(No Model.)

# A. P. MASSEY.

## COMPOUND STEAM AIR COMPRESSOR.

No. 433,951. Patented Aug. 12, 1890.

Fig. 1

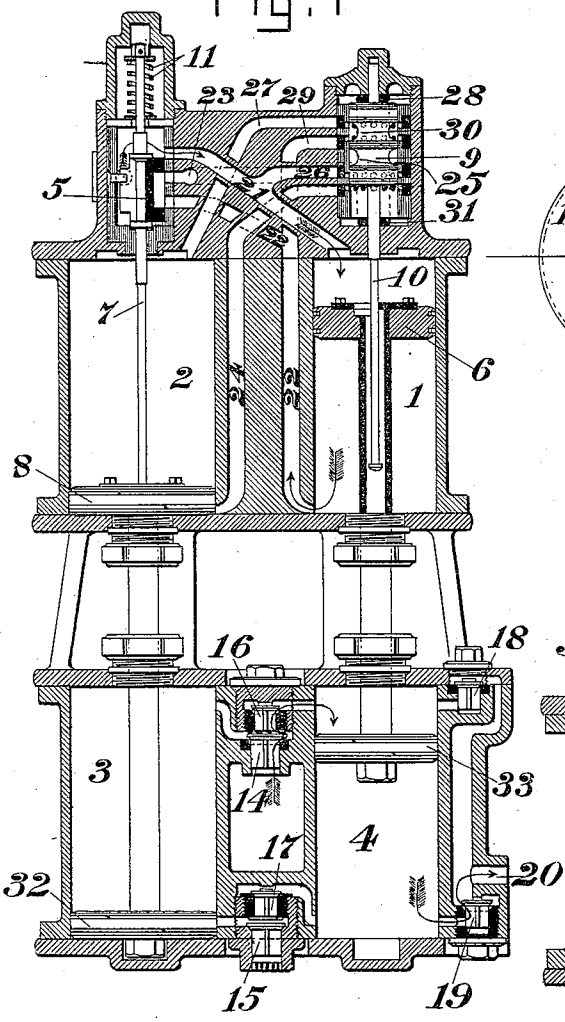



Fig. 3

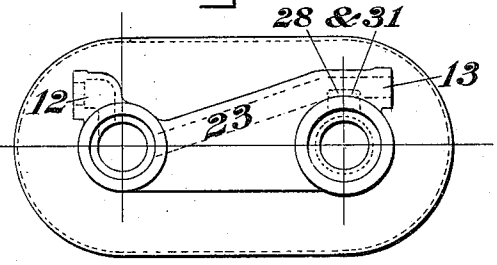
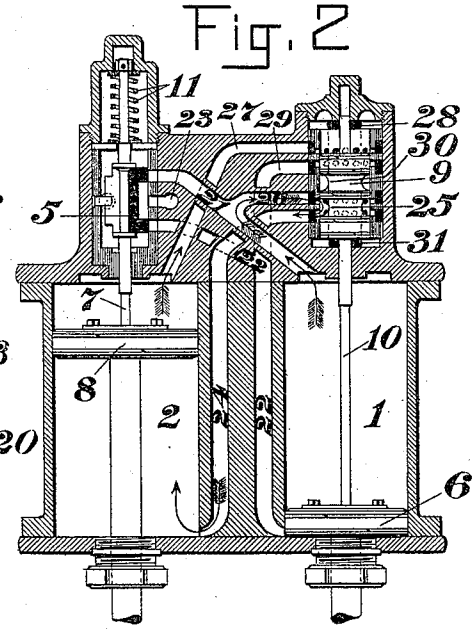



Fig. 2




Witnesses
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# UNITED STATES PATENT OFFICE.

ALBERT P. MASSEY, OF WATERTOWN, NEW YORK, ASSIGNOR TO THE EAMES VACUUM BRAKE COMPANY.

## COMPOUND STEAM AIR-COMPRESSOR.

SPECIFICATION forming part of Letters Patent No. 433,951, dated August 12, 1890.

Application filed June 19, 1890. Serial No. 355,968. (No model.)

*To all whom it may concern:*

Be it known that I, ALBERT P. MASSEY, a citizen of the United States, residing in the city of Watertown, in the county of Jefferson and State of New York, have invented certain new and useful Improvements in Compound Steam Air-Compressors, of which the following, taken in connection with the accompanying drawings, is a specification.

The object of my invention is to produce an air-compressor that will work with greater economy of steam than those at present in use.

In an application filed by me September 21, 1889, No. 324,619, and in Patent No. 428,120, dated May 20, 1890, I have described an air-pump in which steam is used at boiler-pressure in two steam-cylinders to actuate pistons in two air-cylinders, so as first to compress the contents of one air-cylinder into the other air-cylinder and then compress the contents of the second cylinder into the reservoir. The air portion of this compressor is similar, as hereinafter described; but I now use the steam at boiler-pressure in one steam-cylinder and the exhaust from the high-pressure cylinder to actuate the low-pressure piston.

Figure 1 is a sectional view showing the steam-valves in one position. Fig. 2 is a sectional view of the steam-cylinders, showing the valves in another position. Fig. 3 is a top view showing the plan of the steam inlet and exhaust ports.

In the drawings, 1 is the high-pressure steam-cylinder.

2 is the low-pressure steam-cylinder.

3 is the low-pressure air-cylinder, and 4 is the high-pressure air-cylinder. Each steam-piston is connected by a piston-rod with a piston in the corresponding air-cylinder.

5 is a valve controlling the movements of the high-pressure steam-piston 6. It is actuated by valve-stem 7, which in turn is moved by a plate attached to piston 8 and tappets on the valve-stem.

9 is a valve for controlling the movements of the low-pressure steam-piston 8. It is controlled by valve-stem 10 and the plate on piston 6. This is a piston-valve and has packing-rings of the usual construction to prevent leaking. A spring 11 is attached to valve-stem 7 for the purpose of returning valve 5 to a central position whenever it is not held at either end of its stroke by contact of one of the valve-stem tappets with the plate on piston 8.

12, Fig. 3, is the steam-inlet, and 13 the exhaust-passage.

In the air mechanism, 14 and 15 are inlet-valves to admit air from atmosphere to cylinder 3.

16 and 17 are valves to admit air from the chambers above valves 14 and 15 to the cylinder 4.

18 and 19 are valves to admit air from cylinder 4 to the reservoir through outlet 20.

The operation is as follows: Steam at boiler-pressure is admitted through inlet 12 to the chamber of valve 5. In the position shown in Fig. 1 steam is passing through passage 21 to top of piston 6, producing a downward movement to said piston. Meanwhile the exhaust from the under side of piston 6 is passing through passage 22 and exhaust-port 23 to the outlet 13. When piston 6 is nearly at the end of its stroke, the plate on top of it will come in contact with the lower tappet of valve-stem 10 and move valve 9 to the position shown in Fig. 2. This opens the lower chamber of cylinder 2, through passage 24, port 25, (in valve 9,) and passage 26 and 21, to the high-pressure steam in upper chamber of cylinder 1, which expands, as indicated by arrows, under piston 8, thus giving it an upward movement. The same movement of valve 9 opens the exhaust from upper side of piston 8 through passage 27 and exhaust-port 28 to the outlet 13. (Note that in Fig. 1 the piston 8 holds the valve-stem 7 and valve 5 at the lower limit of the valve travel and the spring 11 is in compression.) As soon as piston 8 starts upward, the spring 11 brings valve 5 to the position shown in Fig. 2, where both steam-ports of cylinder 1 are covered by the valve 5; therefore live steam from the boiler cannot enter passage 21. When the plate on piston 8 reaches the upper tappet of valve-stem 7, it raises valve 5 to its highest position and admits steam from the boiler through passage 22 to the under side of piston 6 to cause an upward stroke. The exhaust from

above piston 6 at this time would pass through passage 21 and exhaust-port 23 to the outlet 13. The completion of the upward stroke of piston 6 raises valve 9 to its highest position, as shown in Fig. 1, when the high-pressure steam which has moved piston 6 upward can expand through passages 22 29, port 30, (in valve 9,) and passage 27 to upper side of piston 8 and cause a downward stroke of piston 8. As soon as piston 8 starts downward, the spring 11 moves valve 5 to the position covering both steam-ports of cylinder 1, as before. The exhaust-steam from under piston 8 passes through passage 24 under valve 9 to exhaust-port 31, and thence to outlet 13. This completes the cycle of the steam mechanism, only one piston moves at a time, and each piston practically completes its stroke before the other starts.

The air mechanism is as described in above-mentioned patent, both cylinders are filled with air at atmospheric pressure, the contents of the larger cylinder are compressed into the smaller cylinder and the contents of the smaller cylinder are compressed into the reservoir. The operation is as follows: In the downward stroke of piston 32 the cylinder 3 would become filled with air at atmospheric pressure through valve 14. Piston 32 would then remain at the bottom until piston 33 had made its downward stroke and the cylinder 4 above piston 33 had become filled with air through valves 14 and 16, as shown by the arrow. Piston 32 would then rise and compress its contents through valve 16 into cylinder 4, and finally piston 33 would then rise and compress its contents into the reservoir through valve 18.

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

1. In a compound steam air-compressor, a high-pressure steam cylinder and piston and a low-pressure steam cylinder and piston, in which the steam from the high-pressure cylinder is used expansively, combined with a valve admitting steam from the boiler to the high-pressure cylinder, and a valve admitting steam from the high-pressure cylinder to the low-pressure cylinder, and valve-stems arranged with tappets, so that each piston will control the action of the valve of the opposite cylinder and cause one piston to practically complete a stroke before the other piston starts, substantially as set forth.

2. In a compound steam air-compressor, a double-ported valve between the high-pressure cylinder and the low-pressure cylinder, combined with a valve controlling the admission of steam from the boiler to the high-pressure cylinder, and a spring to return said valve to a position that will cut off steam from the boiler to the passages leading to the cylinders during the stroke of the low-pressure piston, substantially as set forth.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, on this 17th day June, A. D. 1890.

ALBERT P. MASSEY.

Witnesses:
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HENRY W. BOYERS.