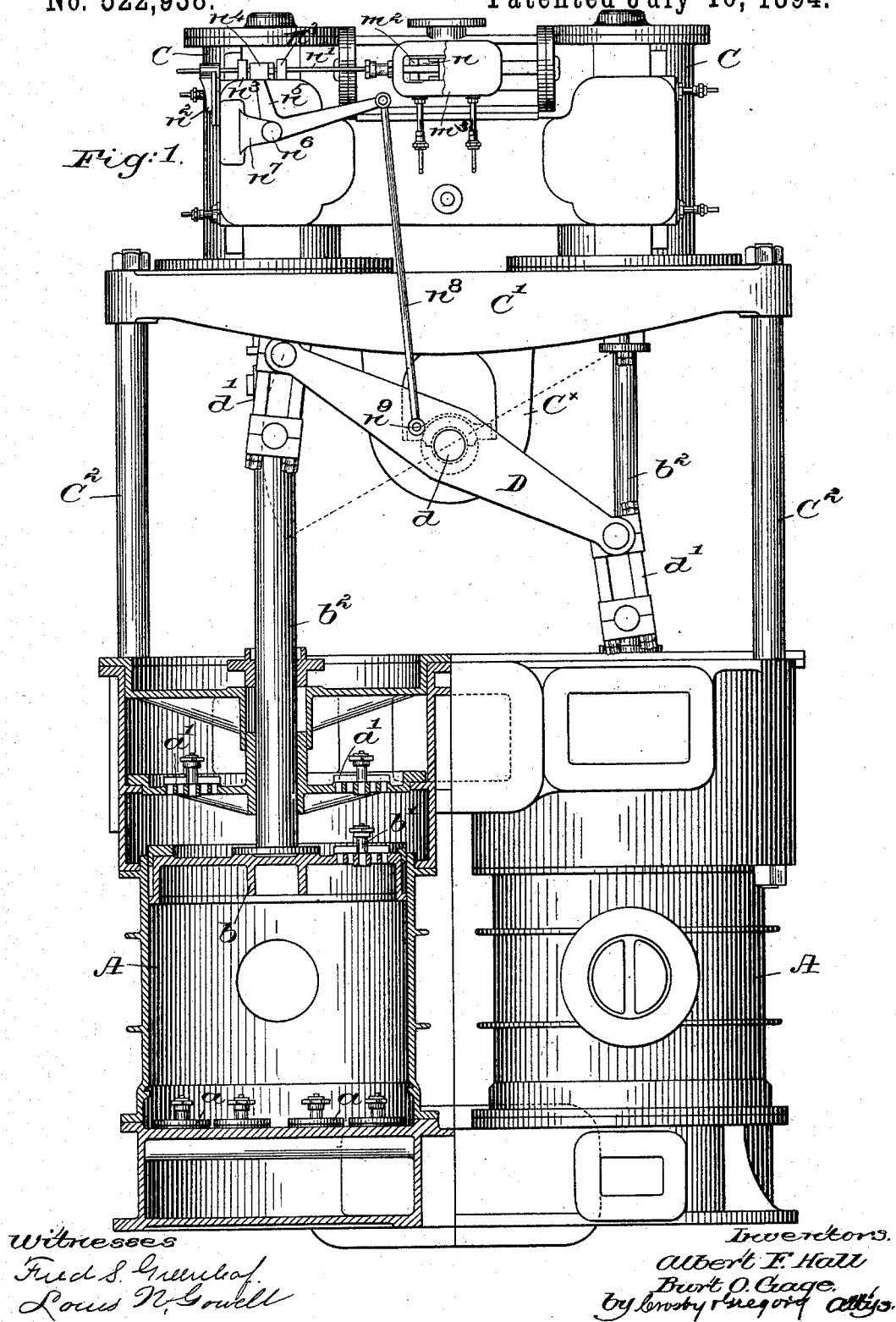


3 Sheets—Sheet 1.

No. 522,938.

Patented July 10, 1894.

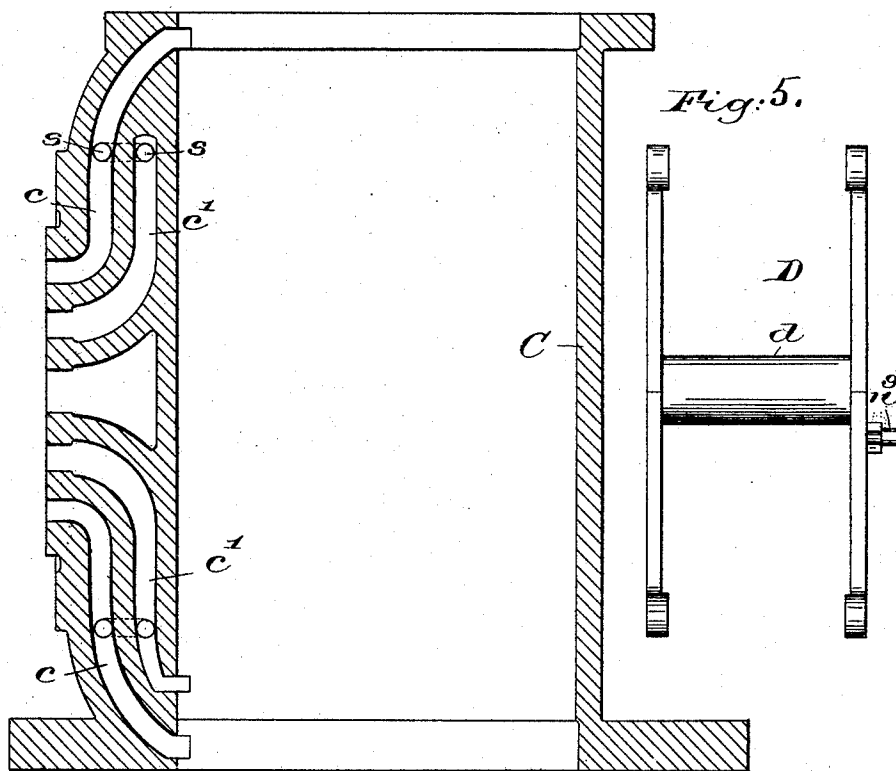
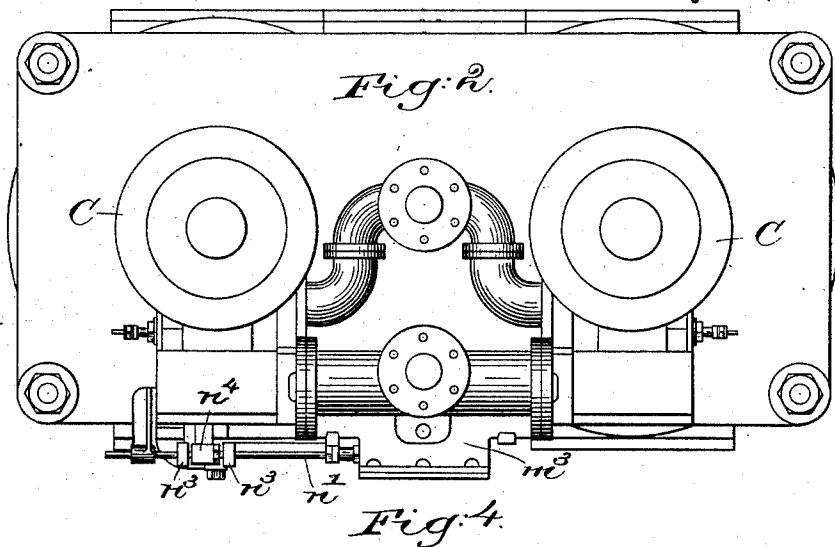
(No Model.)

3 Sheets—Sheet 2.

A. F. HALL & B. O. GAGE.  
PUMPING ENGINE.

No. 522,938.

Patented July 10, 1894.



Witnesses.

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(No Model.)

3 Sheets—Sheet 3.

A. F. HALL & B. O. GAGE.  
PUMPING ENGINE.

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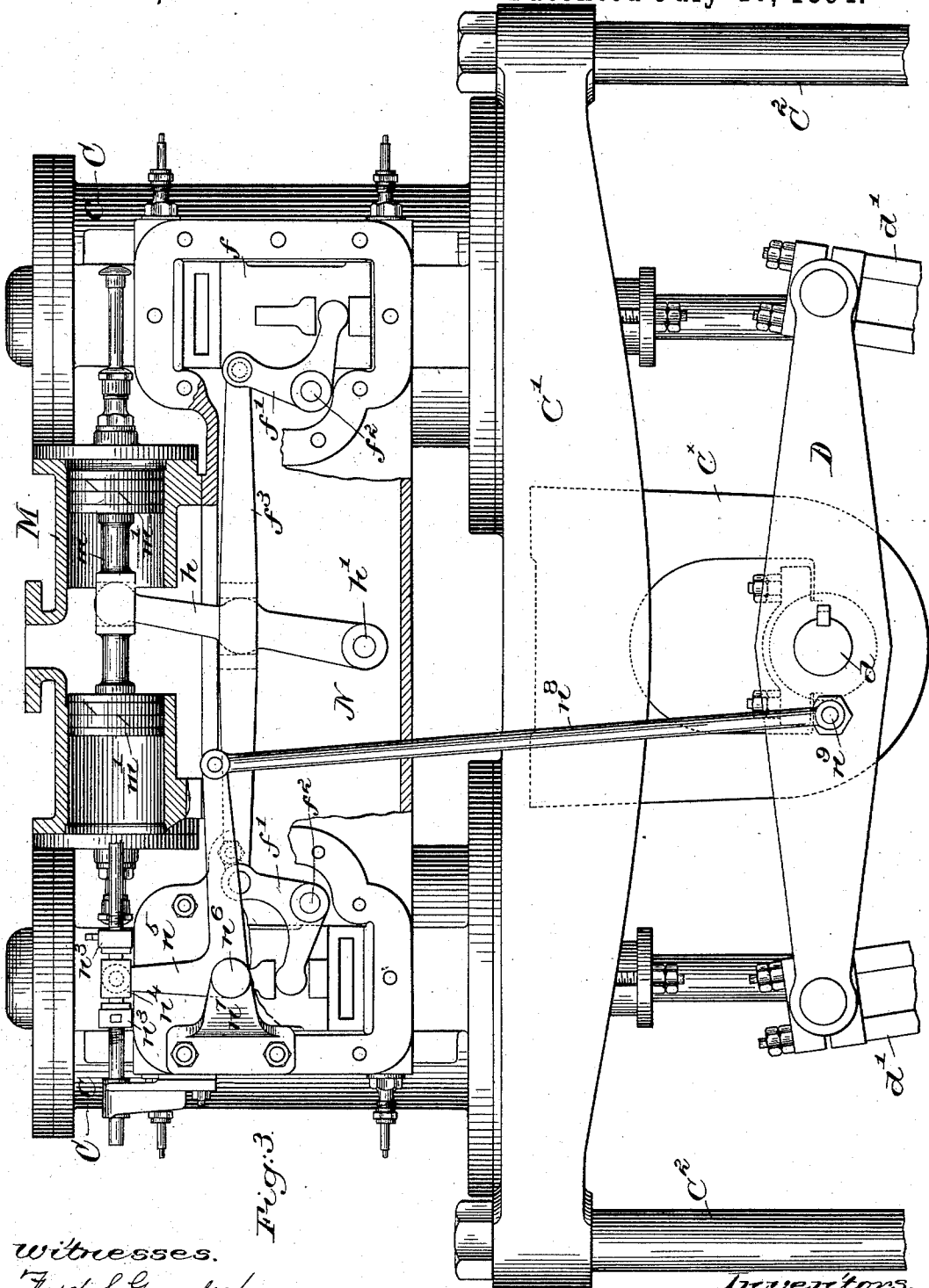


Fig. 3.

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# UNITED STATES PATENT OFFICE.

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## PUMPING-ENGINE.

SPECIFICATION forming part of Letters Patent No. 522,938, dated July 10, 1894.

Application filed June 10, 1892. Serial No. 436,214. (No model.)

*To all whom it may concern:*

Be it known that we, ALBERT F. HALL, of Boston, county of Suffolk, and BURT O. GAGE, of Somerville, county of Middlesex, State of Massachusetts, have invented an Improvement in Pumping-Engines, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

This invention has for its object to simplify and improve the construction and operation of what is known as a twin air pump, but what is herein designated a pumping engine.

Figure 1, of the drawings, represents in elevation, partial section, an air pump embodying this invention. Fig. 2, is a top or plan view of the same. Fig. 3, is an enlarged face view of the upper part of the pump, a portion of its exterior casting being broken away to show its valves and operating mechanism therefor. Fig. 4, is an enlarged vertical section of one of the cylinders showing arrangement of parts; and Fig. 5, shows the rocking beam by itself.

Referring to the drawings, A, A represent the air pump cylinders mounted upon a suitable bed and provided with inlet valves *a*, and outlet valves *a'*, all of which are and may be of usual or desired construction.

The pump buckets *b*, provided with the usual valves *b'*, are secured to and moved by the piston rods *b<sup>2</sup>*, which also constitute the piston rods for the steam cylinders C mounted upon the entablature C', which latter is carried by the supporting columns C<sup>2</sup>, see Fig. 1.

A depending bracket C<sup>x</sup> on the entablature C' furnishes suitable bearings for the journal *d* of the rocking beam D, the latter consisting of two like members arranged at opposite sides of the bearing C<sup>x</sup> and fast to the opposite ends of the journal *d* in said bearing, see Fig. 5, the opposite ends of the said beam being connected by like links *d'* with the piston rods *b<sup>2</sup>*, as shown, so that reciprocation of one piston rod will cause a like opposite reciprocation of the other piston rod, the movements of the two being thereby concordant.

The steam cylinders C are peculiarly constructed to prevent a water hammer in the

pump, said cylinders having independent steam and exhaust ports *c, c'* at opposite ends of each cylinder, the exhaust port at one end of each cylinder entering the same direct, while the exhaust at the opposite end of the cylinder communicates with the cylinder only by means of the auxiliary port or passage *s* and through the steam port at that end of the cylinder, the auxiliary ports being controlled by a suitable valve, not shown.

In the construction herein shown the exhaust ports at the lower ends of the cylinders enter the cylinder direct, while the exhaust ports at the upper ends of the cylinders communicate therewith only through the auxiliary passages and steam ports as described, thus providing freer exhaust for the lower ends of the cylinders than for the upper ends. This forms a cushion for the up stroke of each piston, and as the two pistons are connected through the beam D, the effect is to cushion both strokes and prevent a water hammer in the pumps, the cushion at the upper end of one cylinder cushioning the up stroke of the piston in that cylinder and through the beam D, the down stroke of the piston in the other cylinder, and vice-versa.

The cylinders and valves to control the same are in other respects similar to those now in common use.

The valves *f* which control the admission of steam to the cylinders C are actuated by the oppositely arranged like bell crank levers *f'* pivoted at *f<sup>2</sup>*, the said levers each having one arm extending between suitable lugs on the back of the valve by which the latter is moved. The outer arms of the bell crank levers *f'* are connected together by a link *f<sup>3</sup>* having an intermediate opening between its ends through which is extended a rocking lever *h* pivoted at *h'* and having its upper end engaged and moved by the piston rod *m* carrying at its opposite ends the pistons *m'* fitted to move in the like cylinders M in effect constituting a single cylinder, of an auxiliary or valve driving engine, the inner open ends of the said cylinders communicating with the steam chamber formed within the casting N which connects the cylinders C while the outer ends of the said cylinders are closed and provided

with steam ports  $m^2$  which lead to the valve chest  $m^3$ , one of the ports  $m^2$  only being shown in Fig. 1.

The valve chest  $m^3$  contains a valve  $n$  actuated by the valve stem  $n'$  sliding at its outer end in suitable bearings formed by the bracket  $n^2$ , the said valve stem having two adjustable lugs or tappets  $n^3$  between which moves the sleeve  $n^4$  jointed to one arm of the bell crank lever  $n^5$  pivoted at  $n^6$  to a bracket  $n^7$  on the pump casting, and having its other arm connected by a link  $n^8$  with and actuated by a stud  $n^9$  standing out from the beam D, see Figs. 1 and 3.

Steam is admitted to the interior of the casting N and passes thence to the cylinders C, the movement of the valve  $n$  controlling the admission of steam to the opposite ends of the cylinders M to cause movement of the pistons  $m'$  therein, the latter as they move acting through the lever  $h$  and link  $f^3$  to move the valves  $f$  which control the admission of steam to the cylinders C.

The two pump piston-rods  $b^2$  being connected by the beam D must move concordantly, and the valve  $n$  being moved from the beam D in turn causes proper movements of the valves  $f$ .

The details of construction as shown permit the greatest freedom of access to the various parts below the entablature and while the engine above the entablature presents a plain exterior, all the working parts within the casting N are easily accessible upon removal of any of the proper covers.

This invention is not limited to the particular construction herein shown as the same may be varied without departing from the spirit and scope of this invention.

We claim—

1. The combination of two pump cylinders, two steam cylinders arranged in line respectively with said pump cylinders, buckets in said pump cylinders, pistons in said steam cylinders, and piston-rods connecting said pistons and buckets, valves for said steam cylinders to control the admission of steam thereto and the movements of the pistons therein, a valve driving engine connected with and to positively move said valves, a valve mechanism for said valve driving engine, a rocking beam pivoted at its middle and connected at its ends with and to be rocked by said piston-rods, and a connection between said beam and valve mechanism whereby the movements of the valve-driving engine are positively controlled by the vibration of the beam and the movements of the main steam valves for the steam cylinders by the valve-driving engine, substantially as described.

2. The combination of two pump cylinders, an entablature supported above the same and sustaining thereupon two steam cylinders in line respectively with said pump cylinders and having their pistons connected with buckets in said pump cylinders by com-

mon piston-rods, a bracket on the under side of said entablature, a beam D comprising two members pivoted in said bracket and having its opposite ends connected with and at opposite sides of the said piston-rods, a valve-driving engine having its valve mechanism connected with and operated by said beam, and valves to control the admission of steam to the steam cylinders respectively actuated by said valve-driving engine, substantially as described.

3. The combination of two pump cylinders, buckets therein, two steam cylinders containing pistons connected with and to move the said buckets respectively, separate steam and exhaust ports leading from the valve seat to opposite ends of each of said cylinders, the exhaust port for one end of each cylinder having a freer communication with the cylinder than the exhaust port for the opposite end whereby a cushion is formed at one end of each cylinder, substantially as described.

4. The combination of two pump cylinders, buckets therein, two steam cylinders containing pistons connected with and to move the said buckets respectively, separate steam and exhaust ports  $c, c'$  for the opposite ends of each of said cylinders, the exhaust port at one end of each cylinder opening directly into the cylinder, the exhaust port at the opposite end of each cylinder opening into the steam port at the same end of the cylinder and communicating therethrough with the cylinder, substantially as described.

5. The combination of two pump cylinders, two steam cylinders in line respectively therewith and having their pistons connected by common piston-rods with buckets in the said pump cylinders, steam ports for said steam cylinders and valves to control the same, a rocking lever between said steam cylinders, a link connected at its middle with said rocking lever and at its ends with and to move said valves, and a valve-driving engine connected with and to rock said lever, all to operate, substantially as described.

6. A pumping engine containing the following instrumentalities, viz:—two steam cylinders, steam ports therefor, and valves to control the same, bell crank levers  $f'$  to move the same, the rocking lever  $h$ , a steam piston to rock the same, the link  $f^3$  connected at its middle with the said rocking lever and at its ends with said bell crank levers and the inclosing case N, all to operate, substantially as described.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

ALBERT F. HALL.  
BURT O. GAGE.

Witnesses:

FREDERICK L. EMERY,  
EMMA J. BENNETT.