2 Sheets—Sheet 1.

E. F. ALTHANS.

COMPOUND ENGINE.

No. 181,124. Patented Aug. 15, 1876.

Fig. 1.

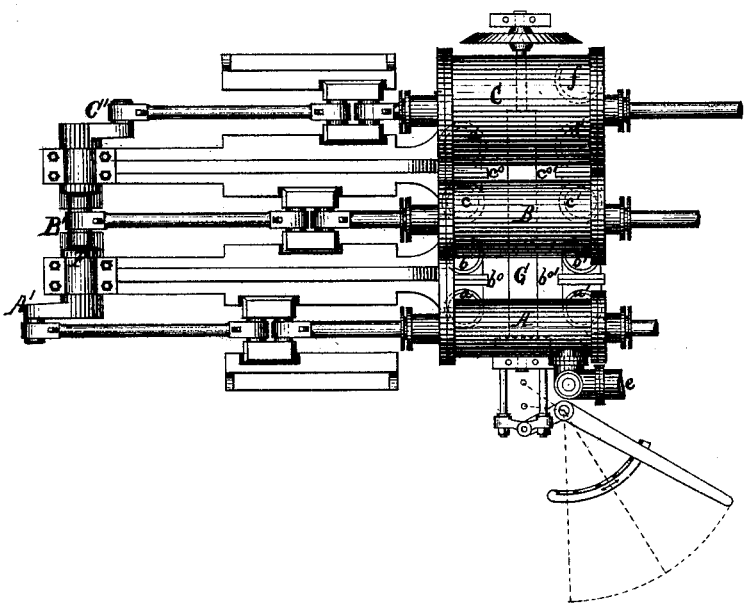


Fig. 2.

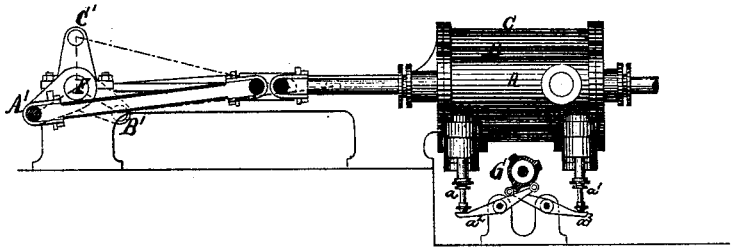
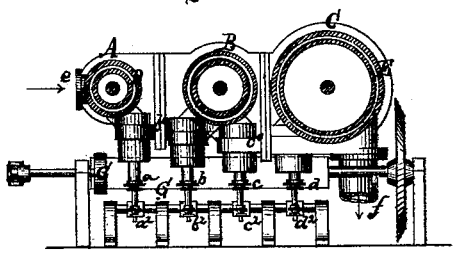


Fig. 4.

Fig. 3.



Witnesses.

Otto Stupeland

Robt E. Miller

Inventors.

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by

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his attorneys

2 Sheets—Sheet 2.

E. F. ALTHANS.

COMPOUND ENGINE.

No. 181,124. Patented Aug. 15, 1876.

Fig. 5.

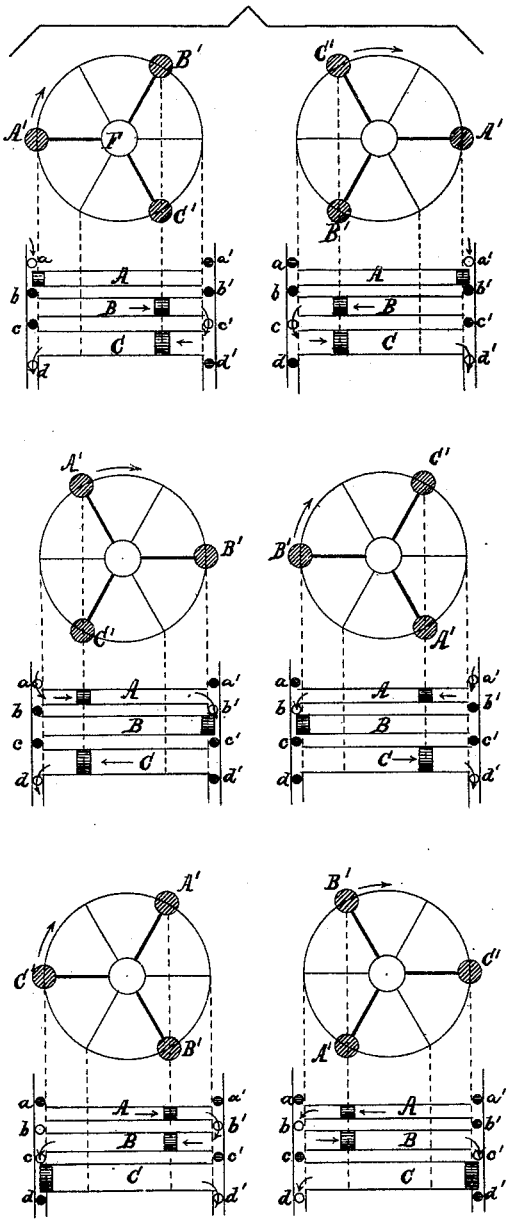
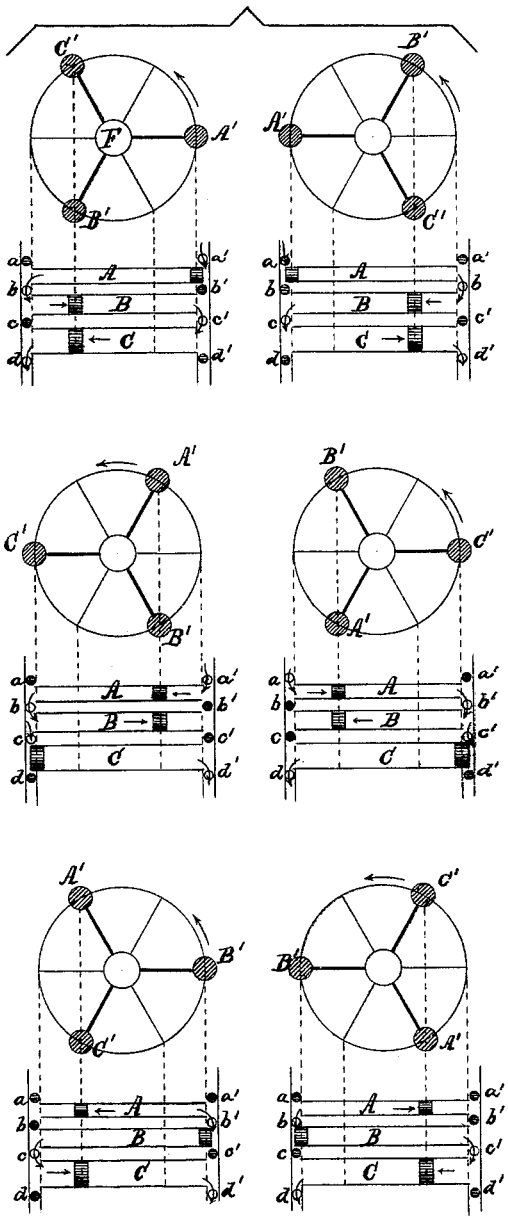


Fig. 6.



Witnesses.

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UNITED STATES PATENT OFFICE.

ERNST F. ALTHANS, OF BRESLAU, GERMANY.

IMPROVEMENT IN COMPOUND ENGINES.

Specification forming part of Letters Patent No. **181,124**, dated August 15, 1876; application filed July 14, 1876.

To all whom it may concern:

Be it known that I, ERNST F. ALTHANS, of Breslau, Germany, have invented a new and useful Improvement in Compound Engines, which improvement is fully set forth in the following specification, reference being had to the accompanying drawing, in which—

Figure 1 represents a plan or top view partly in section. Fig. 2 is a sectional side view. Fig. 3 is a transverse vertical section in the plane *x x*, Fig. 1.

Similar letters indicate corresponding parts.

This invention relates to a compound engine composed of three cylinders of gradually-increasing diameter, in which the small cylinder receives a variable supply of steam, while the remaining steam-distributing valves are so arranged that the valve which controls the exhaust of the small cylinder at the same time controls the supply of the middle cylinder, and the valve which controls the exhaust of the middle cylinder also controls the supply of the large cylinder. By this arrangement the engine is rendered extremely simple, all noxious spaces are reduced to a minimum, and the use of intermediate steam-chambers is avoided. The pistons of the three cylinders of my engine are connected to a common crank-shaft, the cranks of which are set at angles of one hundred and twenty degrees toward each other, and with these parts is combined a valve-gear which allows of reversing the engine.

In the drawing, the letters A B C designate three steam-cylinders, which are situated in one and the same plane, parallel to each other and close together. The bores of these three cylinders are different, that of the cylinder A being the smallest, and that of the cylinder C being the largest. The cylinders A and B are connected at both ends by steam-passages b^0 b^{01}, and the cylinders B and C by steam-passages c^0 c^{01}, and in these passages are situated the valves b b^1 and c c^1. The small cylinder A is provided with two supply-valves, a a^1, and the large cylinder C with two exhaust-valves, d d^1. All these valves are situated beneath the several cylinders, so that the water resulting from condensation in either of the cylinders can flow off without obstruction. The cylinder A is provided with a jacket, D, which is supplied with steam through the steam-pipe *e*, and which communicates with the chambers of the supply-valves a a^1, so that by opening either of these valves steam is admitted to either end of the cylinder. The cylinder C is also provided with a jacket, E, which communicates with the chambers of the exhaust-valves d d', and from which extends the exhaust-pipe *f*, so that by opening either of the exhaust-valves, either end of the cylinder C can be brought in communication with the exhaust-pipe *f*. The pistons of the three cylinders A B C connect with cranks A′ B′ C′, which are secured to a common shaft, F, and which are placed at angles of one hundred and twenty degrees toward each other. If all the valves are opened, the steam passes in two separate currents through the several cylinders, one current in front and the other behind the pistons. All the valves are operated by a common cam-shaft, G, which is situated transversely beneath the cylinders, and which acts on four pairs of levers, a^2 a^3 b^2 b^3 c^2 c^3 d^2 d^3, each of which acts on one of the valves a a^1 b b^1 c c^1 d d^1. In practice, the inner ends of said levers will be armed with small rollers, so that the same will readily ride over the projections of the cam-shaft.

In the example shown in the drawing, the cam-shaft is provided with twenty-four cams, (see Fig. 4, which shows said cam-shaft when developed,) six cams for each valve, three of which are at work when the engine works in one, and the other three when the engine works in the opposite direction, since it has been found to be desirable that the cam-shaft shall make only one revolution for three revolutions of the crank-shaft. But the relative speed of the cam-shaft, and the number of the cams on the same, may be changed. It is essential, however, that one-half revolution of the cam-shaft shall intervene between the time when the rear lever of each pair begins its movement and that of the beginning of the movement of the front lever of the same pair, in order to obtain a regular supply and exhaust for each cylinder.

In the example shown in the drawing, each valve is opened and closed three times for each revolution of the cam-shaft, and the dis-

tance between the bearing-points of the rear and front levers are situated in a plane which is at right angles to the cam-shaft, and as the latter revolves, both levers in each pair are moved by the same cams.

On the cam-shaft are two contiguous rows of cams, a^4 a^5 b^4 b^5 c^4 c^5 d^4 d^5, for each pair of valve-levers, the front rows a^4 b^4 c^4 d^4 being for the motion of the crank-shaft from left to right, and the rear rows a^5 b^5 c^5 d^5 for the motion of the crank-shaft from right to left. The cam-shaft is feathered to its axle, and it can be moved thereon in the direction of its length, so that either the front rows or the rear rows of cams can be brought in operation, and that by moving said cam-shaft, the time for cutting off the steam in the small cylinder can be changed. On the end of the cam-shaft is secured a collar, H, in which said cam-shaft revolves, and to which is connected the apparatus for moving the cam-shaft in the direction of its length. This apparatus may consist of a simple hand-lever or screw, or it may consist of an ordinary ball-governor, so that the position of the cam-shaft is regulated automatically according to the speed of the engine. The cams a^4 a^5, for the steam-valves a a^1 of the small cylinder A, form, when looked at in the developed plane, rectangular triangles, which extend in opposite directions.

When the cam-shaft is set, so that the apexes of the cams a^4 a^5 are opposite the bearing-points of the valve-levers a^2 a^3, the valves a a^1 will remain closed, and no steam is admitted to the small cylinder; but by moving the cam-shaft from this central position in either direction, (according to the direction in which the engine is to work,) the steam can be cut off at any desired portion of the stroke. The cams b^4 and c^4, which control the passage of the steam from the cylinder A to cylinder B, and from cylinder B to cylinder C, when the engine works from left to right, are considerably narrower than the corresponding cams b^5 and c^5, which come in operation when the engine works from right to left. This arrangement is rendered necessary by the peculiar difference in the relation of the dead-centers of the several cranks toward each other, since in turning from left to right the difference between the dead-centers of the cranks A′ and B′ and of the cranks B′ and C′, respectively, is two hundred and forty degrees, while the difference is only one hundred and twenty degrees when the motion of the engine is reversed. This will be readily understood by referring to the diagrams Figs. 5 and 6, where, in Fig. 5, are shown the various positions of the cranks and the corresponding positions of the pistons when the crank-shaft turns from left to right, and in Fig. 6 the same positions when the crank-shaft turns from right to left.

Before my engine is started, it is desirable to fill all the cylinders with live steam, and for this purpose a separate mechanism may be applied for opening all the valves simultaneously, which has also the advantage to blow out the condensed water that may have accumulated in the cylinders.

If desired, however, separate steam-passages may be provided for filling the cylinders with live steam from the boiler. After the cylinders have been filled with steam, it is only necessary to move the cam-shaft from its mean position either forward or backward, according to the direction in which it is desirable to turn the crank-chaft.

By referring to the diagrams Figs. 5 and 6, it will be readily seen that in my engine no intermediate steam-chambers are required, the steam being passed directly from one cylinder to the next.

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

1. A reversible steam-engine, composed of three cylinders connected to cranks set at angles of about one hundred and twenty degrees, and provided with steam and exhaust valves, the exhaust-valves of the first cylinder forming the supply-valves of the second, and the exhaust-valves of the second the supply-valves of the third, all combined and operating with reversible valves, substantially as and for the purposes set forth.

2. The combination, with three cylinders, A B C, and with their supply and exhaust valves a a^1 b b^1 c c^1 d d^1, of a cam-shaft, provided with contiguous rows of cams a^3 a^4 b^3 b^4 c^3 c^4 d^3 d^4, whereby the compound engine can be worked conveniently in either direction, substantially as set forth.

In testimony that I claim the foregoing I have hereunto set my hand and seal this 10th day of July, A. D. 1876.

ERNST F. ALTHANS. [L. S.]

Witnesses:
W. HAUFF,
E. F. KASTENHUBER.