(No Model.) 3 Sheets—Sheet 1.

M. E. CLARK.

APPARATUS FOR COMPRESSING AIR.

No. 558,041. Patented Apr. 14, 1896.

Fig. 1.

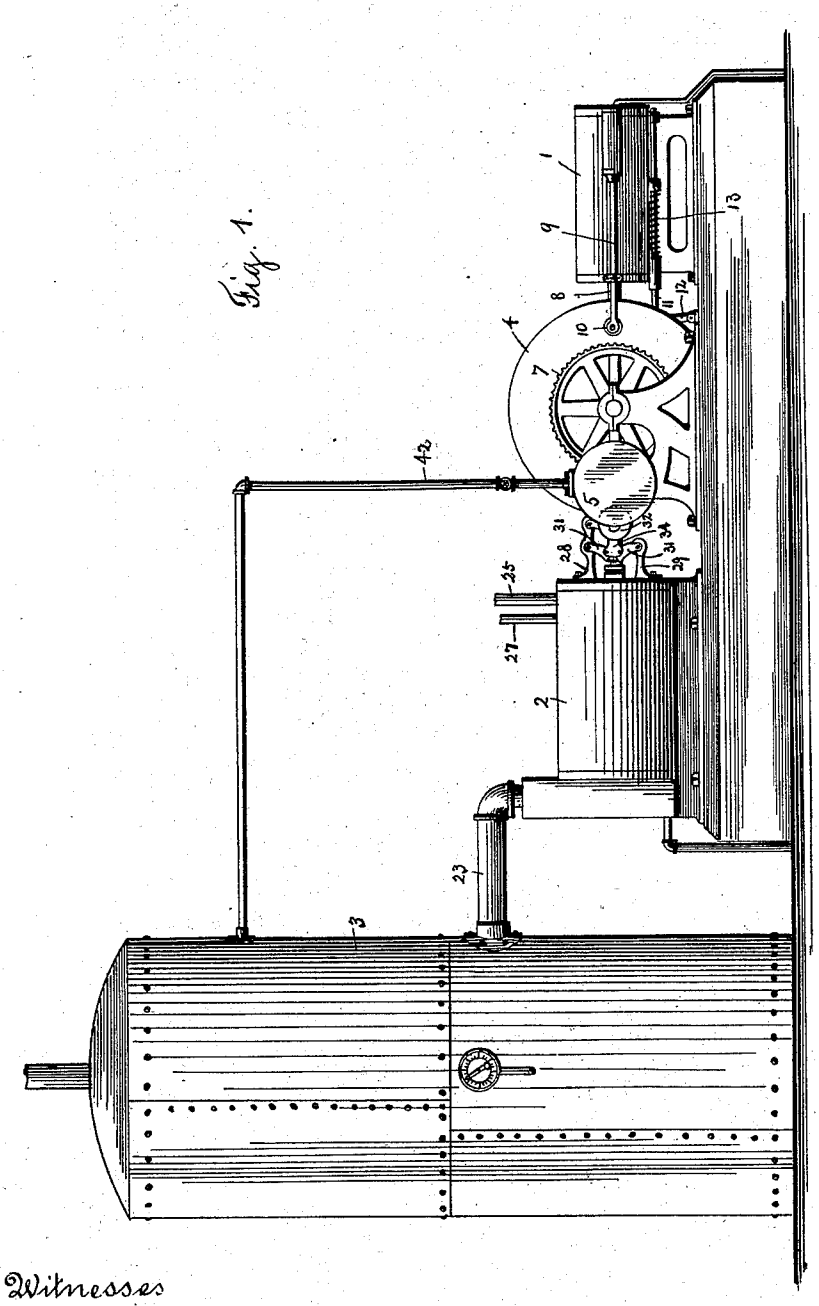

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Fig. 2.

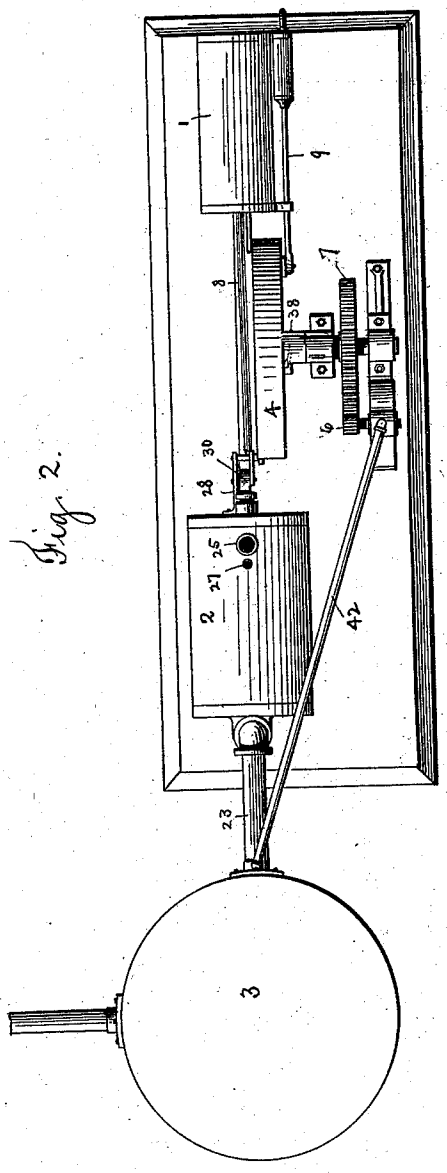
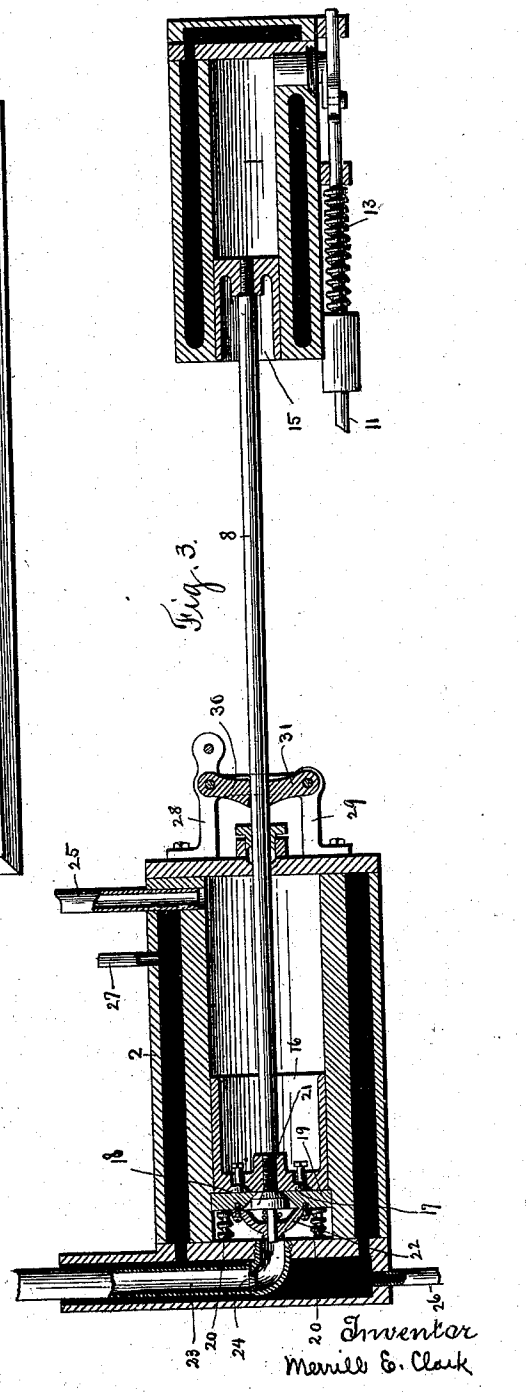


Fig. 3.



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(No Model.) 3 Sheets—Sheet 3.

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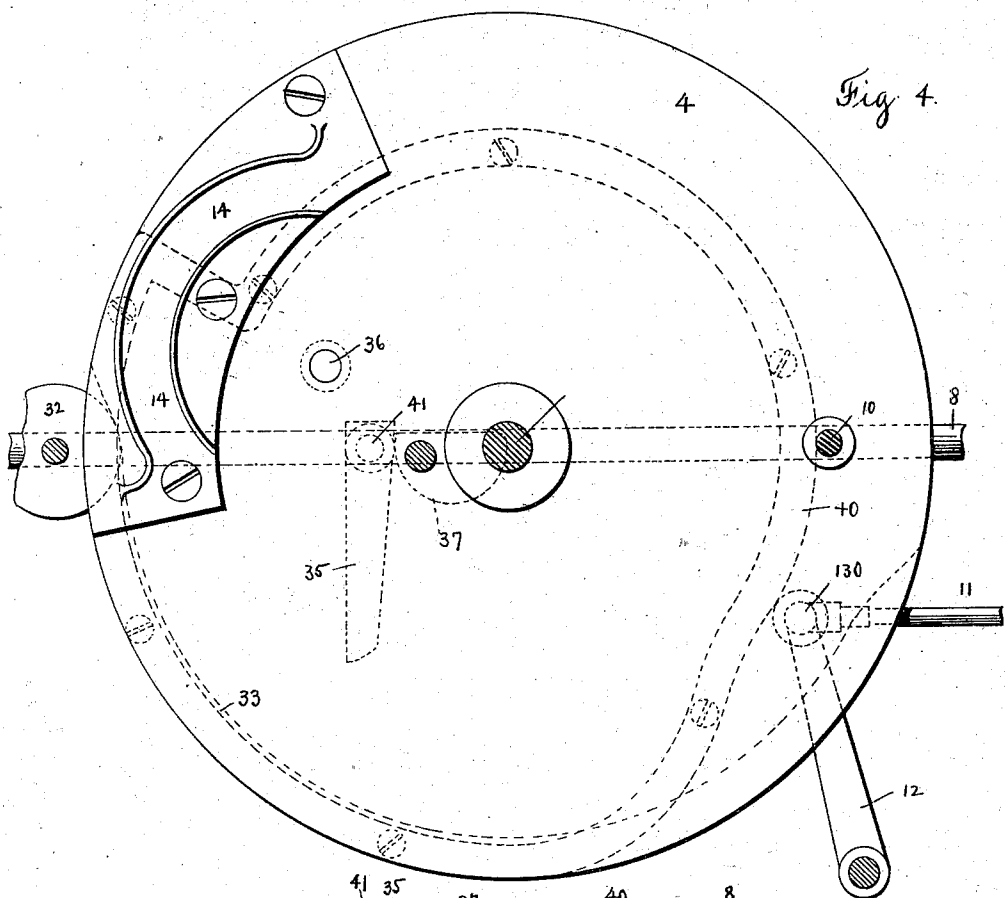
Fig. 4.



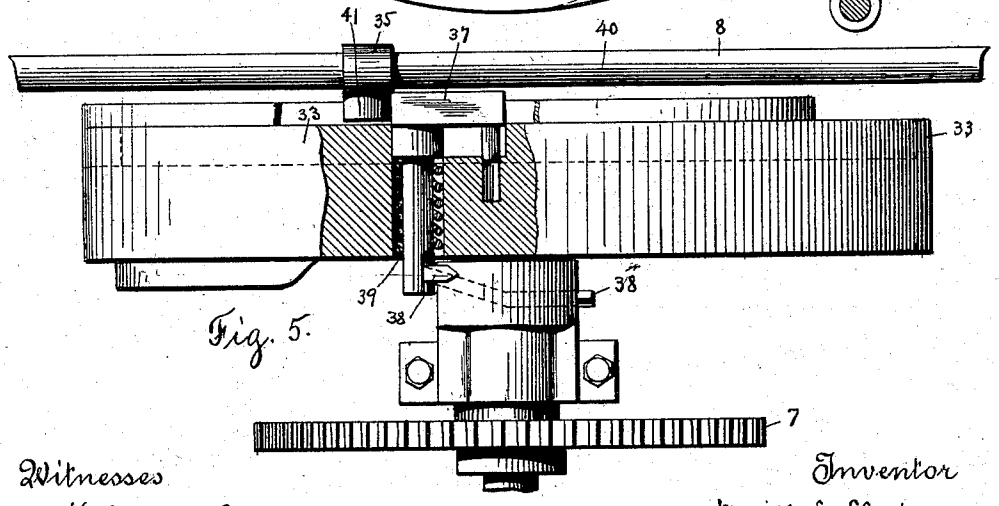


Fig. 5.

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UNITED STATES PATENT OFFICE.

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APPARATUS FOR COMPRESSING AIR.

SPECIFICATION forming part of Letters Patent No. 558,041, dated April 14, 1896.

Application filed August 23, 1895. Serial No. 560,190. (No model.)

To all whom it may concern:

Be it known that I, MERRILL E. CLARK, a citizen of the United States, residing at Worcester, in the county of Worcester and Commonwealth of Massachusetts, have invented certain new and useful Improvements in Apparatus for Compressing Air, of which the following is a specification.

The main object of my invention is to provide apparatus for the compression of air in which as large a proportion as possible of the power used may be exerted directly upon the volume of air to be compressed, avoiding the loss of power incident upon the use of the ordinary crank motion used in the transmission of power.

In the drawings, Figure 1 is a side view of my improved apparatus. Fig. 2 is a plan view of the same. Fig. 3 is an enlarged partial vertical section with the intermediate disk omitted. Fig. 4 is an enlarged side view of said disk, the details of which will be more fully explained later. Fig. 5 is a plan view of the disk and of part of the shaft connecting the piston of a gas-engine with the piston in the air-compressor.

In the drawings, 1 is the cylinder of any desirable type of gas-engine.

2 is the cylinder of the air-compressor.

3 is the chamber in which the compressed air may be stored.

4 is a disk, which is revolved by the air-motor 5 through connecting-pinion 6 and gear 7. (Shown in Fig. 2.)

8 is a shaft connecting the piston of the gas-engine with the piston of the air-compressor.

9 is a rod connecting the roll 10, which moves in the cam-path 14 on the outer face of the disk, with a pump for charging the cylinder of the gas-engine with an explosive mixture.

11 is a rod on the inner side of the disk supported by the rocker-arm 12, attached to the bed of the machine and connected with it and the roller 130, which is adapted to follow the cam-path 40. On the inner face of the disk the arm 11 operates the exhaust-valve of the engine and is restored to its normal position by means of the spiral spring 13.

15 is the piston of the gas-engine, and 16 the piston of the air-compressor, represented in the drawings at the completion of the compression-stroke.

In the piston of the air-compressor are two valves 17 and 18, which are closed by the pressure upon them when the piston of the compressor is traveling from right to left and are opened by the pressure on the opposite side when the piston in the compressor is moving from left to right.

19 is a supplemental cylinder-head backed by the spiral springs 20 and yielding to any impact upon it by the piston 16, so that if for any reason the piston is carried beyond the end of the normal stroke the compressor may not be subjected to any excessive strain.

21 is a valve in the supplemental head 19, which is opened by the pressure of the air upon it when the piston is moving from right to left and is closed by the air-pressure behind it and the spring 22 when the piston is moving from left to right.

23 is an outlet-pipe from the compressor to the storage-chamber, and 24 is a check-valve placed therein. 25 is a pipe through which a supply of air may be taken into the compressor, and 26 is a pipe through which the water-jacket surrounding the compressor is supplied, the water being discharged through the pipe 27.

28 and 29 are studs securely fastened to the inner head of the compressor, and mounted upon them are the jaws 30 and 31, held in place by a spring shown in Fig. 1. Depending from the extremity of stud 28 is a roll 32, adapted to travel in the cam-path 33 on the inner face of the disk, so that at the proper time the connecting-bar 34, (shown in Fig. 1,) which is attached to the wheel 32, and the jaws 30 and 31 may be thrust forward, forcing the jaws apart and liberating the shaft 8, which otherwise would be prevented from moving from left to right. Rigidly attached to the shaft 8 is a downwardly-projecting bar 35, placed in the path of the roll 36, so that the shaft 8 may, after the completion of its movement from right to left, be returned to its initial position.

37 is a cam secured to the disk and having a regular reciprocating motion in a plane parallel to the axis of the disk, such motion being governed by the cam-path 38 on one of

the boxes in which the shaft on which the disk runs is mounted, and which is clearly shown in Fig. 5. As the cam 37 travels away from the shaft 8 it compresses spring 39, which forces cam 37 back to its initial position, when the cam-path permits it to resume such position. The reciprocating motion of the cam is necessary, so as to permit the roll 41, which is rigidly attached to the shaft 8, to return with the shaft to its initial position. The function of the cam 37 is to force the shaft 8 to a full completion of the stroke when for any reason the explosion in the cylinder of the gas-engine fails to do its full work. When the apparatus acts normally the cam 37 has no work to perform.

42 is a pipe leading from the storage-chamber 3 to the air-motor 5, the position of which is indicated, but none of the details of which are shown, as any form of motor may conveniently be used, and the function the motor performs is to revolve the disk which regulates the supply and exhaust valves of the cylinder of the gas-engine, which returns shaft 8 to its initial position, which completes the full stroke when the explosion fails to act with its full efficiency, and which disengages the gripping-arms 30 and 31 at the proper time. These gripping-arms are particularly designed to hold the shaft 8 after the explosion has ceased to act, and until the cam 37 may come in contact with the roll 41 whenever it may happen that the explosion does not result in a complete stroke.

Having now described the details of my mechanism, I will indicate the mode of operation.

The explosive having been ignited in any well-known manner, if the apparatus is working normally the piston in the cylinder of the gas-engine and in the air-compressor will be forced forward into the position shown in Fig. 3 and the air in front of the piston 16 will be forced through the valve 21 and check-valve 24, through the pipe 23, and into the air-receiver 3. Meantime the roll 130 is carried by the cam-path 40 into such a position as to open the exhaust. The revolution of the disk 4 brings the roll 36 into contact with the arm 35 and returns shaft 8 to its initial position, and at the proper time the roll 10 actuates the rod 9, which pumps the explosive into the cylinder of the engine, and the operation is repeated.

Should it happen that the apparatus is not working normally and the piston should fail to be carried through the full stroke, the cam 37 being properly timed to reach the plane of the roll 41 contacts with the latter and completes the stroke, and during the time between the action of the explosion and the action of the cam 37 upon the roll 41 the shaft 8 is prevented from any retrograde movement by the action of the jaws 30 31, and at the completion of the stroke the action of these jaws is released by the thrust imparted to the bar 34 by the roll 32, which travels in the cam-path 33.

It is to be observed that the impulse received by the piston 15 need not necessarily be derived from a gas-engine, but energy produced in any desirable way may be utilized for this purpose; nor is it necessary that the disk 4 should be driven from the storage-chamber, but only that it shall be revolved in some manner to enable it to perform the function for which it is calculated.

The purpose which my apparatus is intended to serve is to exert in the air-compressor as large a proportion as possible of the force of the impact received at the opposite end of the shaft 8, and I believe that this apparatus is calculated to produce this result in the most efficient, reliable, and economical manner.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In apparatus for compressing air, the combination of a shaft, having at one end a piston adapted to be moved, and a piston at the opposite end of said shaft adapted to act upon a volume of air in the cylinder of an air-compressor, and an intermediate disk, and mechanism for imparting motion to said disk, whereby said pistons may be returned to their initial positions after the completion of the stroke, substantially as described.

2. In apparatus for compressing air, the combination of a shaft, having at one end a piston adapted to be moved, and a piston at the opposite end of said shaft adapted to act upon a volume of air in the cylinder of an air-compressor, and an intermediate disk provided with a projection adapted to contact with an arm attached to said shaft, and mechanism for imparting motion to said disk, whereby said pistons may be returned to their initial positions, after the completion of the stroke, substantially as described.

3. In apparatus for compressing air, the combination of a shaft, having at one end a piston adapted to be moved, and at the opposite end of said shaft a piston adapted to act upon a volume of air in the cylinder of an air-compressor and an intermediate disk, provided with a cam adapted to contact with a roll on said shaft, and provided with a projection adapted to contact with an arm attached to said shaft, and mechanism for imparting motion to said disk, whereby an incomplete stroke may be completed, and said pistons returned to their initial positions, after the completion of the stroke, substantially as described.

4. In apparatus for compressing air, the combination of a shaft, having at one end a piston adapted to be moved, and at the opposite end of said shaft a piston adapted to act upon a volume of air in the cylinder of an air-compressor, mechanism for gripping said shaft, and an intermediate disk provided with

a cam adapted to contact with a roll on said shaft, and provided with a projection adapted to contact with an arm attached to said shaft and a cam-path adapted to actuate a roll which imparts a thrust to a bar connected with said gripping mechanism, and mechanism for imparting motion to said disk, whereby said shaft may be gripped, and an incomplete stroke may be completed, and the grip upon said shaft may be released, and said pistons returned to their initial positions, substantially as described.

5. In apparatus for compressing air, the combination of a shaft having at one end a piston adapted to be propelled by an explosion, and at the opposite end, a piston adapted to act upon a volume of air, in the cylinder of an air-compressor, and an intermediate disk, provided with suitable cam-paths, and rolls adapted to travel in said cam-paths, said disk being provided with a projection adapted to contact with an arm attached to said shaft and suitably connected with the exhaust and supply valves of an engine, and properly timed, and mechanism for imparting motion to said disk, whereby the exhaust-valve may be opened by the progress of a roll through one of said cam-paths, and said pistons returned to their initial positions, and the explosive supplied to the cylinder of the engine by the progress of a roll through another of said cam-paths, substantially as described.

6. In apparatus for compressing air, the combination of a shaft, having at one end a piston adapted to be propelled by an explosion, and at the opposite end, a piston adapted to act upon a volume of air in the cylinder of an air-compressor, and an intermediate disk, provided with suitable cam-paths and provided with a cam adapted to contact with a roll on said shaft and provided with a projection adapted to contact with an arm attached to said shaft, said disk being suitably connected with the exhaust and supply valves and properly timed, and mechanism for imparting motion to said disk whereby an incomplete stroke may be completed, the exhaust-valve opened, said pistons returned to their initial positions, and the explosive supplied to the cylinder of the engine, substantially as described.

7. In apparatus for compressing air, the combination of a shaft, having at one end a piston adapted to be propelled by an explosion, and at the opposite end a piston adapted to act upon a volume of air in the cylinder of an air-compressor, to which cylinder is secured mechanism for gripping said shaft, and an intermediate disk provided with suitable cam-paths and provided with a cam adapted to contact with a roll on said shaft, and provided with a projection adapted to contact with an arm attached to said shaft, and a cam-path adapted to actuate a roll which imparts a thrust to a bar connected with said gripping mechanism, said disk being suitably connected with the exhaust and supply valves and properly timed, and mechanism for imparting motion to said pulley, whereby said shaft may be gripped, an incomplete stroke may be completed, the gripping mechanism disengaged, the exhaust-valve opened, said pistons returned to their initial positions, and the explosive supplied to the cylinder of the engine, substantially as described.

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