No. 866,457. PATENTED SEPT. 17, 1907.

G. J. GIBBS.

COMPRESSED AIR INSTALLATION.

APPLICATION FILED OCT. 10, 1904.

3 SHEETS—SHEET 1.

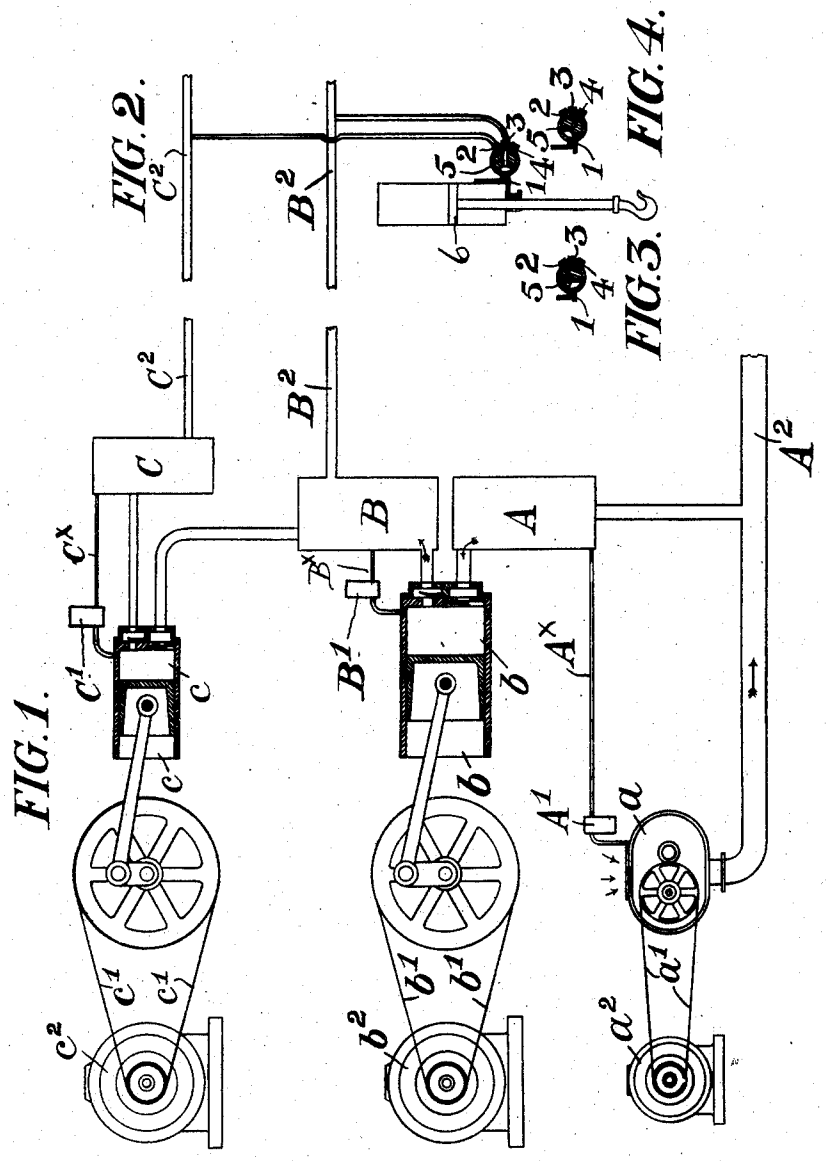

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

Witnesses

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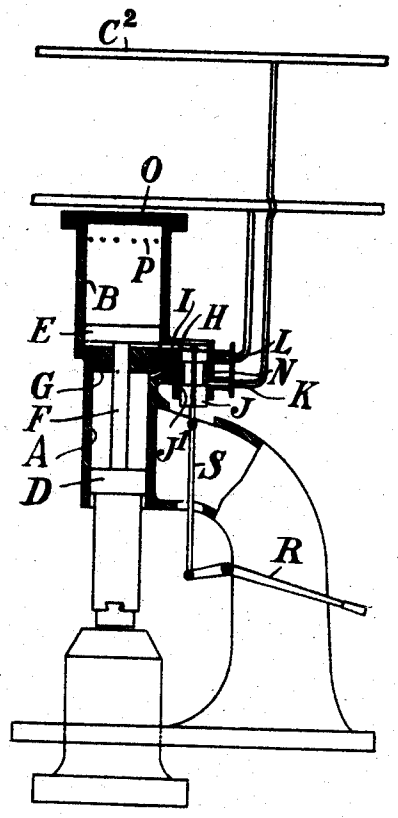
3 SHEETS—SHEET 2.

FIG. 5.



Witnesses

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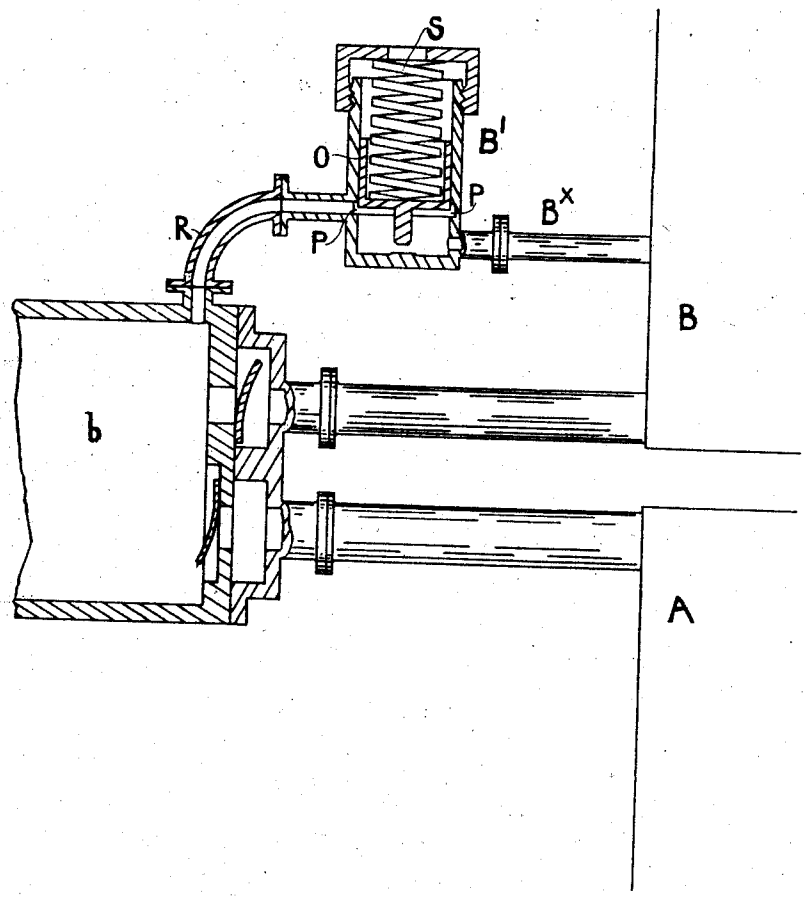
3 SHEETS--SHEET 3.

FIG. 6.



Witnesses
Grace P. Brereton
Albert Popkins

Inventors
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UNITED STATES PATENT OFFICE.

GEORGE JAMES GIBBS, OF BAMBER BRIDGE, ENGLAND, ASSIGNOR OF ONE-HALF TO PETER PILKINGTON LIMITED, OF BAMBER BRIDGE, NEAR PRESTON, ENGLAND.

COMPRESSED-AIR INSTALLATION.

No. 866,457. Specification of Letters Patent. Patented Sept. 17, 1907.

Application filed October 10, 1904. Serial No. 227,861.

To all whom it may concern:

Be it known that I, GEORGE JAMES GIBBS, a subject of the King of Great Britain, residing at Bamber Bridge, near Preston, in the county of Lancaster, in the Kingdom of England, engineer, have invented certain new and useful Improvements in or Connected with Compressed-Air Installations, for which application has been made in Great Britain, No. 6,210, dated 14th March, 1904.

This invention relates to compressed air installations in which the air is used at a wide range of pressures and has for its object the more economical production and consumption of the compressed air at the various pressures than has hitherto been the case.

According to our invention, we may simultaneously and economically supply apparatus with air at a wide range of pressures, while at the same time the apparatus may exhaust and return air into low pressure mains, thus increasing the available supply of low pressure air. Whenever it is necessary to fill a cylinder with air at comparatively low pressure, it is more economical to take the required quantity of that air from a lower pressure main than to take the same quantity of air from a high pressure main, reducing the pressure by throttling as is usually done. Our present invention is eminently advantageous in use with any apparatus which requires at one time high pressure air, and at another time low pressure air, the alteration from one pressure to the other being broken (or rapid), as for instance in air hoists and forge hammers. For such purposes I use two or more compressors compressing air in stages with an air reservoir for each stage of pressure, and I distribute and use air from any reservoir at will. The compressor for each stage may be driven independently of the other compressors and is independently controlled to maintain the desired pressure of air in the reservoir to which it delivers air.

The invention consists in the matters hereinafter described, and referred to in the appended claims.

In the accompanying drawings: Figure 1 is a diagrammatic view of my invention for the economical production and use of compressed air at various pressures; Fig. 2, a sectional view of an air hoist, showing how the present invention applies thereto; Figs. 3 and 4 detail sectional views of the fourway cock; Fig. 5, a sectional elevation showing my invention applied to a forge hammer; Fig. 6 is a detail sectional view of a governing or controlling device.

Fig. 1 of the drawings shows diagrammatically a series of three compressors *a b c* which may be of any suitable type, and also the series of reservoirs A B C placed relatively thereto. As shown in Fig. 1, "*a*" represents a rotary blower, driven by the belt *a'* from the electromotor a^2. "*b*" represents a single acting, single stage air compressor driven by the belt *b'*, from the electromotor b^2, and *c* represents a single acting, single stage air compressor driven by the belt *c'*, from the electromotor c^2. Each compressor *a b* and *c* has its own governing device, for instance when the desired air pressure in reservoir A has been reached, a governing or controlling device A' is automatically brought into action so as to cause the compressor *a* to cease delivering air to the reservoir A or to deliver air at a slower rate. The reservoir B and compressor *b* have also a governing device B' for a similar purpose as also have the reservoir C and compressor *c*. Governing or controlling devices for air compressors are generally actuated by the pressure of air in the air receivers, being connected thereto by a small pipe, such pipes are indicated at A×, B×, C×, in Fig. 1. Various forms of governing or controlling devices are in common use and well known. One form is shown in Fig. 6 and is hereinafter described. Each reservoir would also be provided with the usual accessories such as safety valve, pressure gage, stop valves, etcetera, as may be convenient and desirable. The motors driving the compressors may be of any convenient type such as electro-motors, steam or gas engines, turbines, etcetera, and they may be coupled to the compressors by any convenient power transmitting devices (belts are shown in the figure) or they may be direct coupled.

Three air distributing mains A^2 B^2 and C^2 are shown and any apparatus driven by compressed air may, by means of a suitable arrangement of cocks and valves, derive its air supply from either of these mains, according to the pressure required. For instance furnaces or other apparatus requiring a comparatively large volume of air at low pressure may be supplied from the main A^2 and when as sometimes happens an extra heavy pressure of air is required this may be supplied from main B^2. An air hoist, as shown in Figs. 1 and 2, when lifting a heavy load, requires a supply of air at high pressure, but when lifting a light load only requires air at a lower pressure, and it is more economical to use air from a low pressure main such as B^2 Fig. 1 for lifting light loads, because much less power has been expended in compressing the quantity of air used for the operation. Again when a heavy load is being lowered the air from the main C^2 may be discharged from the hoist cylinder into a lower pressure main B^2 where it is again useful for other purposes.

Referring to the Fig. 2 this shows an air hoist operating according to this invention. It is supplied with air at either of two different pressures by means of the four way cock shown in Fig. 2, the four ways being indicated by the numerals 1, 2, 3, 4, and the plug 5 can be partially rotated by the operator by means of any convenient handle. The passage 1 leads to the hoist

cylinder, 2 leads to the high pressure main C^2, 3 leads to the low pressure main B^2 and 4 is the exhaust port. In the position shown, the lower end of the cylinder is charged with air from the main B^2. If now the valve plug 5 be turned counter clock wise, the lower pressure supply 3 will be cut off, and the high pressure supply 2 put into connection with the lifting cylinder and a heavy load could be lifted, see Fig. 3. Now if the four-way cock be returned to the position shown in Fig. 2 and if the low pressure air supply be insufficient to sustain the load, the piston 6 will descend and the air will be discharged into the low pressure main B^2; on the other hand if the piston does not descend the fourway cock may be rotated into the position of Fig. 4, when the air from under the piston will be discharged to the atmosphere through 4 and the piston 6 will descend. Taking another case, for instance a forge hammer working with compressed air, heavy blows require high pressure air, but light blows require low pressure air. Formerly this low pressure air was obtained by throttling the high pressure supply, with a consequent loss of economy. According to my invention the supply of low pressure air would be obtained direct from a low pressure air distributing main, as will be described below. In a forge hammer the power required for the upstroke is much smaller than that required for the down stroke when delivering heavy blows, the lifting is therefore done according to the present invention with low pressure air and the down stroke or blow is struck with high pressure air excepting, as explained above, in the case of light blows, when these also are struck with low pressure air.

Fig. 5 shows an application of the present invention to a forge hammer. In Fig. 5 A^{10} is a cylinder into which air is admitted to act upon the piston D, attached to the hammer head for the purpose of driving down the hammer head to deliver a blow, B^{10} is a cylinder of larger sectional area, into which air under a lower pressure is admitted below the piston E for the purpose of raising the hammer head. F is a piston rod connecting the two pistons together and passing through a closely fitting hole in the partition G, which separates the two cylinders. J is a piston valve in the chamber J′ and which can be moved longitudinally by means of the hand lever R and the connecting rod S. The chamber J′ is provided with four ports or passages K, I, L, H which are controlled by the valve J. K is the passage through which high pressure air is admitted to the chamber J′. I is a port leading from the chamber J′ to the cylinder A^{10}, L is a passage communicating with a lower pressure air supply main, and H is a port leading to the cylinder B^{10}. The valve J, as shown, is an ordinary cylindrical piston valve, and is provided with an annular recess N. By sliding this valve into various positions, the flow of air through the passages and ports K L I H may be controlled as described below.

A governing or controlling device is illustrated in connection with Fig. 6 and is as follows: Air from the reservoir B is admitted along the pipe $B^{\times}$ to the under side of the piston O which is forced downwards by the spring S. The strength of the spring S and the area of the piston O are so proportioned that when the desired air pressure in the reservoir is exceeded, the spring is compressed, the piston O raised, and the port P opened, and air can now travel freely into the compressor cylinder *b* from the reservoir B through the pipes $B^{\times}$ and R, with the result that the air pressure in the cylinder *b* during the outward stroke of the piston never falls low enough for a fresh supply of air to enter from the reservoir A, consequently the compressor *b* ceases to deliver air and remains in this condition until the air pressure in the reservoir B falls, and permits the spring S to force the piston O down to close the port P. While the port P is closed the compressor *b* draws air from the reservoir *i* at each suction stroke of its piston, and after compression delivers it into the reservoir B. The governor C′ may be an exactly similar device, but I do not claim any invention in governing devices for air compressor, and as many forms of governing devices for air compressors, and as many forms of governors are in common use, further description is unnecessary.

In the case of compressor A which is shown as a rotary "blower" the governing device usually employed is a common pressure relief valve which discharges the excess air into the atmosphere whenever the air pressure in the reservoir A exceeds the desired amount.

I declare that what I claim is:—

1. The combination in compressed air installations in which air is used at a wide range of pressures, of two or more compressors adapted to compress air in stages, each compressor having its own governor acting independently of the governors of the other compressors, a driven apparatus, a distributing main leading from each of the said compressors to the driven apparatus, and cocks and valves, and pipe connections, so arranged as to enable said driven apparatus to be supplied with air from either of the mains according to the power to be developed, and to enable said apparatus to discharge its exhaust air into a lower pressure main or into the atmosphere.

2. The combination in compressed air installations in which air is used at a wide range of pressures, of two or more compressors adapted to compress air in stages, an air reservoir for containing the air at each stage of pressure, a driven apparatus, a distributing main leading from each of the said reservoirs respectively to the driven apparatus, and cocks and valves, and pipe connections so arranged as to enable said driven apparatus to be supplied with air from either of the pressure reservoirs according to the pressure required, or to enable high pressure air when being exhausted to be discharged to a lower pressure main for re-use.

3. In apparatus of the class described, a plurality of reservoirs, means for forcing air thereinto, governing devices for maintaining the air at the desired pressure in each reservoir respectively, a driven apparatus, pipe connections or mains leading from the reservoirs to the driven apparatus, and distributing cocks or valves to enable said driven apparatus to derive its air pressure supply from either of the pressure reservoirs according to the pressure required, or to enable high pressure air when being exhausted to be discharged into the low pressure main for re-use, at the low pressure, or to be compressed again to a higher pressure.

In witness whereof, I have hereunto signed my name this 24th day of Septr. 1904, in the presence of two subscribing witnesses.

GEORGE JAMES GIBBS.

Witnesses:
G. C. DYMOND,
JOHN MCLACHLAN.