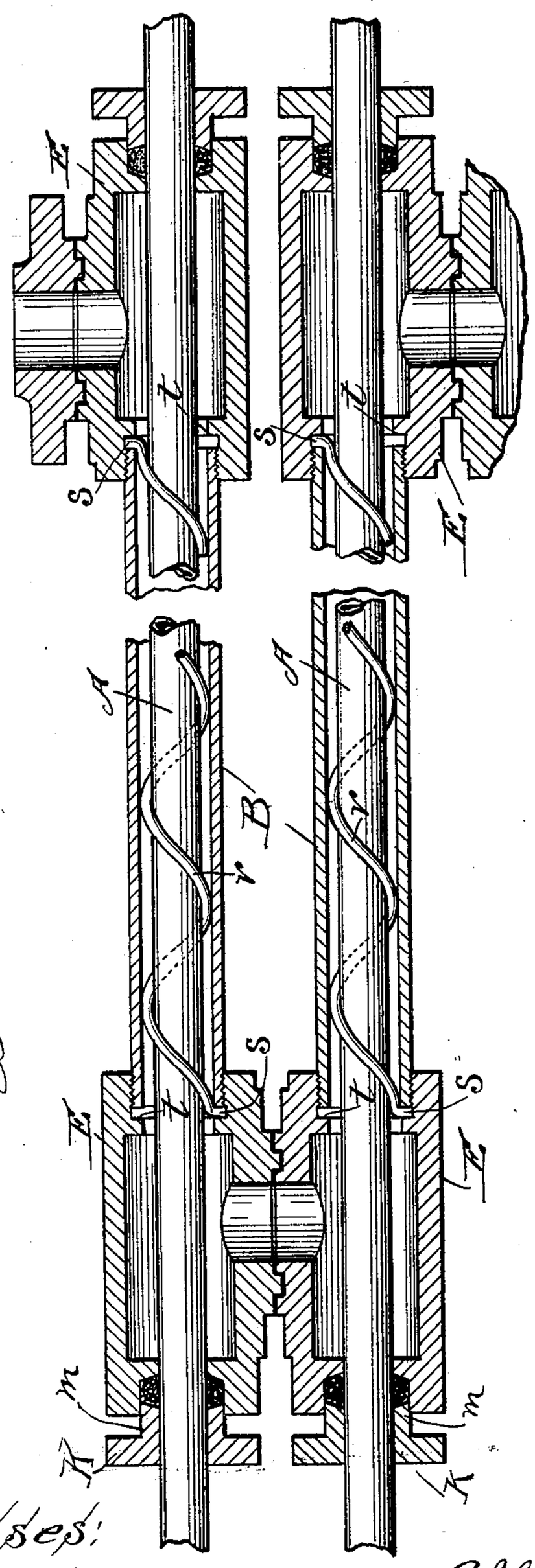

Fig. 9.

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UNITED STATES PATENT OFFICE.

ALLAN CAMPBELL, OF CHICAGO, ILLINOIS, ASSIGNOR OF ONE-HALF TO JOHN M. WESTERLIN, OF SAME PLACE.

CONDENSING-COIL FOR REFRIGERATING-MACHINES.

SPECIFICATION forming part of Letters Patent No. 635,955, dated October 31, 1899.

Application filed January 27, 1899. Serial No. 703,561. (No model.)

To all whom it may concern:

Be it known that I, ALLAN CAMPBELL, a citizen of the United States, and a resident of Chicago, Cook county, Illinois, have invented certain new and useful Improvements in Condensing-Coils for Refrigerating-Machines, of which the following is a full, clear, and exact specification, reference being had to the accompanying drawings.

The modern refrigerating-machine refrigerates by performing with a volatile gas a continual round of three functions, which are briefly known to the art as "compressing," "condensing," and "expanding."

My invention relates to the condensing apparatus or "condensing-coils," into which the gas is pumped from the compressing mechanism and from which the liquefied gas is conveyed to the "expansion-coils." The compression of the gas heats it, and it is hot when it enters the condensing-coil. Commencing at the point where the gas enters the condenser its heat is gradually absorbed by the water or other cooling medium until it is discharged as a liquid. The usual methods of condensation in which water is employed are, first, that in which the gas is passed through coils of pipe which are submerged in a tank of water; second, that in which the water falls down over horizontal coils of pipe through which the gas is forced, and, third, an old but little-used method in which the gas is forced through a pipe that is inclosed in a larger pipe serving as a water-jacket.

The object of my invention is to expose the gas in the condensing-coils to just as great an area of condensing-surface as possible by subjecting it to the cooling action of both the water and the outer atmosphere and by preventing the generation of air-bubbles on the surface of the confining-wells of the water-conduit coming next the heated gas, so as to avoid the formation of a non-conductor between the gas and water by bringing the heated gas in juxtaposition with the warmest water and the cooler gas with the cooler water and at the same time dividing the current of compressed gas when it enters the condenser, so as to expose the same to just twice the condensing-surface it has heretofore had, and thus greatly decrease the extent and dimensions of the said condensing-coils. This I accomplish by the means hereinafter fully described, and as particularly pointed out in the claims.

In the drawings, Figure 1 is a side elevation of my invention. Fig. 2 is an end elevation of the same. Fig. 3 is a detail view of central coupling in cross-section. Fig. 4 is a longitudinal section of the same. Fig. 5 is a detail view of the end coupling of my invention. Fig. 6 is a longitudinal section of the same. Fig. 7 is a side elevation of a modification of my invention. Fig. 8 is a cross-section through one of the straight sections of pipe of said invention. Fig. 9 is a longitudinal central section of a portion of a coil, showing the application of modified means for centering the inner pipe of a coil and giving a spiral movement of the gas traveling in the annular space between the pipes at the same time.

In my invention the water-pipe A, commencing with its inlet at the bottom of the coil, extends continuously without a break in horizontal stretches alternately back and forth to the top of the coil. The return-bends of this pipe A are made by elbows *a a*, which are suitably connected to the straight sections of the pipe by connections *b b*.

Between the connections *b b* the straight sections of the water-pipe are inclosed and surrounded by the pipes B, which latter are of such diameter as to leave an annular space between the same and said water-pipe through which the gas circulates. The pipes B B extend from a point near the connections *b* to near the center of length of the coil, and are there connected to the fellow section of pipe B, alining therewith, by means of a T-coupling C D, and are connected to the pipe B above or below it, as the case may be, by twin T-couplings E, located at their ends, which latter are so constructed as to furnish a communicating passage between the bores of each successive parallel pairs of said pipe B, arranged in superimposed progressions.

T-couplings C and D, which correspond in construction, consist of a cylindrical body *c*, with alining lateral flanges *d* projecting from one side thereof, as shown. The bore of these couplings is slightly reduced at each end and

screw-threaded to receive the threaded ends of pipes B, and at about its center of length it is provided with several inwardly-projecting spacing-lugs *e*, that support and retain the water-pipe extending therethrough in concentric position. The bore of these couplings is also provided at about its center of length with a transverse opening *f*, that strikes through the center of the outer plane surface produced by the flanges *d*, and its mouth of this opening *f* is surrounded by a concentric circular raised surface, which is provided with an annular tongue or tenon *g*. The couplings C, connecting the two lowermost alining sections of pipe B B and the two uppermost sections of pipe B, need not be provided with these tongues *g* and may have the opening *f* interiorly screw-threaded to receive the ends of the valve-controlled outlet-pipe F and inlet-pipe G, respectively. The remainder of these centrally-located couplings, however, are arranged in pairs C D, and each pair is so placed that the mouths of the openings *f* thereof face and communicate with each other in vertical alinement and after a lead gasket *h*, having a central opening therein, is placed between them said couplings are clamped together by suitable bolts and nuts *i*.

The twin couplings E are constructed of two T-couplings, substantially like couplings C, except that the outer end of the cylindrical body *k* thereof is provided with a lozenge-shaped flange *e'*. The outer portion of the opening in the outer end of couplings E is slightly greater in diameter than the inner portion thereof, (which latter is made just large enough for the pipe A to pass through,) and the shoulder *x* made by such increased diameter is preferably beveled slightly. The annular space thus formed is filled with suitable packing, and this packing is compressed by the circumferential flange *m* of the plate K, which is clamped to coupling E by means of suitable bolts and nuts *n*, as shown, so as to make a perfectly gas-tight joint in the outer end of said coupling. The two parts of the twin coupling are connected together in the same manner that the parts of the couplings C are, with a lead gasket of suitable shape between them.

The operation of my improved condenser-coil is very simple. The gas enters the uppermost coupling C through the inlet-pipe and then divides, one half of its volume going to the right and the other half to the left through the alining pipes B. The main body of the divided currents of gas continue to travel to and from the outer couplings E on that half of the condenser into which it originally entered and passes in transit through pipe B to said twin coupling, then through said coupling to and through the next lower pipe B back to the coupling C D, through which it passes to the next lower pipe B, and so on back and forth to the lowermost central coupling C, from whence the products of condensation drain through the outlet-pipe on the way to the expansion-coil. The result of this construction is that the gas as it circulates in the annular space between the water-pipe and the gas-pipe is subject to the condensing qualities of the water within and air without and has twice the condensing-surface it could possibly get in any other way, and in addition to this great advantage should the condensation proceed faster on one side of the central couplings than on the other the free communication between said halves permits the pressure to adjust itself, so that at all times a steady even pressure is maintained in the coils.

Fig. 7 of the drawings illustrates a modification of my invention, which shows the adaptation of my improvements as a refrigerating-coil. This refrigerating-coil consists of a continuous coil of pipe N, through which brine or some other suitable incongealable liquid is circulated and which has its inlet at the upper end and its outlet at the lower end. The straight stretches of this coil N are inclosed between the return-bends thereof by sections of pipe M of larger diameter. The ends are connected to T-couplings O, similar in every respect to couplings E of the condenser-coils heretofore described. Two of these couplings O connect the sections of pipe M with the fellow section above it at one end and with the fellow section below it at the other end, and thus form a gas-tight conduit for the liquid-feed from the condenser, which is drawn into it through the single coupling secured to the end of the lower section of pipe M adjacent to the outlet of pipe N and is sucked out of it from the coupling O next the inlet of said pipe N by the compressor. In the place of a central coupling similar to C of the condenser-coil, which is dispensed with in the refrigerator-coil, I can, if desired, employ set-screws or pegs *n*, which are driven radially into pipe M, preferably from below, at suitable distances apart, so as to support and center the pipe N in said outer pipe M.

It is obvious that instead of employing but two half-sections in the construction of the condenser-coil, through each of which separate currents of gas are forced, any multiple of the same could be used, and the same thing can also be claimed with regard to the refrigerating-coil.

In Fig. 9 of the drawings I show means which when used in connection with my improvements avoids the necessity of the spacing-lugs *e* of the couplings C D and increases the travel of the gas in transit through the coils. This consists simply of a wire *r* of sufficient diameter, the ends *s s* of which are bent outward and clamped between the ends of pipes B and the shoulder *t* of the countersunk screw-threaded mouths of couplings E, into which said pipes B are tapped. The remainder of the length of the wire *r* is wound upon and pursues a spiral course around pipe A between said couplings E and effectually pre-

vents the inner pipe A coming in contact with the outer pipe B and causes the gas to take a spiral course, so that through a given length of coil it has to travel a much greater distance than it would without the wire. This wire *r* can be used either with the couplings C D having the spacing-lugs *e* or with such couplings not possessing such lugs *e* and can be used either in the condensing-coil, as shown in Fig. 1 of the drawings, or in a refrigerating-coil.

What I claim as new is—

1. The combination in a condenser-coil with a continuous water-pipe coil, of straight sections of gas-pipe surrounding the straight sections of said water-pipe between the return-bends thereof; the top section of said gas-pipe having an intake between its ends and the bottom section thereof having an outlet between its ends; and each of the intermediate sections of gas-pipe communicating at its ends with a companion section on one side and at a suitable point between its ends communicating with the companion section on the other side of it.

2. The combination in a condenser-coil with a continuous water-pipe coil, of a gas-pipe surrounding the straight portions thereof that has its gas-intake located between the ends of the top section thereof and its outlet between the ends of the lower section thereof, and each section of which is connected at its ends and at a suitable point between its ends so that the gas is divided into two oppositely-moving currents each of which travels back and forth to said outlet in that end portion of the condenser into which it originally passed.

3. The combination in a condenser-coil for refrigerating-machines with a continuous water-pipe coil A, of sections of gas-pipe B two of which surround the greater portion of each straight part of coil A, T-couplings C connecting each two alining sections of gas-pipe and connected with the corresponding coupling of the next adjacent parallel alining sections of gas-pipe on one side, and T-couplings E on the outer ends of said sections of gas-pipe connected with the corresponding coupling E on the ends of the next adjacent parallel alining section of pipe B on the other side of it, as and for the purpose set forth.

4. The combination in a condenser-coil of a refrigerating-machine with a continuous water-pipe coil A, of sections of gas-pipe B two of which surround the greater portion of each straight part of coil A, T-couplings C having inwardly-projecting spacing-lugs for centering said water-pipe and connect the two alining sections of gas-pipe and connect with the corresponding coupling C of the next adjacent parallel alining sections of pipe B on one side, and T-couplings E having inwardly-projecting spacing-lugs for centering the water-pipe passed therethrough secured to the outer ends of said sections of gas-pipe, which connect with the corresponding coupling E on the end of the next adjacent parallel alining section of pipe B on the other side as and for the purpose set forth.

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