(No Model.) 2 Sheets—Sheet 1.

G. P. SCHNEIDER.

PUMPING APPARATUS FOR GAS, AIR, WATER, &c.

No. 521,675. Patented June 19, 1894.

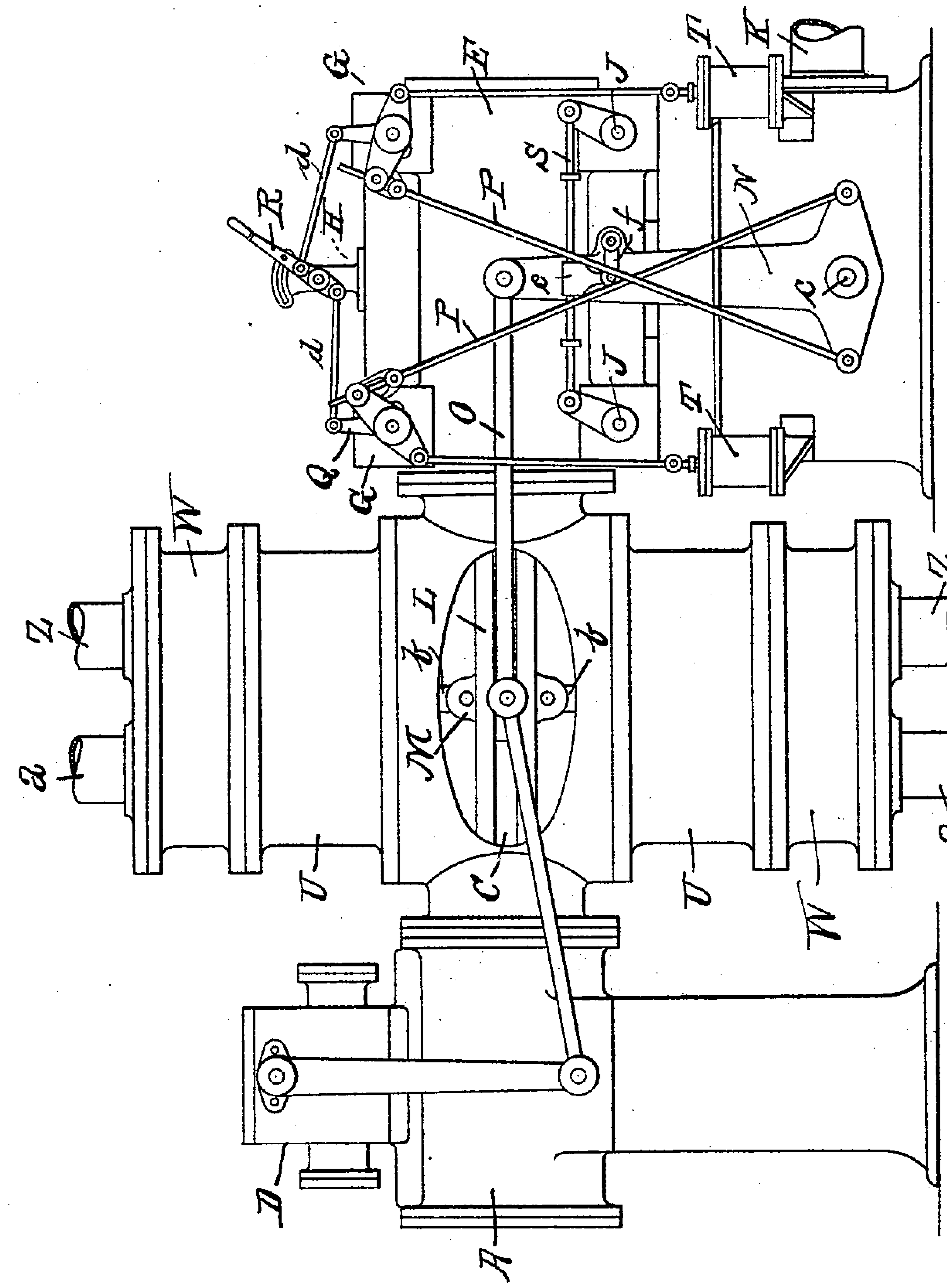

Fig. 1.

George P. Schneider
Inventor

by James W. See
Attorney

Witnesses:
M. S. Belden
P. P. Sheehan

(No Model.) 2 Sheets—Sheet 2.

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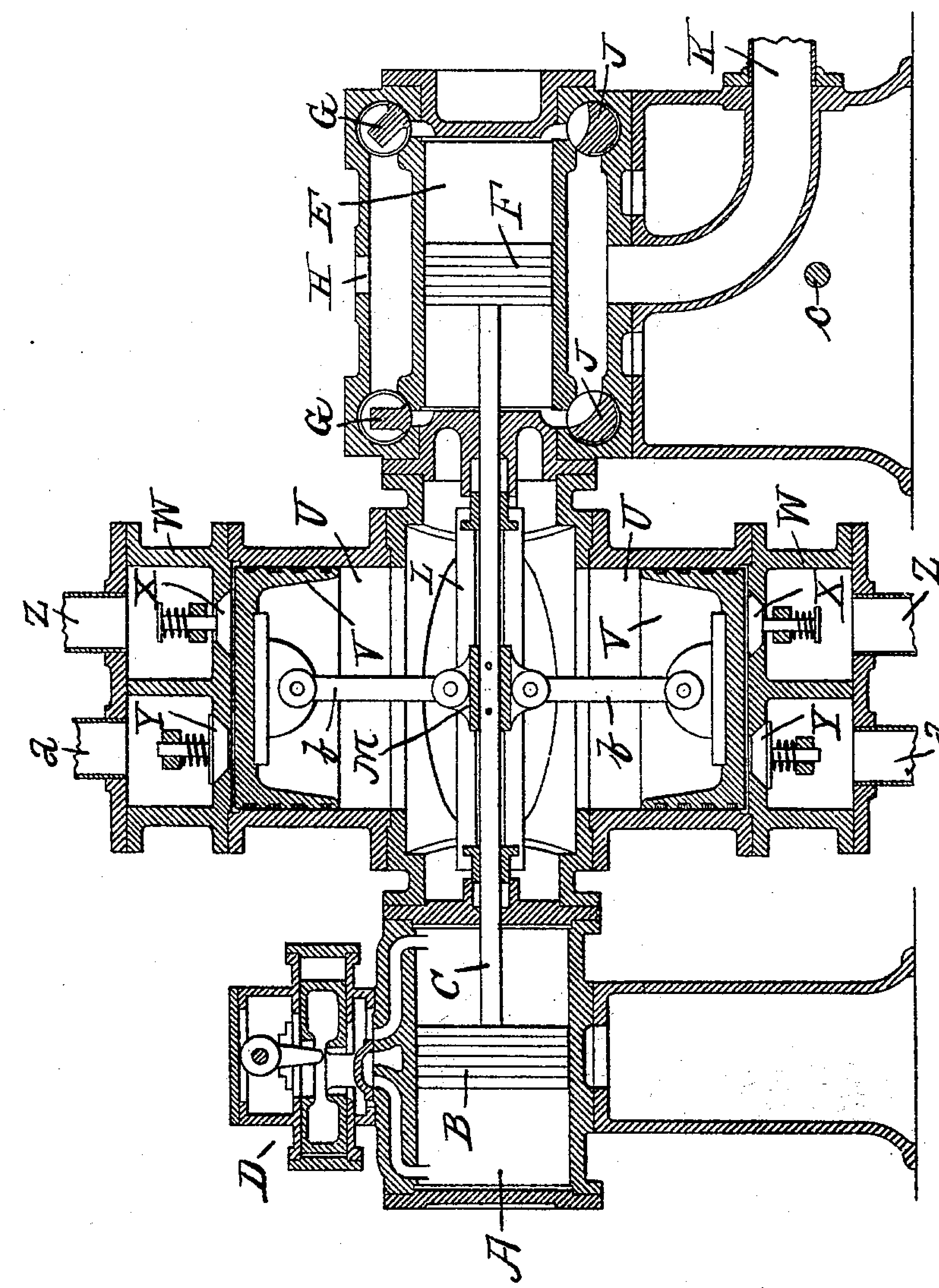

Fig. 2.

George P. Schneider

Witnesses:

W. S. Belden

P. P. Sheehan

Inventor

by James W. See

Attorney

THE NATIONAL LITHOGRAPHING COMPANY,
WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

GEORGE P. SCHNEIDER, OF CLEVELAND, OHIO.

PUMPING APPARATUS FOR GAS, AIR, WATER, &c.

SPECIFICATION forming part of Letters Patent No. 521,675, dated June 19, 1894.

Application filed February 11, 1893. Serial No. 461,937. (No model.)

To all whom it may concern:

Be it known that I, GEORGE P. SCHNEIDER, of Cleveland, Cuyahoga county, Ohio, have invented certain new and useful Improvements in Pumping Apparatus for Gas, Air, Water, &c., of which the following is a specification.

This invention pertains to improvements in apparatus for pumping air, water, gas, &c., and for utilizing expanding air and gas, &c.

My improvements will be readily understood from the following description taken in connection with the accompanying drawings, in which—

Figure 1, is a side elevation of a machine exemplifying my present improvements; and Fig. 2, a vertical central longitudinal section thereof.

In the drawings:—A, indicates the steam cylinder of the actuating engine: B, the piston thereof: C, the piston-rod thereof: D, the valve mechanism thereof, to be of any usual or suitable character, the drawings showing an ordinary type of direct acting steam valve gear: E, an expansion cylinder with its axis in line with that of the steam cylinder A: F, the piston of the expansion cylinder, on same rod with steam piston B: G, inlet valves for the expansion cylinder, of the Corliss type: H, inlet connection for expansion cylinder: J, exhaust valves of the expansion cylinder of the Corliss type: K, discharge pipe of expansion cylinder: L, crosshead guides, parallel with piston-rod C, between the steam cylinder and the expansion cylinder: M, a crosshead fast on piston-rod C and working in the crosshead guides: N, a vertical rocker alongside the expansion cylinder and pivoted at its base: O, a link connecting the upper end of this rocker with the crosshead M: P, valve-rods extending from arms at the base of the rocker N up into communication with the inlet valves G of the expansion cylinder through the medium of such release gear as is usually employed in valve gearing of the Corliss type: Q, arms of the usual releasing cams of the inlet valves: R, a hand-lever pivoted adjustably to the expansion cylinder and connected by rods *d* with cam arms Q whereby those cam arms may be fixed in adjusted positions of release action: S, a rod connecting the arms of the two exhaust valves J, this rod extending across the rocker N and being provided with tappet collars: T, dash-pots for closing the valves G, upon release of their gear: U, two compression cylinders with their axes in one line at right angles to the axial line of the steam and expansion cylinders, one compression cylinder being above and the other below the axis of the steam and expansion cylinders: V, a piston in each of these compression cylinders: W, valve chests for these compression cylinders: X, inlet valves for the compression cylinders: Y, outlet valves for the compression cylinders: Z, inlet pipes for the compression cylinders: *a*, outlet pipes for the compression cylinders: *b*, links connecting crosshead M with the compression pistons V: *c*, pivot of the rocker N: *d*, the links which connect hand-lever R with the releasing cams Q: *e*, a tappet loose on the rod S and moving with the rocker N: and *f*, a link connecting tappet *e* with rocker N.

Ignore, for the present, the presence of the compression cylinders U. Assume that the apparatus is to be used in a compressed air refrigerating system to form the expansion machine therefor. Assume the air to have been compressed and then cooled and ready for regulated expansion into a refrigerating chamber. Assume the compressed and cooled air to enter the expansion cylinder at H, and that, after expansion, it departs at K to the refrigerating chamber. Rocker N takes its motion from the movement of piston B. Assume piston F to be at the left-hand end of its stroke in Fig. 2 and ready to move to the right. At this instant the left-hand discharge valve is closed and the left-hand inlet valve is full open. The piston starts to the right, cooled compressed air flowing into the cylinder behind it. Early in the stroke the left-hand release cam becomes effective and the left-hand inlet valve is quickly closed by its dash-pot. This leaves a given quantity of cooled compressed air behind the piston F. The piston continues its motion to the right and the confined air behind it expands. When the piston has finished its stroke to the right then the left-hand discharge valve opens and the expanded air flows from the expansion cylinder through K to the refrigerating chamber, the degree of expansion having been measured by the proportion of piston stroke at time of inlet-valve release to the whole stroke. This proportion, and consequently the degree of expansion, can be regulated by adjusting hand-lever R, which puts the release cams Q in any desired position to effect the closure of the inlet valves G at any desired point in the stroke. The discharge of the expanded air continues during the return stroke of the piston to the left until the piston is again at the left-hand end of its stroke when the operation is repeated. While the piston was making its stroke to the right, the left-hand discharge valve being closed, the right-hand discharge valve was open, the air at the right of the piston being discharged. The two ends of the cylinder work the same, one discharge valve being closed while the other discharge valve is open, and one inlet valve being closed while the other inlet valve is open early in the stroke and closed later. In other words, as the piston moves to the right the left-hand discharge valve is closed and the left-hand inlet valve open for a time and then closed, the right-hand discharge valve being open and the right-hand inlet valve closed throughout the stroke.

We have thus far ignored the compression cylinders U and have assumed that the compressed air received by the expansion cylinder was compressed by any proper sort of compressor which compressed the air and then delivered it, through a cooler, to the expansion cylinder. The compression cylinders U are designed to form the compression apparatus in such a system.

Links *b* form toggle elements and it is obvious that when piston B is at the beginning of its stroke, pistons V are at the inner ends of their strokes, and that piston B, in making its stroke, causes the pistons V to make their full outward stroke and return again to their inward position, each single stroke of piston B therefore producing a complete double stroke of each compression piston V.

Assume pipes Z to be connected with the source from which the air to be dealt with is to be taken, say the atmosphere, or the refrigerating chamber in case the spent dry air therein is to be employed. Assume pipes *a* to lead to the cooler which is to cool the compressed air before it goes to the expander. Then, at each complete double stroke of pistons V, air will be drawn in through Z and compressed in cylinders U and forced out through *a*. The greatest resistance offered by the pistons V, by the air being compressed, will be at the extremes of their outward strokes. At this point in their strokes the toggle-links *b* are acting under the most favorable conditions, great travel of the crosshead representing comparatively small travel of pistons V. When piston B has reached its mid-stroke and thus accomplished the work of compression in cylinders U, the work in the cylinders U ceases, the pistons V moving inward without doing work, thus permitting piston B to perform the last half of its stroke without doing work in the compression cylinders U. Thus it will be seen that the system is favorable to the use of steam expansively in cylinder A, the greatest amount of work being called for at the beginning of the stroke of the steam piston when the steam pressure is the highest, the work to be done lessening as the pressure of the steam lessens by expansion in cylinder A. The conditions are also most favorable to the utilization of the forces acting in the expansion cylinder.

In a compressed air refrigerating system the apparatus may be employed in the complete form indicated, the compression cylinders discharging their product to the cooler from which it comes back to the expansion cylinder from which it goes to the refrigerating chamber.

Where the apparatus is to be used in an ammonia ice system the expansion cylinder may be omitted, and similarly when the apparatus is used for ordinary air compressing purposes.

I claim as my invention—

The combination, substantially as set forth, of a steam cylinder and an expansion cylinder arranged in a common line, a piston-rod common to both of said cylinders, a crosshead on said rod, a guide for said crosshead, a pair of compression cylinders in a common axial line at right angles to said guide, inlet and outlet valves for said compression cylinders, a piston in each of said compression cylinders, and toggle-links connecting the pistons of the compression cylinders with said crosshead.

GEORGE P. SCHNEIDER.

Witnesses:
CHARLES F. MORGAN,
ALBERT H. ATWATER.