(No Model.)

G. METZGER.

COMPOUND COMPRESSOR.

No. 411,252. Patented Sept. 17, 1889.

Fig. 1.

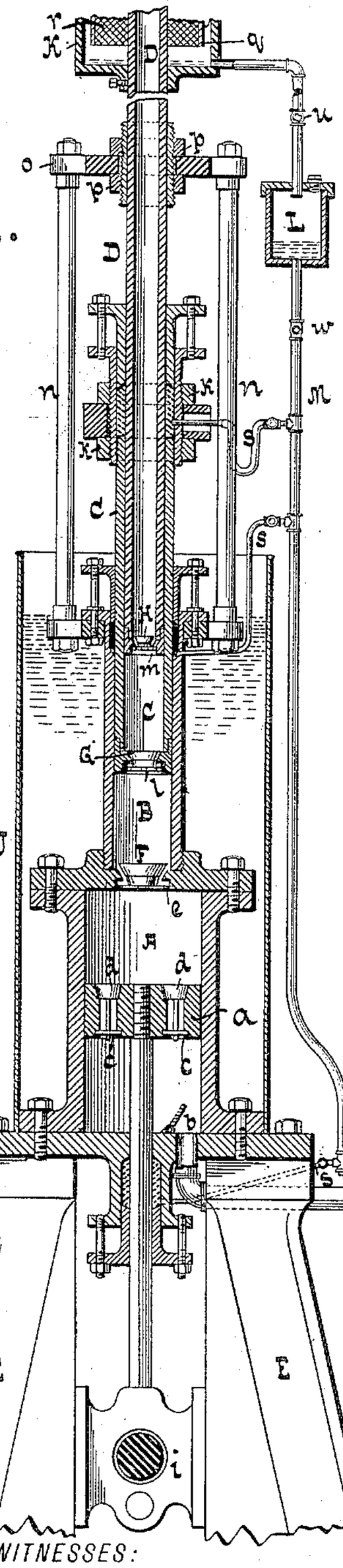


Fig. 3.

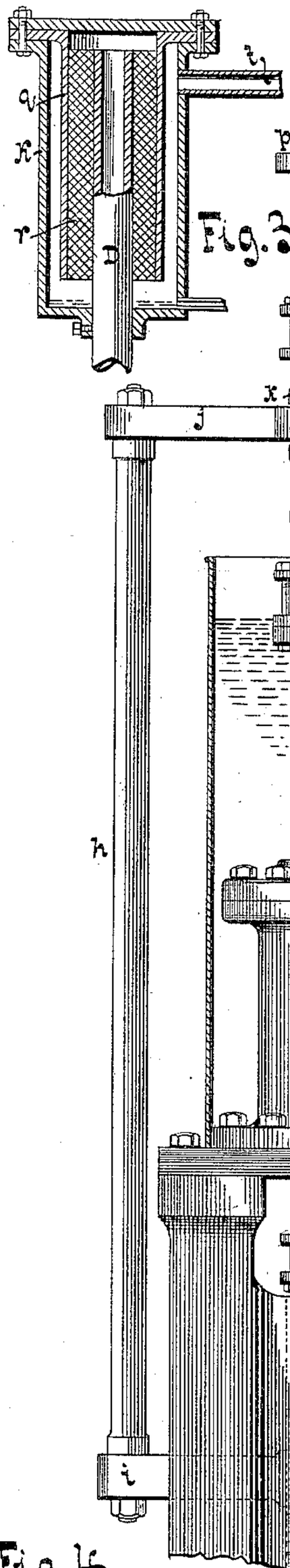
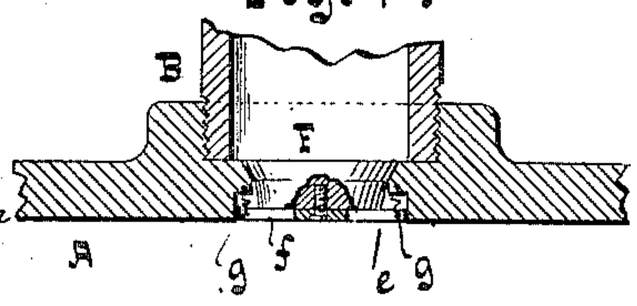


Fig. 2.

Fig. 4.



WITNESSES:

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UNITED STATES PATENT OFFICE.

GUSTAV METZGER, OF NEWARK, NEW JERSEY.

COMPOUND COMPRESSOR.

SPECIFICATION forming part of Letters Patent No. 411,252, dated September 17, 1889.

Application filed November 19, 1888. Serial No. 291,267. (No model.)

To all whom it may concern:

Be it known that I, GUSTAV METZGER, a citizen of the United States, and a resident of Newark, in the county of Essex and State of New Jersey, have invented a new and useful Improvement in Compound Compressors, of which the following is a specification.

My invention relates to improvements in compound gas-compressors, and has for its object to reduce, as far as possible, the total clearance in such structures. To this end I arrange the cylinders in line and place the valve-passages in the ends of the cylinders, pistons, or plungers, the valves being so arranged as to nearly fill up such passages in the cylinders, pistons, or plungers, as fully pointed out in the following specification and claims, and illustrated in the accompanying drawings, in which—

Figure 1 represents a vertical section of my improved compressor arranged for triple compression. Fig. 2 is a side elevation thereof. Fig. 3 is a sectional elevation of the filter for the compressed gas. Fig. 4 is an enlarged sectional view of one of the valves.

Similar letters indicate corresponding parts.

In the drawings, the letters A and B designate two stationary cylinders. C is a reciprocating hollow plunger, and D is a stationary discharge-pipe, all arranged in line.

The lower cylinder A is supported on a suitable frame E and contains a reciprocating piston *a*, which may be actuated by any of the usual means. The lower head of the cylinder A is provided with one or more air-inlets *b*, which may have suitable valves; but such valves are not essential under all circumstances. The piston *a* has transverse passages *c*, provided with upwardly-opening valves *d*, which, when closed during the upward stroke of the piston, lie flush with the upper face of the piston. The piston-rod is so adjusted that at the end of the upward stroke the upper surface of the piston *a* and valves is as close to the cylinder-head as to leave substantially no clearance.

The upper cylinder-head contains a passage *e*, closed by a valve F, as shown on a larger scale in Fig. 4. The valve F, when closed, almost entirely fills the passage *e*. It has at its bottom a spider *f*, which plays in corresponding recesses. Suitable springs *g* may be used to facilitate the action of the valves.

The cylinder B is connected with the head of the cylinder A in any suitable manner and contains the hollow plunger C, which at the same time forms the third cylinder, for which reason I have termed it the "plunger-cylinder." A reciprocating motion corresponding to that of the piston *a* is imparted by any suitable means to this plunger-cylinder C—for instance, as shown in the drawings—by connecting it with the cross-head of the piston by rods *h h* and bridges *i j*.

The position of the plunger-cylinder can be adjusted on the bridge *j* by means of nuts *k*, so that when on its extreme downward stroke the clearance shall be reduced to a minimum. The plunger-cylinder C has at its lower end a valve-closed passage similar to the valve-closed passage of the cylinder A, said valve and passage being respectively designated by the letters G and *l*.

The discharge-pipe D is stationary and forms the plunger for the reciprocating cylinder C. Its lower end is provided with a passage *m* and valve H, similar to the passage and valve of cylinder A. In the example shown in the drawings the discharge-pipe D is held stationary by means of rods *n n*, fastened to lugs on the cylinder B and a bridge *o*. The stationary plunger or discharge-pipe is adjusted within the bridge by means of nuts *p p* so as to reduce the clearance to a minimum.

The general operation of the apparatus is as follows: When air is to be compressed, it is admitted through the inlet or inlets *b* in the lower part of the cylinder A during the upward stroke of the piston *a*. If other gases are to be compressed, they are carried to the inlets by means of a suitable pipe or pipes, as I. During the downward stroke of the piston *a* the gas passes through the piston to the upper part of the cylinder A without being compressed. On the next upward stroke the piston *a* forces the gas into the cylinder B, which is of smaller diameter than the cylinder A, and in which the plunger-cylinder C is moving upward with the piston. Consequently when the piston *a* and the plunger cylinder

C are in their extreme upward positions, substantially all of the gas has been forced into the second cylinder B and is compressed correspondingly to the reduced area of the smaller cylinder. When the plunger-cylinder C is on its downward stroke, a second compression is effected by transferring the gas from the cylinder B into the hollow part of the plunger-cylinder C, which necessarily is of a smaller diameter. On the upward stroke of the plunger-cylinder C the gas is subjected to a third compression by being forced into the discharge-pipe D, the degree of compression in this case depending upon the back-pressure maintained in the discharge-pipe. To abstract the heat produced by compression, the first two cylinders A and B may be surrounded by a tank or water-jacket J, through which a circulation of water may be maintained. For the upper parts of the apparatus water-cooling is not essential, the transmission of heat through the metal being sufficient.

I have found that in carbonic-acid compressors and in other compressors impurities—such as lubricating-oil from the stuffing-boxes—are carried off with the compressed gas. To separate them from the gas, I pass the discharge-pipe D into a vessel K, its upper end terminating near the top thereof. Within this vessel a flanged cylinder *q* is suspended so as to surround the discharge-pipe. It extends to near the bottom of the vessel and is filled with a filtering material *r*, which may be wire-cloth or other suitable substance. The gas is thus forced to pass through this filtering material, which causes the particles of oil to unite and drop into the lower part of the vessel K, whence they are carried to an oil-cup L, from which the oil is distributed to the various stuffing-boxes through a main pipe M and branch pipes *s s*, having suitable valves. The branch for the movable stuffing-box is movable or jointed, or a separate oiler is provided for the same. Whenever necessary the oil-cup can be provided with fresh oil through a suitable opening closed by a plug. While introducing fresh oil into the cup the valves *u* and *w*, placed respectily above and below the cup, are closed. The gas after passing through the filtering material passes upward through the space between the vessel K and the inner cylinder *q* and is carried off by a pipe *t*.

When two compressions only are required, the valves of the piston *a* and of the lower head of the cylinder A may be removed—in fact, by omitting the whole of the cylinder A with its piston the operation of the apparatus is reduced to duplex compression.

In practice, when compressing to a very high degree, I prefer to use steel in the construction of the cylinders as far as permissible.

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

1. In a triple-compression machine, a first fixed cylinder A, containing a reciprocating piston provided with a valved transverse passage *c* and having a cylinder-head provided with a valved passage *e*, a second cylinder B, of smaller diameter, supported upon said cylinder-head and communicating with the first cylinder through the valved passage *e*, a stationary discharge-pipe D, with a valved passage *m* at its lower end, and a reciprocating plunger-cylinder C, with a valved passage at its lower end, said plunger-cylinder forming the plunger for the second cylinder B, and also forming a reciprocating cylinder, for which the discharge-pipe D forms a stationary plunger, substantially as described.

2. The combination, with the discharge-pipe of a gas-compressor, of an outer vessel K, closed at its upper end, and into which vessel the discharge-pipe extends to near the upper end thereof, an inner hollow cylinder *q*, surrounding the discharge-pipe and forming therewith a space for the reception of the filtering material, an outlet near the upper end of the vessel K for the passage of the gas, and an outlet near the bottom of the vessel for the passage of the oil, substantially as described.

3. In a gas-compressor, the combination, with the discharge-pipe, of an outer vessel K, closed at its upper end, and into which vessel the discharge-pipe extends to near the upper end thereof, an inner hollow cylinder surrounding the discharge-pipe and forming therewith a space for the reception of the filtering material, an outlet near the upper end of the vessel K for the passage of the gas, an outlet near the bottom of the vessel for the passage of the oil, an oil-cup connected with the latter passage, and a distributing-pipe leading from the oil-cup, substantially as described.

In testimony that I claim the foregoing as my invention I have signed my name, in presence of two witnesses, this 12th day of November, 1888.

GUSTAV METZGER.

Witnesses:
JOHN OTTO,
WILLIAM BENEDICT.