(No Model.) 3 Sheets—Sheet 1.

F. M. RITES.

HIGH SPEED FLUID COMPRESSOR.

No. 542,426. Patented July 9, 1895.

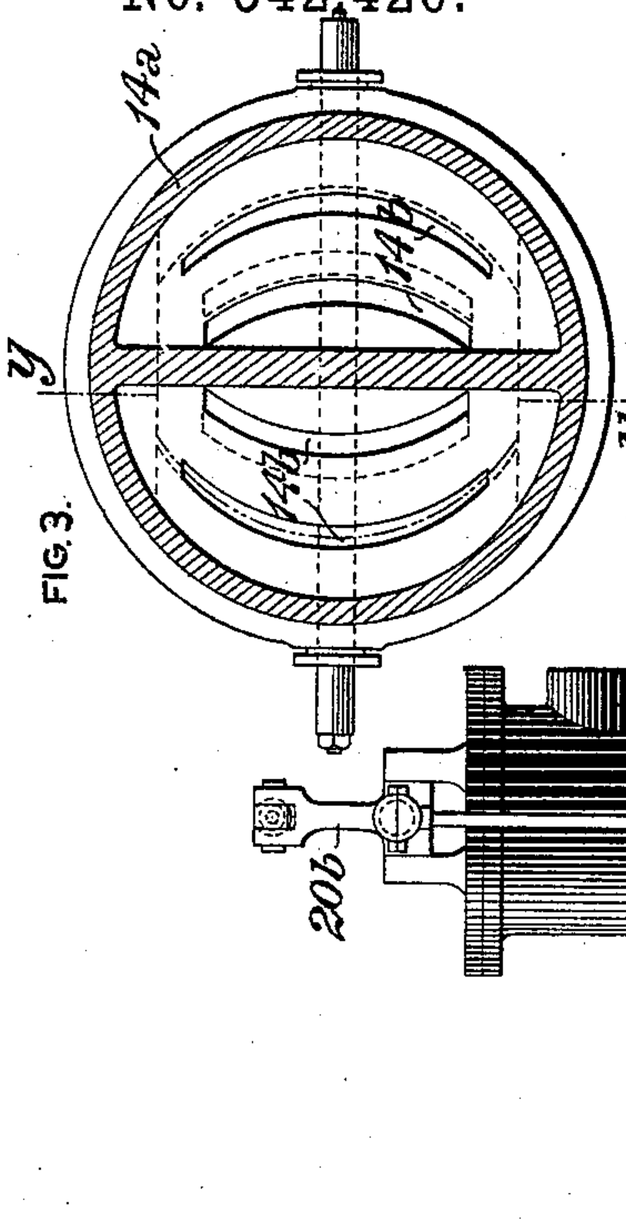

FIG. 3.

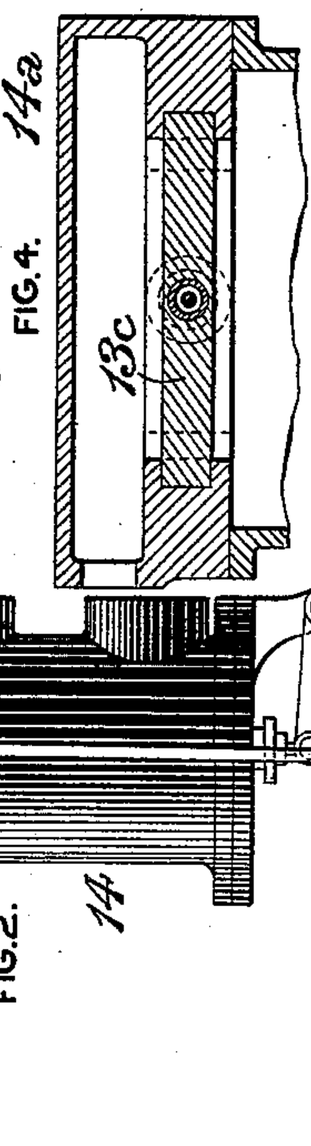

FIG. 4.

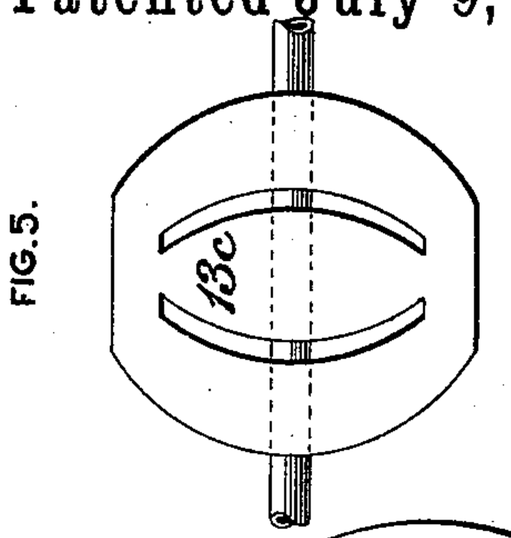

FIG. 5.

FIG. 2.

FIG. 1.

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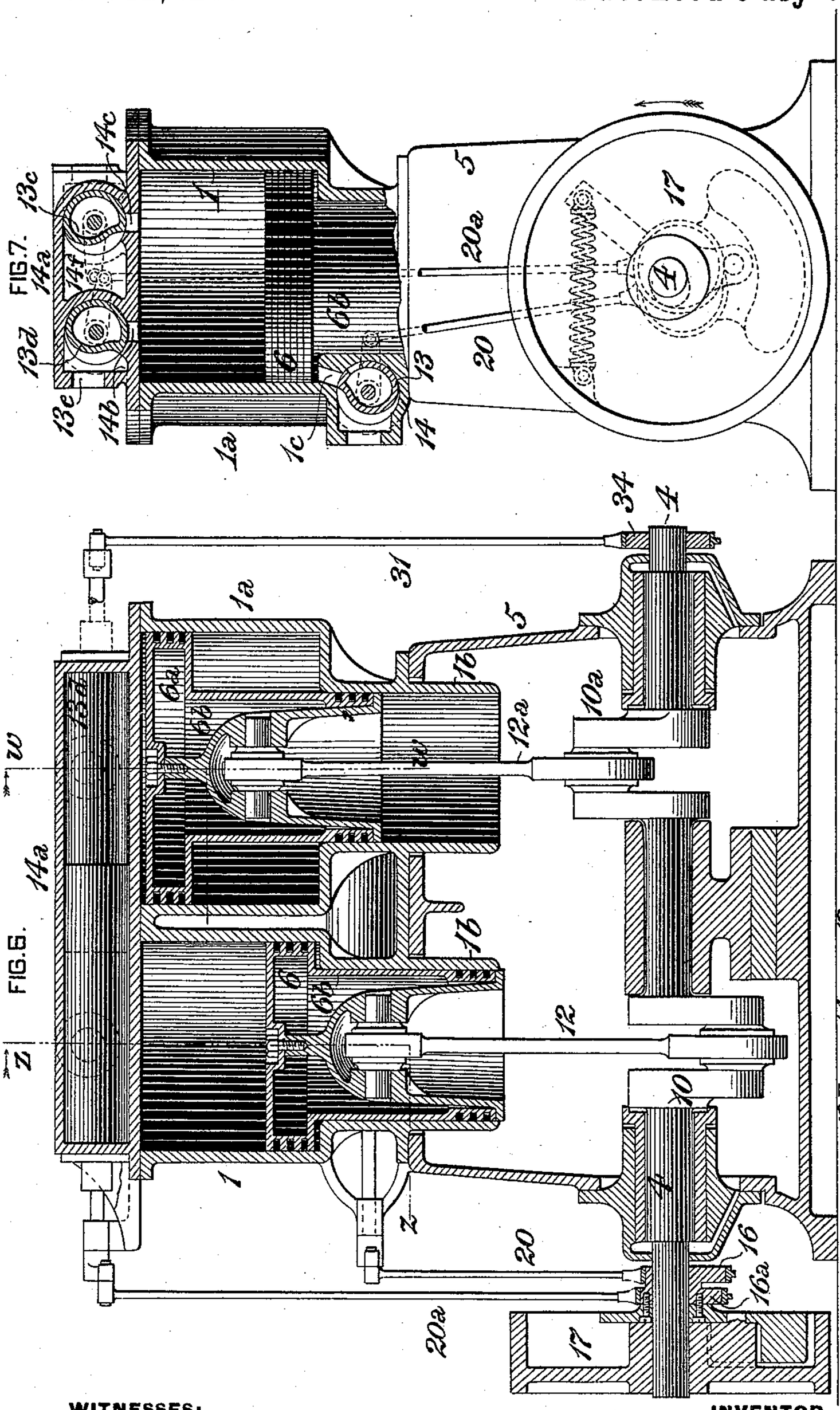
Att'y.

(No Model.) 3 Sheets—Sheet 2.

F. M. RITES.

HIGH SPEED FLUID COMPRESSOR.

No. 542,426. Patented July 9, 1895.



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(No Model.) 3 Sheets—Sheet 3.

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HIGH SPEED FLUID COMPRESSOR.

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FIG. 13.

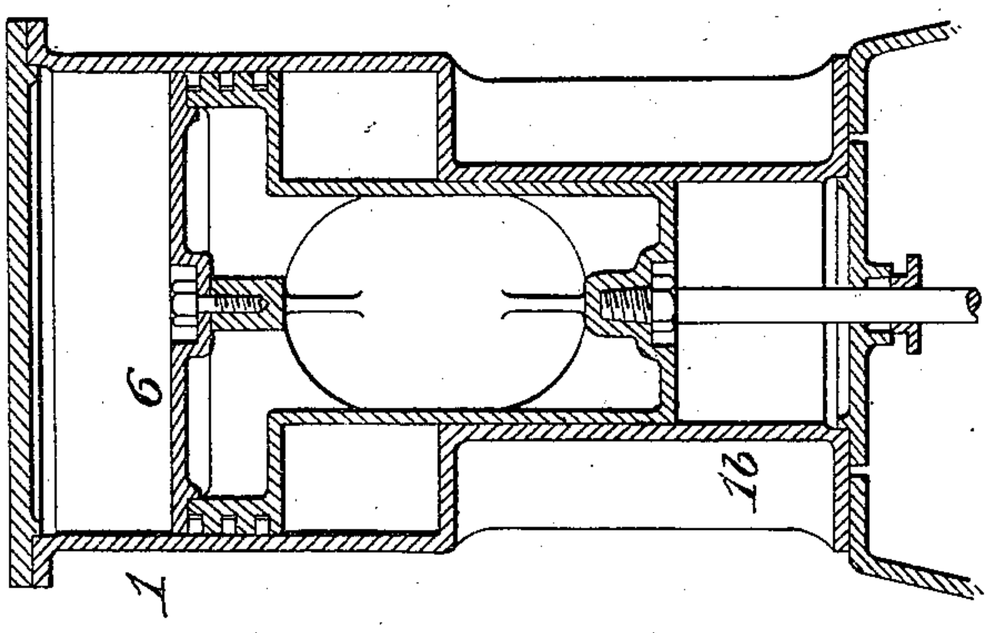


FIG. 11.

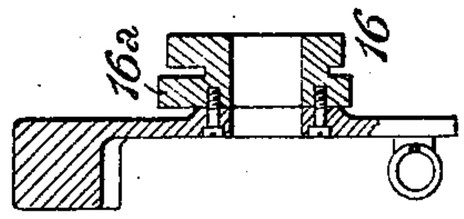


FIG. 10.

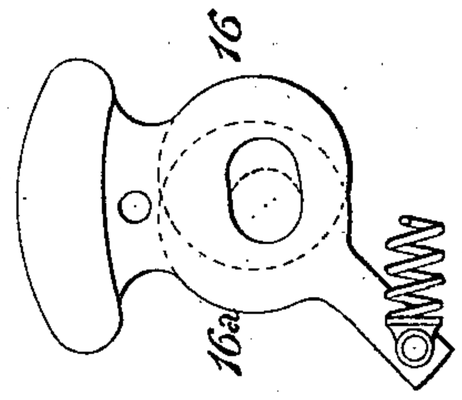
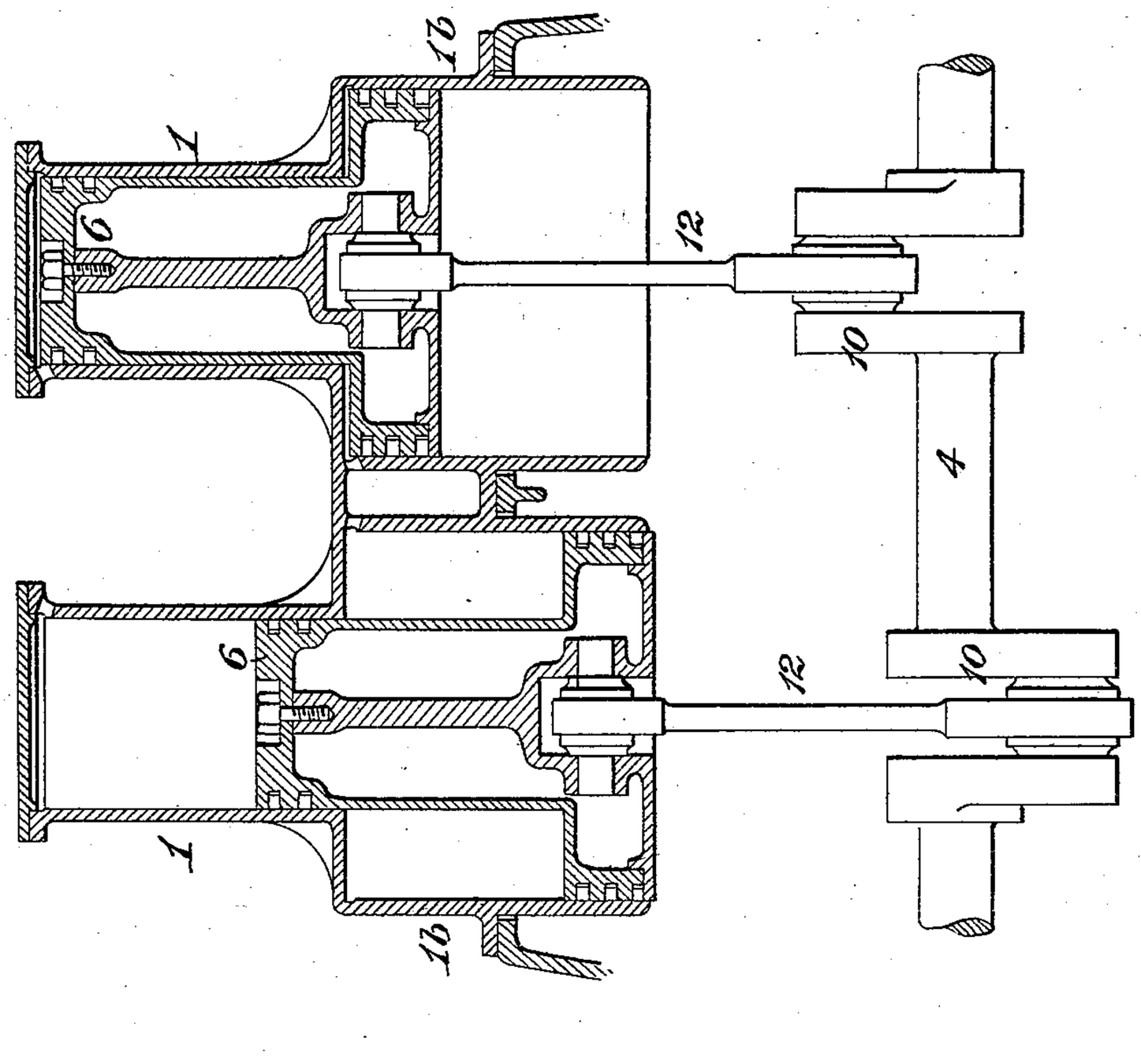


FIG. 12.



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by Howden Bell.

Att'y.

UNITED STATES PATENT OFFICE.

FRANCIS M. RITES, OF PITTSBURG, PENNSYLVANIA.

HIGH-SPEED FLUID-COMPRESSOR.

SPECIFICATION forming part of Letters Patent No. 542,426, dated July 9, 1895.

Application filed October 16, 1894. Serial No. 526,044. (No model.)

To all whom it may concern:

Be it known that I, FRANCIS M. RITES, a citizen of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented or discovered a certain new and useful Improvement in High-Speed Motors and Fluid-Compressors, of which improvement the following is a specification.

The object of my invention is to provide a compressor for air or other elastic fluid which shall be of simple and inexpensive construction and which in operation shall attain a greater degree of efficiency than has heretofore been attained in compressors of the several known types and effectively perform its required functions at a high speed.

To this end my invention, generally stated, consists in the combination of a compressor-cylinder, a valve mechanism controlling the eduction function thereof, an adjustable eccentric actuating the eduction-valve mechanism, and a governor controlling said adjustable eccentric; also, in the combination of a cylinder, a differential piston working therein, a valve mechanism controlling the distribution of motive fluid to and from one or more of the surfaces of said piston, and a valve mechanism controlling the distribution of fluid to be compressed to and from another surface or surfaces of said piston.

The improvement claimed is hereinafter fully set forth.

In the accompanying drawings, Figure 1 is a vertical central section through a motor and fluid-compressor, illustrating an application of my invention; Fig. 2, a partial end view showing the governor and valve connections; Fig. 3, a horizontal section through the compressor valve-chest at the line *x x* of Fig. 1; Fig. 4, a transverse section through the same at the line *y y* of Fig. 3; Fig. 5, a plan or top view of the compressor-valve; Fig. 6, a vertical longitudinal central section through a double-cylinder compressor in which a double expansion of motive fluid and a double compression is effected; Fig. 7, an end view, partly in section, at the line *z z* of Fig. 6, looking from the left; Fig. 8, a transverse section through the compressor valve-chest, and Fig. 9 a similar section through the motor valve-chest, both being taken at the line *w w* of Fig. 6; Fig. 10, a view in elevation of the adjustable eccentrics and governor-weight detached; Fig. 11, a transverse section through the same, and Figs. 12 and 13 diagrammatic sectional views illustrating modifications in the construction of the cylinders and pistons.

In the practice of my invention, as exemplified in the construction shown in Figs. 1 to 5, inclusive, I provide a cylinder 1, which serves both as a motor and a compressor cylinder and is fitted with a differential piston 6—that is to say, a piston having surfaces of respectively different areas, through one of which it acts as a motor-piston and through another as a compressor-piston. In this instance a tubular extension or trunk 6^b is formed upon the piston and works in a corresponding tubular open-ended extension 1^b of the cylinder 1. The cylinder 1 is fixed upon a frame or housings 5, and its piston 6 is coupled by a connecting-rod 12 to the pin of a crank 10 on a crank-shaft 4, journaled in bearings in the frame. Motive fluid is admitted to and exhausted from the cylinder-space around the trunk 6^b and acts upon the annular lower surface of the piston 6, and fluid to be compressed is admitted to and discharged from the cylinder-space above the piston and is acted on by the latter throughout its circular upper surface.

The distribution of motive fluid is effected by a distribution-valve 13, which is shown as of the piston type and is fitted to reciprocate in a valve-chest 14 on the side of the cylinder 1 and to control a port 1^c therein, adjacent to its lower end. The motor distribution-valve 13 is actuated by an adjustable eccentric 16, which is mounted on the crank-shaft 4 and is varied and controlled in position thereon by a governor 17. The rod 20 of the eccentric 16 is coupled to the stem 15 of the distribution-valve 13 through the intermediation of a rock-shaft 37, having arms 36 and 38, which are connected respectively to the eccentric-rod 20 and to the valve-stem 15.

The induction and eduction of fluid to be compressed to and from the cylinder-space above the piston 6 is effected by a slide distribution-valve 13^c, fitted to reciprocate in a valve-chest 14^a on the top of the cylinder 1 and controlling-ports 14^b, through which fluid to be compressed passes from an inlet-open-

ing 13^f to the space above the piston, and thence to a discharge-pipe 13^e, leading to a reservoir or receiver.

The compressor distribution-valve 13^c is actuated by an adjustable eccentric 16^a, which is mounted on the crank-shaft 4 and is, similarly to the eccentric 16 of the motor distribution-valve, varied and controlled in position by the governor 17. The adjustable eccentrics 16 and 16^a are, in this case, shown as formed integral, and they project oppositely from the vertical central plane of the crank-shaft, so that adjustments by the governor which increase the eccentricity of the eccentric of the motor distribution-valve coincidently and correspondingly decrease the eccentricity of the eccentric of the compressor distribution-valve.

By a construction substantially as above described the eduction function of a compressor-cylinder is effected by valve mechanism actuated by an adjustable eccentric which is controlled by a governor, and the distribution functions of a motor-cylinder and a compressor-cylinder are coincidently and inversely varied by the positive application of a common controlling influence in the manner set forth in a separate application (Case C) filed by me of even date herewith, Serial No. 526,043. The method set forth in said application is not claimed as of my present invention, but the apparatus of the latter is suitably adapted to the practice of said method. The construction also attains the advantage of a material structural simplification in admitting of the employment of a single cylinder and piston for the performance of both motor and compressor functions through the utilization of different surfaces of a differential piston and different spaces in the same cylinder for the reception of motive fluid and of fluid to be compressed, respectively.

Figs. 6 to 9, inclusive, illustrate my invention as applied in a double-cylinder compressor, which so far as its essentials of structure and manner of operation are concerned may be said to be two compressors, substantially as above described, united in a single apparatus. The construction embodies, however, the further features of providing for a double expansion of motive fluid and a double compression of fluid operated on and the utilization of separate valves for compression induction and eduction functions.

The cylinders 1 and 1^a are of different diameters, respectively, and are, similarly to the cylinder of the instance first described, secured upon a frame or housings 5 and provided with tubular extensions 1^b, within which the trunks 6^b of the pistons 6 6^a reciprocate. The pistons 6 6^a are coupled by connecting-rods 12 12^a to the pins of cranks 10 10^a, set oppositely, or one hundred and eighty degrees apart, on the crank-shaft 4. The distribution functions of the motor-cylinders, or, more properly, cylinder-spaces, being the spaces around the trunks 6^b and below the annular lower surfaces of the pistons, are effected by a single distribution-valve 13 of the piston type, fitted to vibrate about its axis in a valve-chest 14 and actuated through a rocker and arm by the rod 20 of an adjustable eccentric 16, which is mounted on the crank-shaft 4 and is varied and controlled in position thereon by a governor 17. The induction function of the compressor-cylinder spaces—to wit, those above the pistons 6 6^b—is effected by a distribution-valve 13^c fitted to vibrate about its axis in a chest 14^a, above the cylinders, and controlling a port 14^c leading into the compressor-space of the cylinder 1, and a port 14^e, leading into the compressor-space of the cylinder 1^a. The induction distribution-valve 13^c is actuated by an eccentric 34 fixed upon the crank-shaft 4 and having its rod 31 coupled to an arm on the stem of the valve 13^c. The eduction or discharge function of the compressor-spaces is effected by a distribution-valve 13^d fitted to vibrate about its axis in the chest 14^a and controlling a port 14^b, leading into the compressor-space of the cylinder 1, and a port 14^d, leading into the compressor-space of the cylinder 1^a. The eduction distribution-valve 13^d is actuated by an adjustable eccentric 16^a, mounted on the crank-shaft 4, and varied and controlled in position thereon coincidently with the adjustable eccentric 16 of the motor distribution-valve by the governor. The rod 20^a of the eccentric 16 is coupled to an arm on the stem of the valve 13^d and, as in the instance first described, the eccentrics 16 16^a project in opposite directions from the vertical central plane of the crank-shaft and are formed integral.

In the operation of the apparatus motive fluid is admitted to the annular space below the piston of the smaller or high-pressure cylinder 1, and, after effecting the upward stroke of the piston 6 thereof, is exhausted into the larger annular space below the piston of the larger or low-pressure cylinder 1^a, in which it is expanded and effects the upward stroke of the piston 6^a, after which it is exhausted to the atmosphere or to a condenser, as the case may be. The air or other fluid to be compressed enters the inlet-passage 13^f and is admitted by the valve 13^c, through the port 14^e, to the larger compressor-space above the piston of the low-pressure cylinder 1^a, in which it is initially compressed by the upward stroke of the piston 6^a thereof. It is then exhausted therefrom by the valve 13^d, through the port 14^d, into the space 14^f between the valve in the chest 14^a. It is then admitted by the valve 13^c, through the port 14^e, to the smaller compressor-space above the piston of the high-pressure cylinder 1, in which it is subjected to a further and final compression by the upward stroke of the piston 6, and is thereafter exhausted by the valve 13^d, through the port 14^b, to the discharge-passage 13^e, which is connected by a suitable

pipe with the receiver or reservoir of compressed fluid.

It will be seen that, as in the former instance, the induction function of the motor-cylinder spaces and the eduction function of the compressor-cylinder spaces are coincidently and inversely varied through the adjustments of position of the adjustable eccentrics which actuate the respective distribution-valves by a governor or controlling mechanism connected to and common to both of said eccentrics. A structural simplification in accordance with that of the instance first described is also provided, and the operative advantage of a double expansion and a double compression of the motive fluid and of the fluid to be compressed, respectively, is attained.

In the instances exemplified pistons of trunk form have been illustrated as providing an annular area for the action of motive fluid materially less than the area of their opposite sides, which act upon the fluid to be compressed in correspondence with the ordinary material difference between the pressures of the two fluids. It will be obvious, however, that pistons of such type are not essential, and also that they may have more than two working-surfaces and that their differential areas may be so relatively proportioned that either may be adapted to act upon or to be acted upon, either the fluid to be compressed or the motive fluid, as the case may be. Thus Fig. 12 shows a construction in which motive fluid acts upon the smaller circular surfaces of pistons having enlargements on their lower ends working in tubular extensions of the cylinders, and the fluid to be compressed is acted upon by the smaller annular surfaces of the enlargements of the pistons. In such case the downward stroke of the piston of one cylinder effects compression in the annular space around the body of the piston of the other cylinder during the upward stroke of the latter piston, and vice versa. Fig. 13 shows a piston of similar form, but reversed in position in the cylinder, the portion which is of smaller diameter working in the tubular extension of the cylinder, which is closed at its outer end, and the piston being secured upon a piston-rod adapted to be connected to a crank in the ordinary manner. The piston thus presents three working-surfaces of different areas, respectively, one or more of which may be acted on by motive fluid and one or more caused to act upon the fluid to be compressed. Motive fluid may be applied to the lower circular surface of the piston and expanded into the space below the annular surface of its enlarged portion, compression being effected in the space above the upper and larger surface of its enlarged portion. As an alternative operation motive fluid may be applied to the lower circular surface of the piston, preliminary compression effected in the space above the upper and larger surface of its enlarged portion, and final compression effected in the space below the annular surface of its enlarged portion. It will be obvious that for the practice of this latter operation a two-cylinder apparatus having its pistons connected to opposite cranks, as in Figs. 6 and 12, will be required.

I claim as my invention and desire to secure by Letters Patent—

1. In an apparatus for the compression of elastic fluid, the combination, substantially as set forth, of a cylinder, a differential piston working therein, a valve mechanism controlling the distribution of motive fluid to and from one or more of the surfaces of said piston, a valve mechanism controlling the distribution of fluid to be compressed to and from another surface or surfaces of said piston, and a single governing mechanism connected to and controlling both of said distribution valve mechanisms.

2. In an apparatus for the compression of elastic fluid, the combination, substantially as set forth, of two cylinders of different diameters, each having a tubular extension, differential pistons, each fitting one of said cylinders and the tubular extension thereof, a valve mechanism controlling the distribution of motive fluid to and from a smaller surface of the piston of the smaller cylinder, and thence to and from a smaller surface of the piston of the larger cylinder, valve mechanisms independently controlling the induction and eduction of fluid to be compressed to and from a larger surface of the piston of the larger cylinder and thence to and from a larger surface of the piston of the smaller cylinder, and a governor connected to the motive fluid distribution valve mechanism and to the eduction valve mechanism of fluid to be compressed.

3. In an apparatus for the compression of elastic fluid, the combination, substantially as set forth, of a motor, a compressor cylinder, a valve mechanism controlling the eduction function thereof, an adjustable eccentric actuating the eduction valve mechanism, and a governor actuated by the motor and controlling said adjustable eccentric.

4. In an apparatus for the compression of elastic fluid, the combination, substantially as set forth, of a cylinder, a piston working in said cylinder and forming a division between spaces therein for the reception of motive fluid and of fluid to be compressed, respectively, a valve mechanism controlling distribution in the motive fluid space, a valve mechanism controlling eduction from the space for fluid to be compressed, adjustable eccentrics, each actuating one of said valve mechanisms, and a governor connected to and controlling both of said eccentrics.

5. In an apparatus for the compression of elastic fluid the combination of a motor, a compressor, a valve mechanism for the motor, a valve mechanism for the compressor, two adjustable eccentrics, one having connections to the valve mechanism of the motor and the

other having connections to the valve mechanism of the compressor, and means connecting the eccentrics whereby the adjustment of one of the eccentrics, by a governor, or otherwise, for the purpose of varying the functions of the valve mechanism to which it is connected, effects an inverse adjustment of the other eccentric, for the purpose of varying the functions of the valve mechanism to which it is connected, substantially as set forth.

6. An adjustable valve operating device comprising two connected eccentrics having connections for operating two separate valve mechanisms and adapted to be adjusted on a shaft so that any variation in the adjustment of one of the eccentrics and the valve mechanism operated thereby will cause an opposite variation in the other eccentric and the valve mechanism operated thereby, substantially as set forth.

7. The combination with the valve mechanism of a motor and with the valve mechanism of a compressor of two rigidly connected adjustable eccentrics for operationg the valve mechanisms and means whereby the two eccentrics may be simultaneously adjusted to cause opposite variations in the valve mechanisms, substantially as set forth.

8. In a combined motor and compressing apparatus, the combination of a crank shaft, a cylinder, a differential piston fitting the cylinder and forming a division between spaces therein for the reception of motive fluid and fluid to be compressed, connections from the piston to the shaft, a valve mechanism controlling the distribution of motive fluid, a valve mechanism controlling the eduction of compressed fluid, connections from each of the valve mechanisms to an adjustable eccentric on the shaft, and a governing device for adjusting the eccentrics to vary the distribution of motor fluid and the eduction of compressed fluid, substantially as set forth.

In testimony whereof I have hereunto set my hand.

FRANCIS M. RITES.

Witnesses:
J. SNOWDEN BELL,
F. E. GAITHER.