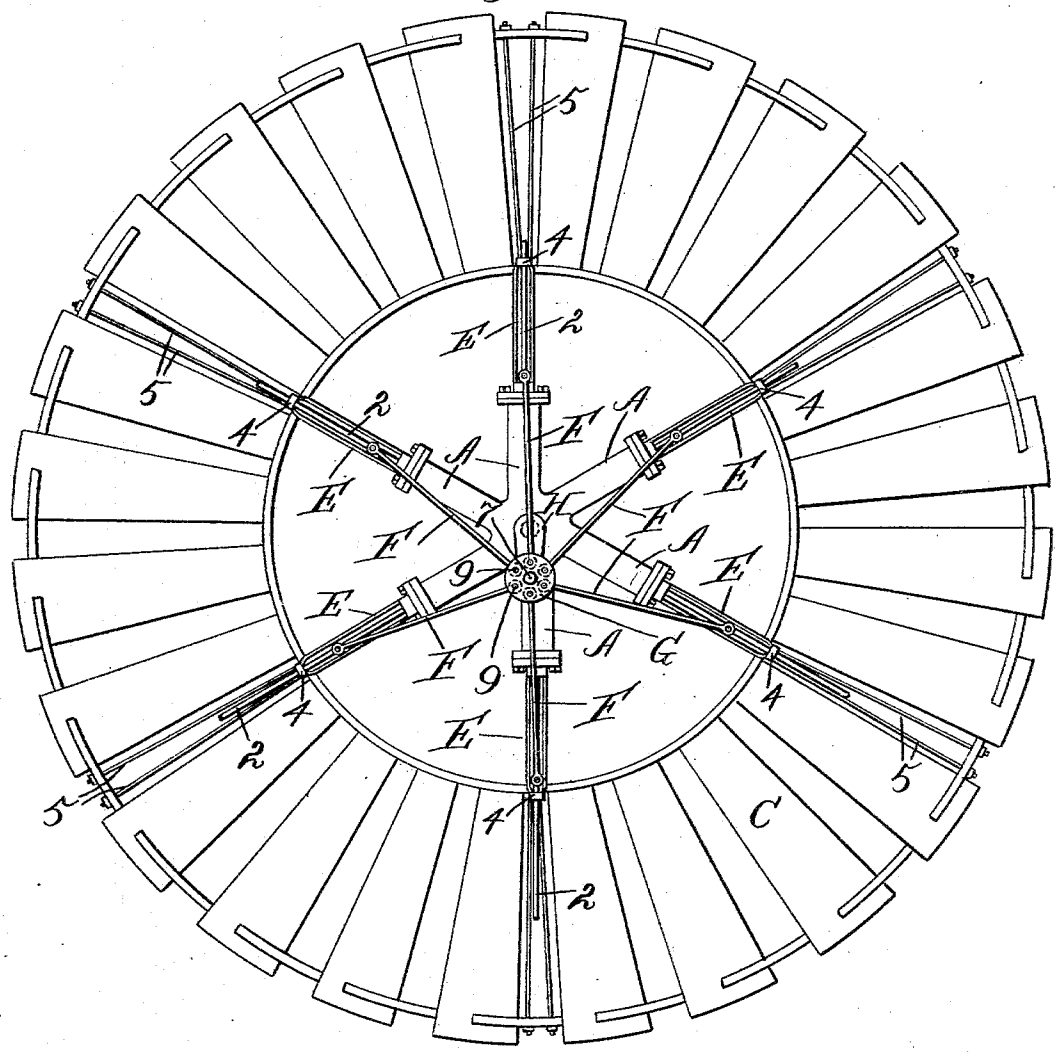
(No Model.) 5 Sheets—Sheet 1.

LA VERNE W. NOYES.

AIR COMPRESSOR.

No. 563,794. Patented July 14, 1896.

Fig. 1



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LA VERNE W. NOYES.

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Fig. 2.

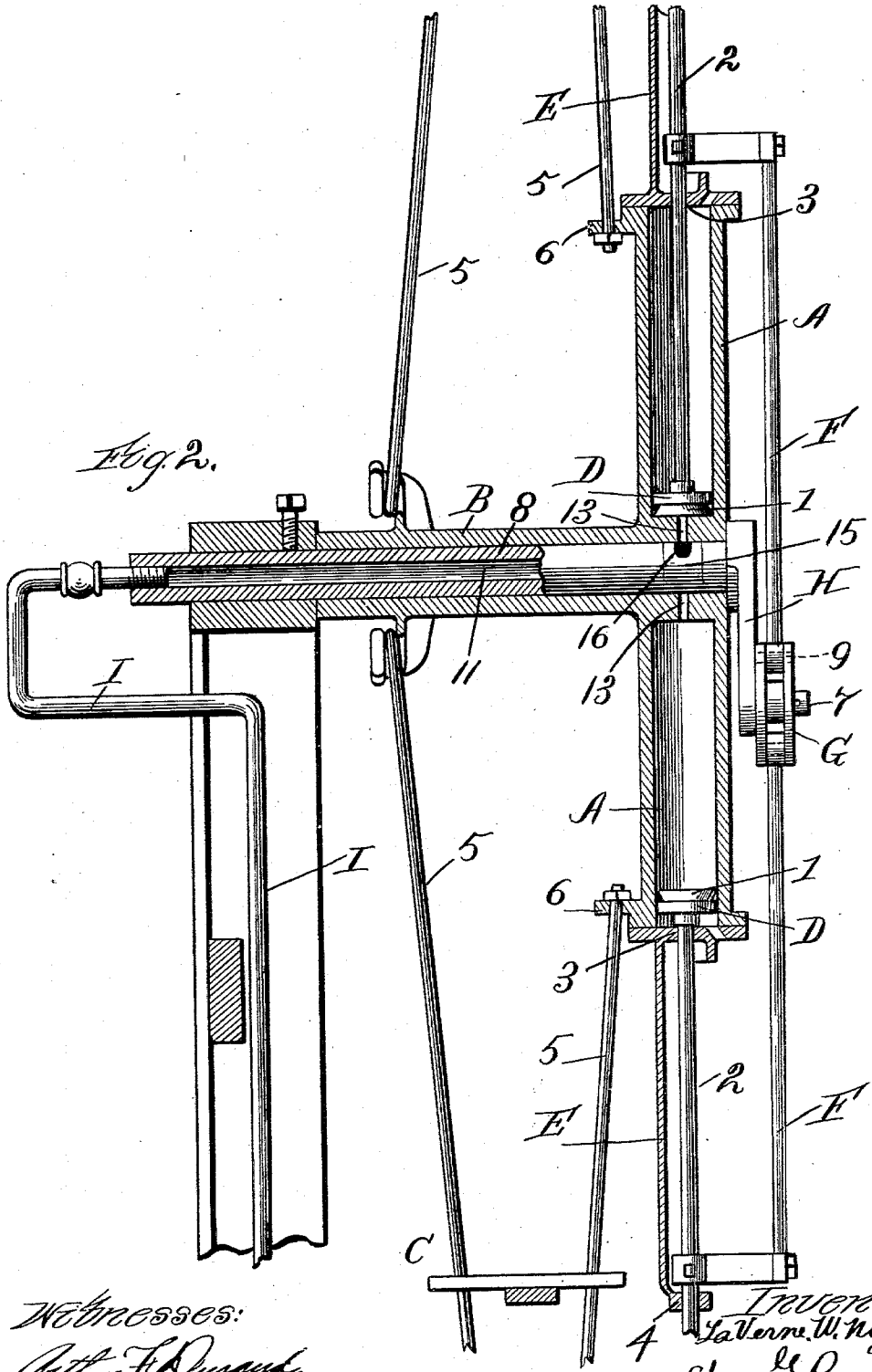

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Fig. 5.

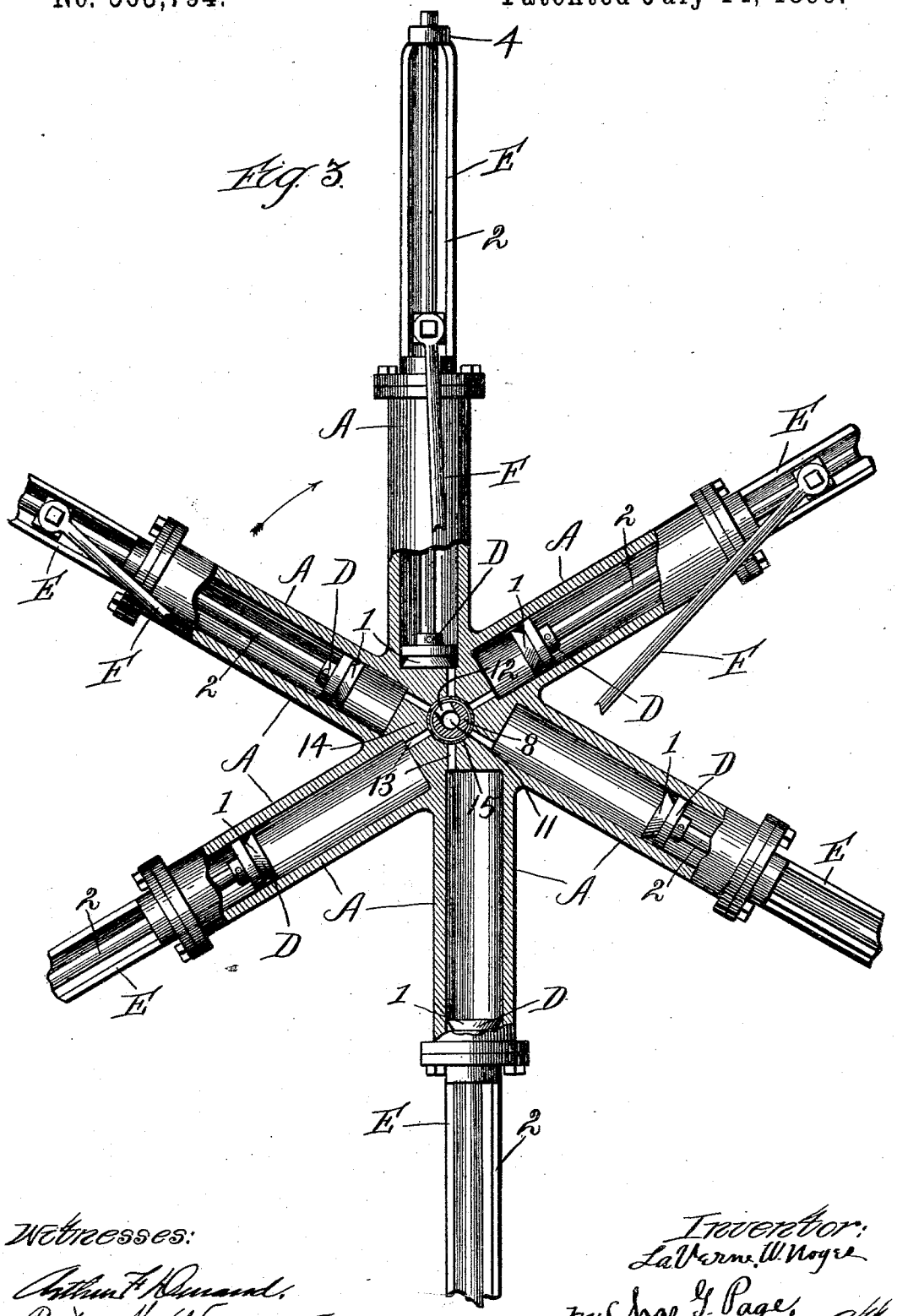

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Fig. 4.

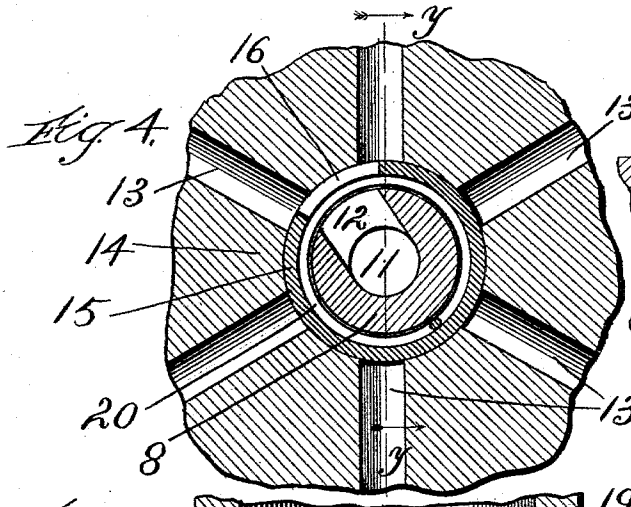

Fig. 6.

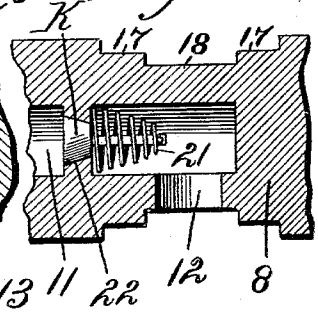

Fig. 5.

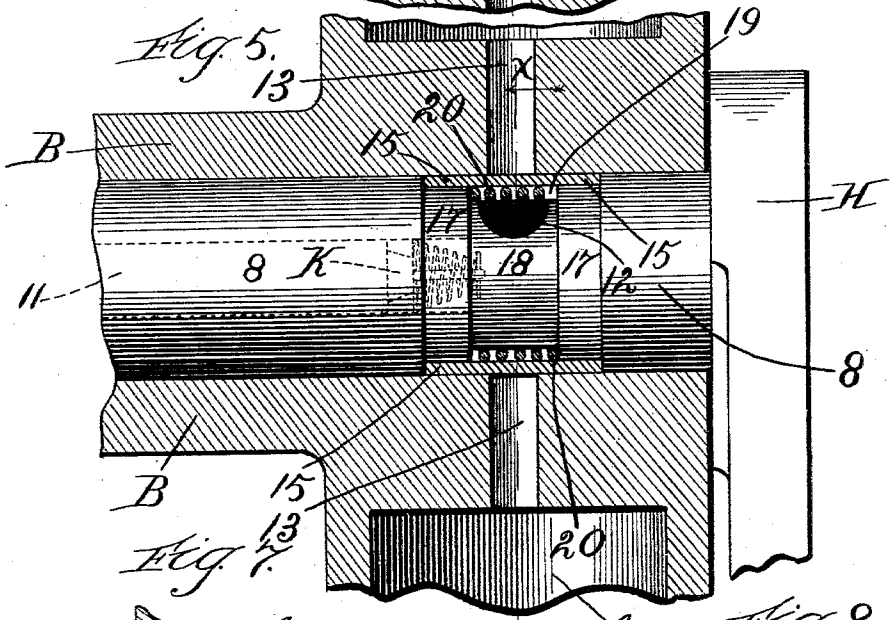

Fig. 7.

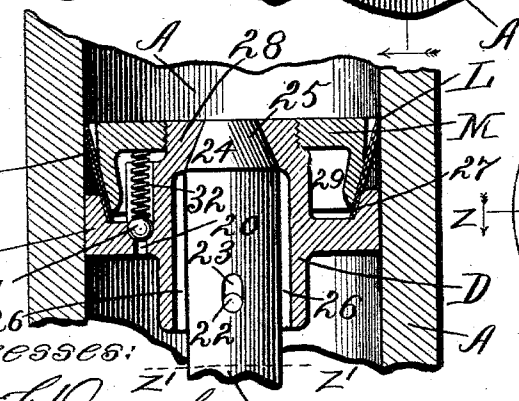

Fig. 8.

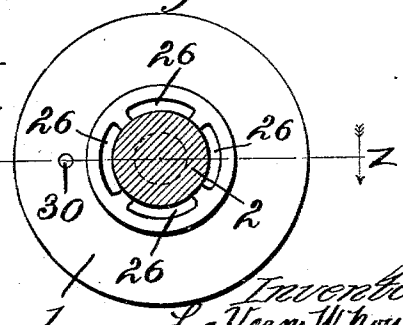

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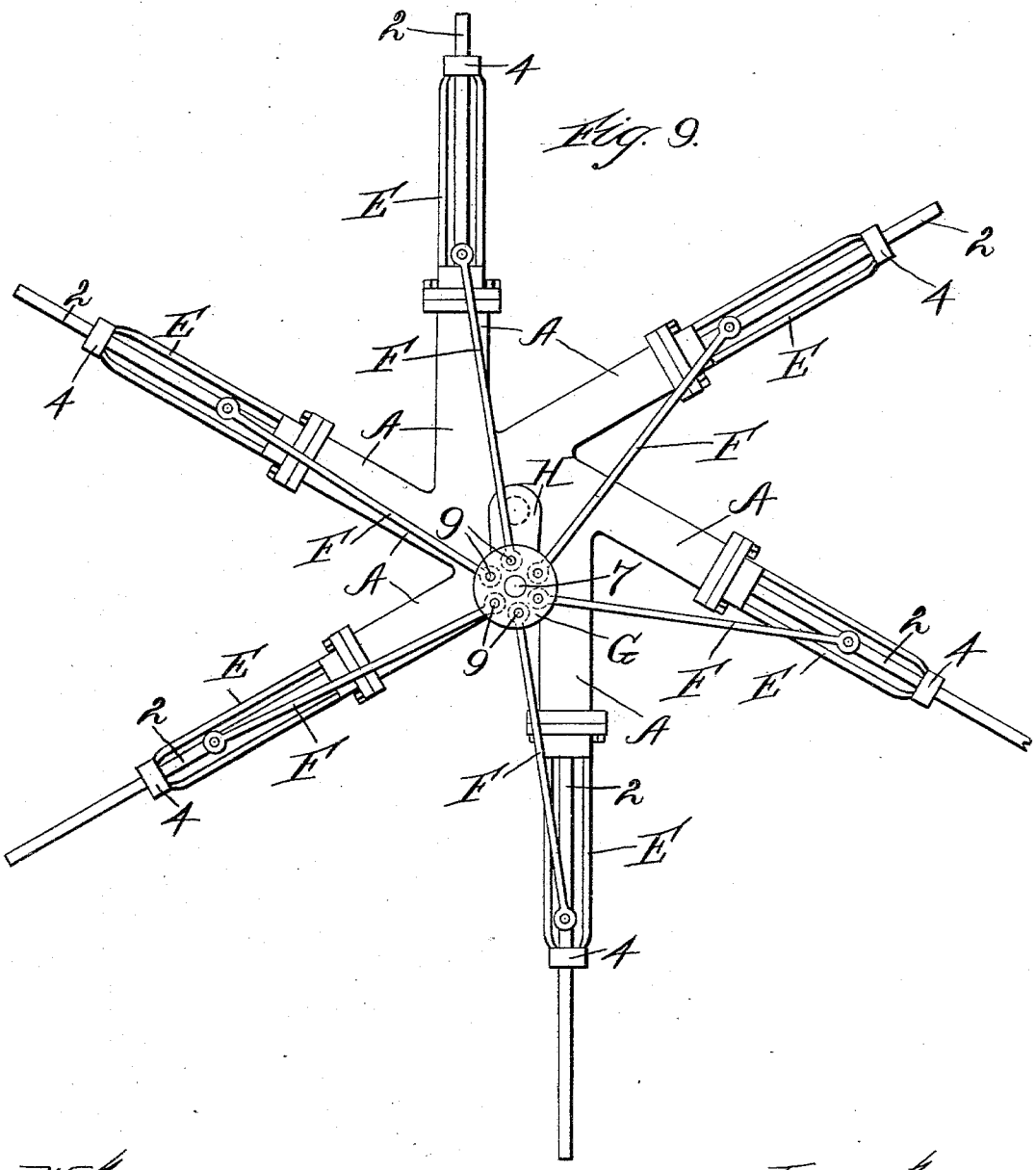
Fig. 9.



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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

LA VERNE W. NOYES, OF CHICAGO, ILLINOIS.

AIR-COMPRESSOR.

SPECIFICATION forming part of Letters Patent No. 563,794, dated July 14, 1896.

Application filed December 31, 1894. Serial No. 533,433. (No model.)

To all whom it may concern:

Be it known that I, LA VERNE W. NOYES, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Air-Compressors, of which the following is a specification.

My invention relates to air-compressing machines or "air-compressors" (as they are commonly termed) adapted to condense air as a motive fluid or for other purposes and comprising a set of air-compressing piston-cylinders arranged in annular series and provided with differentially-operating pistons, that is to say, with pistons which reciprocate non-coincidently.

In an air-compressor characterized by my invention the air is compressed by the action of pistons in cylinders, and is allowed to escape before the approaching pistons through a valved passage to such reservoir or storage means as may be employed.

The piston-cylinders are arranged in annular series and are provided with differentially-operating pistons. The set of piston-cylinders revolves in unison with one of the members of a rotary discharge-valve, which is ported to discharge the compressed air from the piston-cylinders successively, by which arrangement I can provide the rotary member of such valve with the piston-cylinders, and also I can arrange the piston-cylinders upon a wind-wheel and adapt the hub of such wheel to form one of the members of said valve. Where the set of piston-cylinders is thus carried by a wind-wheel, which serves as a motive power, the ports of the rotary member of the valve lead to the piston-cylinders, and since such member operates in conjunction with another ported member the discharge-outlets from the piston-cylinders will be positively opened and closed during the rotation of the wheel, and as a direct result of such rotation.

The piston-rods project from the outer ends of the cylinders, and are caused to operate by reason of a series of pitmen, which are severally pivoted to the piston-rods and tied to swing about a center eccentric to the center or arbor about which the piston-cylinders are arranged. The piston-cylinders could be held stationary, and said eccentric, to which the pitmen are tied, could be the wrist-pin of a revoluble crank arranged to carry such pin in a circular path about a point central to the annular series of piston-cylinders, but as a preferred arrangement and matter of special improvement the annular set of piston-cylinders revolves, while the center about which the pitmen are arranged to swing is fixed. This arrangement causes a differential action on the part of the pistons, whereby, while some of them compress air within their respectively-allotted cylinders, others are making reverse strokes, and hence the operation of condensation and service will be continuous.

The provision of a hub or head, comprising or provided with a series of piston-cylinders and having a series of ports leading from the back or inner ends of the piston-cylinders and arranged radial or substantially so to a ported hollow arbor about which the head revolves, involves an automatic valve action whereby the said ports in the head are successively opened and closed, said ports being successively brought into communication with the conducting-passage in the arbor, so as to discharge therein, and after such discharge carried out of register and automatically closed. Hence the discharge will be continuous, and at the same time the cylinders will communicate with the conducting-passage only at such times as they are brought into service to discharge condensed air. With this arrangement, therefore, a check-valve in the conducting-passage could be dispensed with, since back pressure within the arbor or conducting-passage will be met and overcome by the constantly inflowing condensed air, and will have no opportunity of gaining access to the cylinders in which the pistons are making return strokes, since such cylinders will be closed during such periods.

Various other matters of detail, construction, and arrangement serving to provide a highly efficient air-compressor are hereinafter fully set forth in connection with the accompanying drawings, in which—

Figure 1 represents in side elevation an air-compressor embodying my invention and applied to a wind-wheel. Fig. 2 is a section taken vertically and centrally through Fig. 1. Fig. 3 represents, partly in side elevation and partly in longitudinal section, the annular se-

ries of piston-cylinders, said view also including the pistons and portions of some of the pitmen. Fig. 4 is a section taken through the greater portion of Fig. 5 on line x x. Fig. 5 is a section on line y y in Fig. 4. Fig. 6 is a section taken centrally and longitudinally through a portion of the hollow arbor, about which the annular set of piston-cylinders revolves. Fig. 7 represents on a larger scale a longitudinal section through one of the piston-heads and a portion of its allotted cylinder, the plane of section through the piston-head being indicated by line z z in Fig. 8. Fig. 8 is a section taken on line z' z' in Fig. 7, looking upwardly, so as to show the piston-head. Fig. 9 shows in side elevation the annular set of piston-cylinders and illustrates an arrangement whereby the piston-cylinders are arranged tangential to the arbor in a way to permit the pistons doing the greater work to be parallel with their allotted pitmen.

In said drawings the piston-cylinders A are rigid with and project from a head or hub on one end of a sleeve B, arranged to form the hub of a wind-wheel C. In this way I provide at the center of the wheel a multiple cylinder-head, which revolves in unison with the wheel, and which carries a series of piston-cylinders arranged for a corresponding series of pistons D. The heads 1 of the pistons work within the cylinders A, and the rods 2 of said pistons project from the outer ends the cylinders and work through guide-bearings, which are conveniently formed by castings E, secured upon the outer ends of the cylinders and adapted to provide bearings 3 at said ends of the cylinders, and bearings 4 at points somewhat remote from the same.

The cylinders may be rigidly secured to or they can be made integral with the hub or head, and any further suitable means for bracing the cylinders can be employed. For example, the rods 5 of the wheel can be secured to lugs 6 on the outer end portions of the cylinders. Where the set of pistons are to be operated from a point which is fixed with relation to the revoluble set of pistons and which is eccentric to the axis about which the set of piston-cylinders revolve, I provide for the pistons a corresponding series of pitmen F, having their inner ends maintained upon a bearing which is eccentric to the axis about which the set of pistons revolve, and having their outer ends connected with the pistons.

The bearing G herein provided for the inner ends of the pitmen is arranged to revolve upon the wrist-pin 7 of a crank H, which is preferably rigid with one end of a stationary arbor 8, provided for sleeve B. The inner ends of the pitmen are desirably received within an annular recess of the bearing G, and are pivotally held within said recess by pins 9. By such arrangement the pitmen are free to swing about a fixed center which is eccentric to the axis about which the set of piston-cylinders revolve, and since the pitmen are pivotally connected with the pistons carried by said cylinders the pistons will be operated by a rotation on the part of the head comprising a series of piston-cylinders A, as aforesaid. The actions of the pistons will necessarily be timed by the bodily rotation of the set of cylinders and pistons about an axis eccentric to the bearing to which the pistons are tied by the pitmen, an illustration of the two extremes of throw or stroke on the part of two directly opposite pistons being shown in Figs. 1, 2, 3, and 9.

The piston-cylinders may be described as radiating from a hub or head, for example, and for the broader purposes of my invention they may be so considered; but as a matter of further improvement these cylinders are set tangential to the arbor for the purpose of temporarily bringing such piston as may be doing the greatest amount of work parallel or nearly parallel with its allotted pitman, whereby a more direct pull is attained and the resistance to be overcome lessened. Thus in Figs. 1 and 3 the piston-cylinder at the highest point is understood to have just completed its discharge, while the one at the left of the same is discharging condensed air.

In Fig. 1 the pitmen connected with the pistons of said cylinders are not strictly parallel with the same, but in Fig. 9 the tangential arrangement of piston-cylinders is such that said pistons and pitmen are parallel at the point of discharge.

The rotary hub or head B, which carries the set of piston-cylinders, is mounted upon a shaft or arbor 8, which latter is made hollow and adapted for connection with any suitable storage tank or reservoir by pipe connection I.

The hollow arbor 8 is also adapted to receive compressed air from the piston-cylinders, and to such end it is provided with a port so arranged that during the revolution of the set of piston-cylinders said cylinders will successively communicate therewith. Two or more cylinders may through the medium of suitable ports communicate with the air-conducting passage 11, formed through arbor 8, the arrangement of ports in Fig. 3 being adapted to permit the piston-cylinders to thus communicate with said passage successively in pairs. Thus in Fig. 3 two cylinders are shown in communication with passage 11.

With reference to the arrangement of portage, the hollow arbor is provided with a lateral port 12, communicating with passage 11, formed within said arbor. The cylinders have their inner ends interiorily connected with ports or passages 13, which latter are radial to arbor 8 and arranged through the central portion 14 of a head common to and comprising or provided with the set of cylinders. During the revolution of the set of cylinders the passages 13 will successively communicate in pairs with port 12. In connection with the foregoing, a packing ring or

sleeve 15 is arranged between the head and the arbor, and is provided with a port 16, arranged over the port in the arbor and made of a size to permit it to connect at any one time with two of the ports 13, as best illustrated in Fig. 4. The arbor is reduced to form offsets 17, Fig. 5, adapted to provide seats for the ends of the packing ring or sleeve, and said arbor is also further reduced in diameter between such offsets or seats, as at 18, so as to leave an annular space 19 between the ported portion 18 of the arbor and the packing-ring.

In order to expand the packing-ring to an extent to hold it close against the rotary hub or head and thereby prevent leakage through such ports 13 as are out of register with the port in the packing-ring and thereby closed by said packing-ring, a spring 20 is coiled about the ported portion of the arbor so as to lie between the same and the packing-ring. This spring is coiled so as to cause it to tend to uncoil to an extent to press against the inner side of the packing-ring and thus tend to expand the latter. It will also be noted that the convolutions of said spring will always be apart and hence insure the communication between ports 12 and 16 of the arbor and packing-ring. It will be noted that by such arrangement port 12 of the arbor can be considerably smaller than port 16 through the packing-ring, since air entering port 16 will pass into the space between the ported portion 18 of the arbor and said packing-ring.

The arbor is provided with a suitable check-valve *k* to prevent back escape of compressed air. This valve is conveniently arranged within passage 11, Fig. 6, and opens toward the storage end of such passage. It will therefore permit air from the pistons to be forced through passage 11 past said valve in a direction toward the point of storage, while on the other hand it will close with the storage pressure. Said valve is also preferably provided with a spring 21 to insure perfect working, and has its seat 22 arranged within passage 11.

As hereinbefore mentioned, however, said valve can be dispensed with, since, owing to the arrangement of ports in the head and packing-ring, the ports after discharging the air from their alloted cylinders will pass out of register with said port in the packing-ring and hence will be closed. This closed condition exists while the pistons are making their back or return strokes, and only terminates at times when the cylinders are ready for discharging condensed air into the port of the packing. The foregoing matters therefore provide an automatic rotary valve arrangement comprising a series of ports which, by reason of the rotation of the head carrying a set of air-condensing piston-cylinders and pistons, successively open and close, as hereinbefore described.

It will also be seen that the hollow shaft or arbor provided with a suitably-arranged port forms one member of a rotary valve, and that the head or hub provided with the piston-cylinders forms another member of such valve, and that the ports of said head or hub lead to the piston-cylinders.

The piston-heads 1 are valved so as to permit them to make their back strokes. Fig. 7 illustrates one of said valved piston-heads. Referring to said figure, the head 1 fits within the cylinder, and has a limited movable connection with its allotted rod 2. To such end, the head is centrally bored to receive an end of the rod, and is provided with a pin 22, which passes through a longitudinal slot 23 in the rod, so as to limit the extent of relative longitudinal movement between the head and rod. The end of the rod is beveled or tapered, as at 24, and one end of the bore within the head is correspondingly tapered, as at 25, so as to form a seat for the tapered end 24 of the rod. The walls of the bore through the head are also provided with longitudinally-arranged channels 26, (see also Fig. 8,) which said channels open at one end of the head, but terminate short of seat 25. By such arrangement the rod serves as a valve and the seat 25 as a valve-seat, since, during the stroke of the piston in a direction to compress air, said valve will be closed upon its seat, while on the other hand, during the back stroke of the piston, the tendency to create a vacuum back of the same will cause the head to lag to an extent to open a passage-way entirely through the head. Said passage-way is thus formed through channels 26 and the beveled end of the bore through the head, the beveled end of the rod being at such time back from seat 25 and opposite the channels 26.

As a means for packing the piston-head 1 it is provided with an annular beveled or inclined seat 27 for an annular sheet-brass or metallic packing-ring L, which can be in two or more plies or layers. The packing-ring flares outwardly from its seat so as to bear against the inner wall of the piston-cylinder, and by properly grinding the outer bearing edge of such ring the outer layer, which bears against the inner wall of the cylinder, will be sharpened, and thereby provide an air-tight packing. Said ring is held against its seat by a nut M, which is screwed upon a neck 28 on the head and arranged to press said packing so as to cause the same to bear against the inner wall of the cylinder.

The nut M is chambered, as at 29, to receive a lubricant, and this chamber can be supplied by way of a port 30, formed through the head and valved by any suitable means, for example, by a ball-valve 31, normally closed by a spring 32.

In place of revolving the set of piston-cylinders they could be held stationary, and the crank H could be arranged to revolve, and hence in certain claims I desire to include such arrangement. My improved machine can be applied to a wind-wheel, as shown, or

it can be applied to any other suitable driving-wheel or rotary driving-head.

What I claim as my invention is—

1. An air-compressor comprising a revoluble set of air-compressing piston-cylinders provided with reciprocating pistons operating substantially as set forth, and a rotary discharge-valve constructed with a couple of coacting ported members for effecting the discharge from a plurality of piston-cylinders, successively, one member of the valve being arranged to revolve with the revoluble set of piston-cylinders and provided with a series of ports which are severally connected with the piston-cylinders and arranged for successively establishing and cutting off the discharge from such piston-cylinders through the other coacting member of the said rotary valve, substantially as described.

2. An air-compressor comprising a set of air-compressing piston-cylinders provided with reciprocating pistons operating substantially as set forth, and a rotary discharge-valve constructed with a couple of coacting ported members for effecting the discharge from a plurality of piston-cylinders, successively, one member of the valve being provided with a series of ports severally connected with such piston-cylinders, and the other member being a hollow, laterally-ported shaft which also provides an eduction-passage leading from the said valve, substantially as described.

3. An air-compressor comprising a set of air-compressing piston-cylinders provided with reciprocating pistons operating substantially as set forth, and a rotary valve constructed with a couple of coacting ported members for effecting the discharge from a plurality of piston-cylinders, successively, one member of the valve being provided with a series of ports severally connected with such piston-cylinders, and the other member being a laterally-ported hollow shaft which also provides an eduction-passage leading from the valve, said shaft being also provided with a crank with which the pistons are connected, substantially as described.

4. An air-compressor comprising a wind-wheel carrying a set of air-compressing piston-cylinders having reciprocating pistons operating substantially as set forth, and a rotary discharge-valve operated by the wind-wheel and ported to effect the discharge from a plurality of piston-cylinders, substantially as described.

5. An air-compressor comprising a wind-wheel carrying a set of air-compressing piston-cylinders and having a hub upon which said cylinders are arranged, a rotary discharge-valve constructed with a couple of ported members and comprising as one of said members the hub of the wind-wheel, and reciprocating pistons for the piston-cylinders, operating substantially as described.

6. In an air-compressor, the combination of the hollow shaft having a laterally-arranged port, a set of piston-cylinders arranged to revolve about the shaft and provided with reciprocating pistons and interiorly connected at their inner ends with ports which successively open to communicate with and discharge into the port of the hollow shaft, and pitmen connected with the pistons and tied to swing about a point eccentric to the axis about which the set of piston-cylinders revolves, substantially as described.

7. In an air-compressor, a hollow shaft providing a passage through which compressed air is conducted to some suitable receiver and having a lateral port, a head arranged to revolve about the hollow shaft and comprising a series of air-compressing piston-cylinders provided with reciprocating pistons, a packing arranged between the hollow shaft and the head and having a port in communication with the port of the hollow shaft, said hollow shaft being adapted to provide space between its ported portion and the ported packing, and the head being provided with ports arranged radial to the packing and leading from the piston-cylinders, substantially as described.

8. In an air-compressor, a revoluble set of air-compressing piston-cylinders arranged tangential to the axis of rotation and provided with reciprocating pistons operating substantially as described.

9. In an air-compressor, a rotary head, a set of piston-cylinders carried by the said head and arranged tangential to the axis of rotation, reciprocating pistons, and pitmen attached to the pistons and tied to swing about a center eccentric to said axis, substantially as described.

10. In an air-compressor, the rotary head or hub provided with air-compressing cylinders and having ports 13, in combination with the hollow shaft and packing ported as set forth, and a spring between the hollow shaft and packing.

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