(No Model.)

E. HILL.

FLUID COMPRESSOR.

No. 407,205. Patented July 16, 1889.

Fig. 1

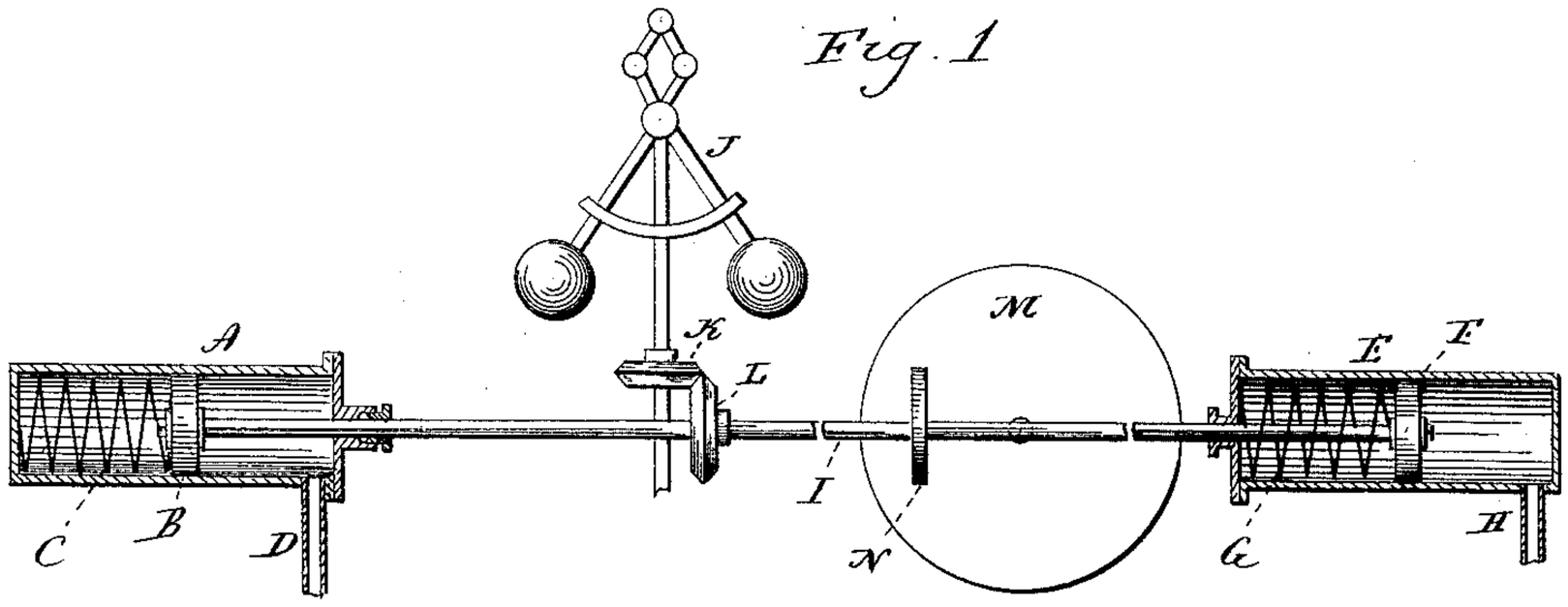


Fig. 2

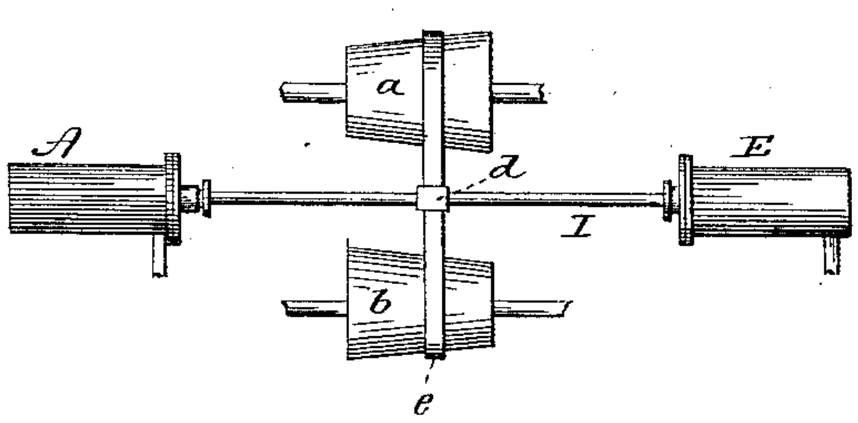


Fig. 3

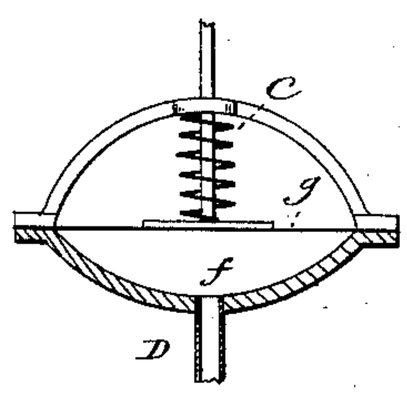


Fig. 5

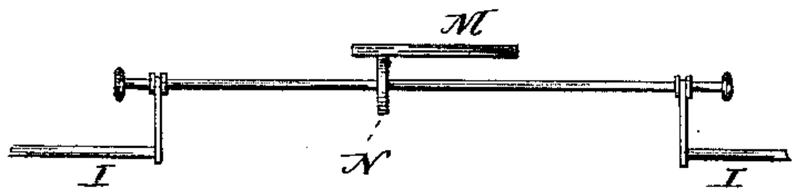
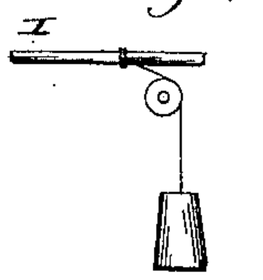


Fig. 4



Witnesses.
J. F. Shumway.
Fred C. Earle

Ebenezer Hall.
Inventor
By atty.
Wm. E. Earle.

UNITED STATES PATENT OFFICE.

EBENEZER HILL, OF SOUTH NORWALK, CONNECTICUT.

FLUID-COMPRESSOR.

SPECIFICATION forming part of Letters Patent No. 407,205, dated July 16, 1889.

Application filed April 15, 1889. Serial No. 307,274. (No model.)

To all whom it may concern:

Be it known that I, EBENEZER HILL, of South Norwalk, in the county of Fairfield and State of Connecticut, have invented a new Improvement in Apparatus for Governing Fluid-Compressors; and I do hereby declare the following, when taken in connection with accompanying drawings and the letters of reference marked thereon, to be a full, clear, and exact description of the same, and which said drawings constitute part of this specification, and represent, in—

Figure 1, a side view of the governing apparatus, the motor and air-compressor not being shown; Fig. 2, a modification in the mechanism for imparting revolution to the governor; Figs. 3 and 4, modifications in the governing-cylinders; Fig. 5, a modification in the connections between the governor and pistons.

This invention relates to an apparatus for governing the operation of air, gas, or other fluid compressors, the object being to insure a regular and constant pressure from the discharge, irrespective of the varying pressures upon the inlet or varying consumption from the discharge.

In the employment of fluid-compressors the variation in the pressure is due to two causes: first, variation in the consumption, and, second, to variation of the pressure at the inlet. The increased consumption reduces the pressure produced by the compressing apparatus, and vice versa. Under a varying pressure of the inlet an increase or decrease of pressure on the inlet will correspondingly increase or decrease the pressure of discharge—that is to say, if the compressor is taking its supply at normal atmospheric pressure and working properly under those conditions, if the pressure at the inlet be doubled, so that the compressor now takes its supply under double the normal pressure, the increase of pressure from the compressor will be correspondingly increased.

The invention is especially adapted for pumping natural gas, where the pressure from the wells varies to a considerable extent; but it is necessary that the pressure in the mains shall be uniform.

By my invention I govern the speed of the compressor, so that it shall vary inversely as the pressure of the inlet varies. For example, if the compressor is running at one hundred revolutions, under a certain pressure of the inlet-gas, and that inlet-pressure should be suddenly increased to double its former pressure, the governing apparatus will cause the compressor to move at one-half its former speed, so long as the said double pressure shall exist, and the speed be reduced or increased accordingly as the inlet-pressure is increased or reduced; consequently the gas actually discharged into the main by the compressor will be without variation.

The invention consists in a cylinder and piston, or their equivalents, having a normal or standard pressure upon one side of the piston, the reverse side of the piston open to the pressure of the inlet or discharge, as the case may be, the said piston in connection with a speed-varying mechanism between the piston and the governor, whereby the movement of the said piston under the varying pressure of the supply or discharge, as the case may be, will correspondingly vary the speed of the governor which controls the compressing apparatus.

In Fig. 1 I represent a cylinder A, in which is a piston B, provided with a spring C, operating against the piston, tending to force the piston in one direction, the cylinder from the other side of the piston being in connection, by a pipe D, with the inlet or supply. In line with this cylinder is a second cylinder E, like the cylinder A, and provided with a piston F. This cylinder E, I also prefer to provide with a spring G to operate upon its piston, like the spring C of the cylinder A. From the reverse side of the piston a pipe H communicates with the discharge. These two pistons are connected to a shaft I, so that the pistons are maintained in the same relation to each other, the shaft being permitted to revolve freely. The governor is operated from this piston-shaft I. As here illustrated, the governor J is a common construction of ball-governor. Its vertical shaft is provided with a bevel-pinion K, which connects with a corresponding pinion L on the shaft I, the said pinion L being splined to its shaft, so as to permit longitudinal movement of the shaft,

but yet so that the pinion will partake of the revolution of the piston-shaft and communicate that revolution to the governor.

To impart revolution to the shaft I, a friction-disk M is arranged, which is caused to revolve in a plane parallel with the plane of the shaft I by a connection with the engine which drives the compressor.

I do not illustrate the motor or the compressor, as such are well-known and do not require to be illustrated or described further than to say that the motor imparts revolution to the disk M.

Fixed to the shaft I is a friction-wheel N, which works in contact with the surface of the disk M. The axis of the disk M is at right angles to the axis of the shaft I and in a plane therewith, as shown. The friction-wheel N works in frictional contact with the surface of the disk M, and so that the revolution of the disk M will impart corresponding revolution to the friction-wheel N, which revolution will be communicated to the governor J. The friction-wheel N is made fast to the shaft I, so as to partake of the longitudinal movement which may be imparted to the said shaft.

It will be obvious that the velocity with which the shaft I will revolve will depend upon the position which the friction-wheel N bears to the center of motion of the disk M—that is to say, the nearer the wheel N is to the center of motion of the disk M the slower will be the revolution of the shaft I, and vice versa.

The fluid-pressure upon the piston of the cylinder A will always be that of the supply-pressure to the compressor, and the fluid-pressure in the cylinder E will always be that of the discharge. The springs are adjusted so that under the normal pressure the pistons will stand in a position to bring the friction-wheel N to such a position on the disk M as to cause the governor to run at a given speed, that speed being the speed required for such normal pressure.

If the inlet-pressure is increased, it follows that the piston B of the cylinder A will be forced against its spring and move according to such increased pressure, and this movement of the pressure will draw the shaft I, so as to bring the friction-wheel N at a greater distance from the center of motion of the disk M, and thereby increase the velocity of the governor, which increase of movement of the governor immediately operates to cut off the steam, or whatever the force may be to operate the motor. If, on the contrary, the inlet-pressure be reduced, then the reaction of the spring of the cylinder will cause the piston to move in the opposite direction and carry the friction-wheel nearer the center of motion and correspondingly reduce the speed of the governor.

If the pressure of the discharge be varied, as by an increased consumption, the pressure in the cylinder E will be reduced accordingly, the spring will react upon the piston, and will draw the shaft and the friction-wheel N nearer the center of motion of the disk M and reduce the speed of the governor accordingly, thereby increasing the power of the motor; or if, on the contrary, the pressure of the discharge be increased, then the piston of the cylinder E will be moved in the opposite direction and correspondingly increase the speed of the governor and reduce the motive force. Under this arrangement the speed of the governor is controlled entirely by the pressure of the fluid either upon the inlet or discharge, any variation at either point correspondingly varying the speed of the governor.

In some cases the variation to be corrected may be only from the inlet. In that case the cylinder for the discharge may be omitted; or in some cases the inlet may be unvarying. In that case the cylinder upon the discharge side will only be required; but in pumping uatural gas variation of pressure occurs both from the inlet and from the discharge. In such apparatus a cylinder is employed both for the inlet and discharge.

The governor may be otherwise operated, but yet controlled from the piston-shaft—as, for illustration, as seen in Fig. 2. In this case cone-pulleys *a b* are employed, one being driven from the motor and the other in connection with the governor. The piston-shaft I in this case does not revolve, but carries a band-guide *d*, which serves as a shifter for the band E, which runs upon the cone-pulleys *a b*, so that the band being adjusted to different positions on the cone-pulleys will correspondingly vary the speed of the governor.

I have said that equivalents for the pistons and cylinders may be employed. To illustrate this fact I show in Fig. 3 a chamber *f*, upon which is a diaphragm *g*—the chamber open, say, to the inlet-pipe D, so as to bring the pressure of the inlet or supply upon the diaphragm. Upon the other side of the diaphragm a spring C is arranged, as upon the piston. It will be obvious that the same result will be accomplished in this case as in the employment of a piston and cylinder. Therefore by the term "piston and cylinder," as herein used, I wish to be understood as including any substantial equivalent therefor.

The governing apparatus is applicable to the compressing of all fluids, as gas, air, or water.

Any suitable device may be employed to yieldingly resist the action of the pressure upon the piston—such, for illustration, as a weight (see Fig. 4,)—it only being necessary that there shall be a reactive resistance to the movement of the piston.

I have represented the shaft by which revolution is communicated to the governor as in direct connection with the piston; but the governor-shaft may be an independent shaft in connection with the piston-rods, as seen in Fig. 5, the movement of the pistons communicating longitudinal movement to the shaft

in substantially the same manner as in the first illustration.

I claim—

1. In a fluid-compressing apparatus, the combination of a governor adapted to control the speed of the motor, a piston and cylinder, one side of the piston open to the pressure of the fluid and with a reactive resistance upon the piston in the opposite direction, mechanism between the said piston and the governor for imparting rotation to said governor, and a speed-controller between said mechanism and said piston, substantially as described, and whereby the movement of the said piston under varying pressure of the fluid correspondingly varies the speed of the governor.

2. In a fluid-compressing apparatus, the combination of a cylinder, a piston in said cylinder free for longitudinal movement, a resisting-spring upon one side of the piston, the other side of the piston open to the fluid-pressure, a shaft in connection with said piston and movable longitudinally therewith, a governing mechanism, substantially such as described, for imparting revolution to said governor, and a speed-controller in connection with said piston-shaft between the said governor and said mechanism, substantially as described.

3. In a fluid-compressing apparatus, the combination of a cylinder, a piston in said cylinder free for longitudinal movement, a resisting-spring upon one side of the piston, the other side of the piston open to fluid-pressure, a shaft in connection with the said piston and arranged to revolve, a disk adapted to receive revolution from the compressor-motor, the axis of said disk at substantially right angles to the axis of said piston-shaft, a friction-wheel on the said piston-shaft and arranged to work upon the surface of the said disk, whereby the said piston-shaft receives revolution from said disk, the said friction-wheel movable radially on the surface of said disk according to the movement of said piston, and a governor in connection with said piston-shaft, whereby the rotation of the piston-shaft is imparted to the said governor, substantially as described.

4. In a fluid-compressor, the combination of two cylinders, a piston in each of said cylinders, a resisting-spring against each of said pistons, the piston of one cylinder open to the inlet-pressure, the corresponding side of the piston of the other cylinder open to outlet-pressure, a shaft connecting said pistons, a governor mechanism, substantially such as described, to impart revolution to said governor, and a speed-controller in connection with said piston-shaft, substantially as described, which, under the longitudinal movement of the pistons, produced by either the inlet or outlet pressure, will correspondingly vary the revolution of the governor.

EBENEZER HILL.

Witnesses:
CHAS. J. HILL,
JOHN A. SLATER.