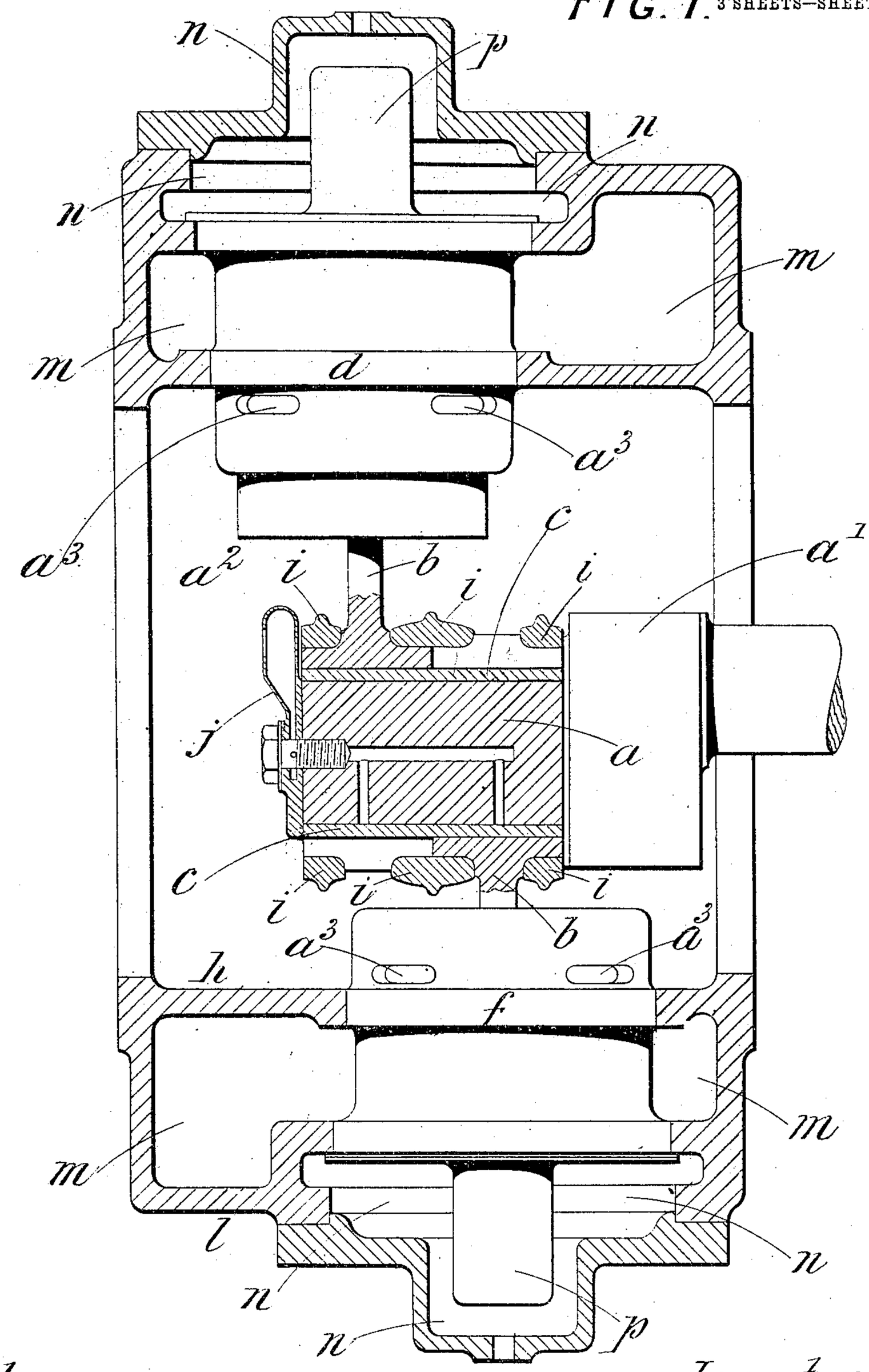
No. 819,924. PATENTED MAY 8, 1906.

W. REAVELL.

AIR COMPRESSOR.

APPLICATION FILED FEB. 6, 1904.

FIG. 1. 3 SHEETS—SHEET 1.



Witnesses.

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3 SHEETS—SHEET 2.

FIG. 2.

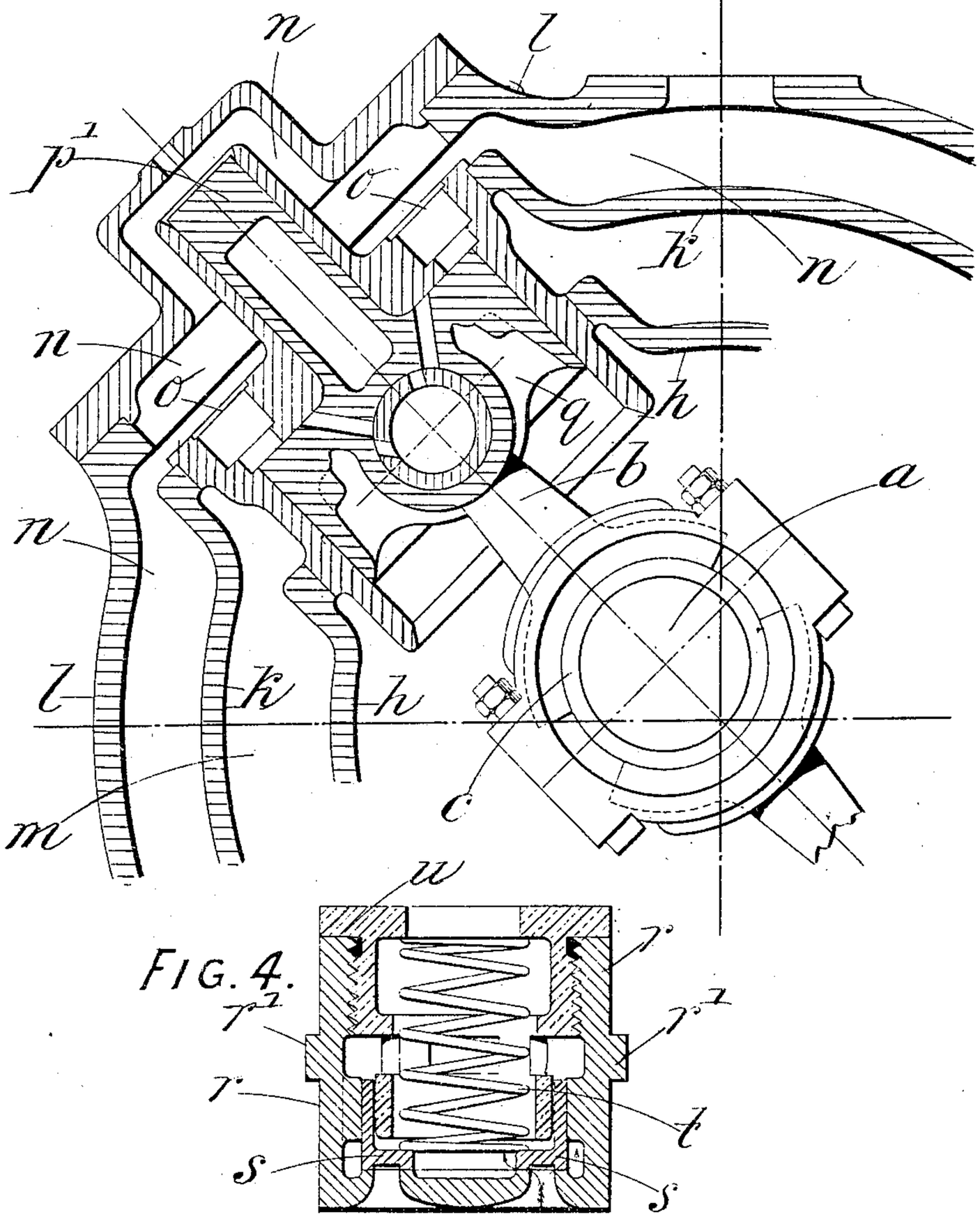
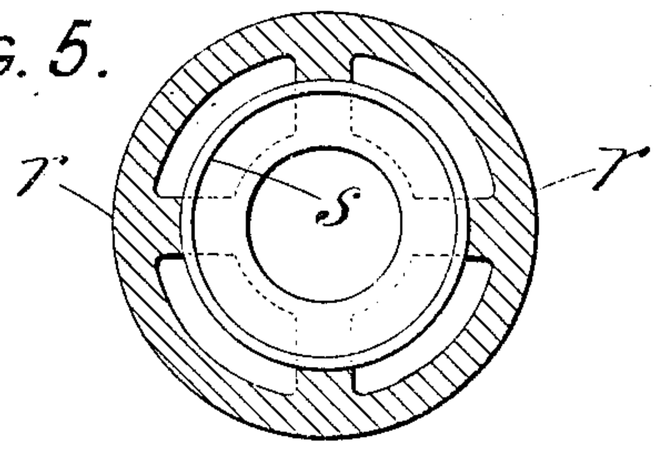


FIG. 4.

FIG. 5.



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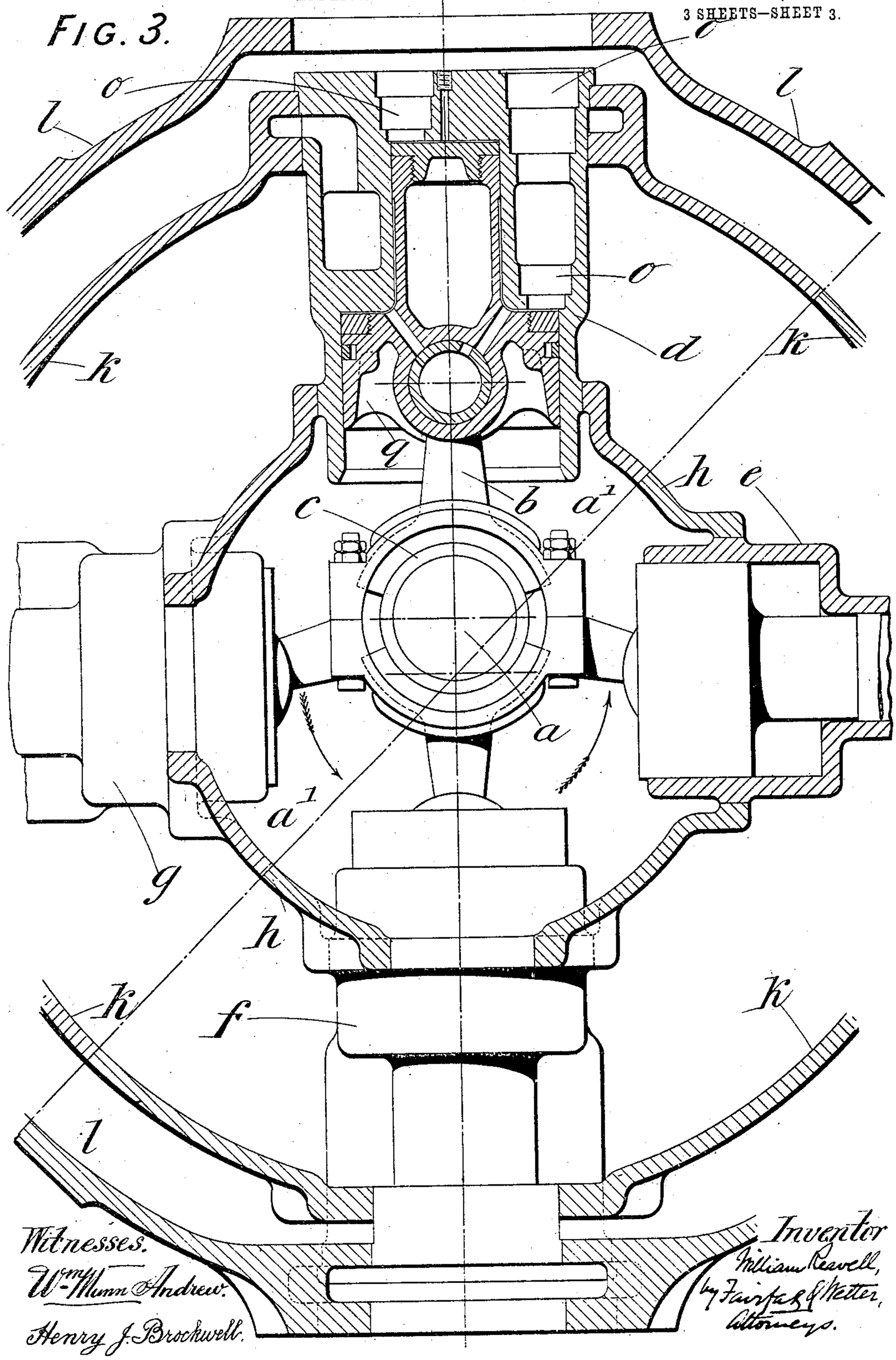
3 SHEETS—SHEET 3.

FIG. 3.



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UNITED STATES PATENT OFFICE.

WILLIAM REAVELL, OF IPSWICH, ENGLAND.

AIR-COMPRESSOR.

No. 819,924. Specification of Letters Patent. Patented May 8, 1906.

Application filed February 6, 1904. Serial No. 192,423.

To all whom it may concern:

Be it known that I, WILLIAM REAVELL, a subject of the King of the British Dominions, residing at Ipswich, England, (whose post-office address is Ranelagh Works, Ipswich, in the county of Suffolk, England,) have invented certain new and useful Improvements in Air-Compressors, of which the following is a specification.

This invention relates to air-compressors, and comprises improvements upon the invention described in British Letters Patent dated June 24, 1899, No. 13,161, and United States Patent No. 676,080, dated June 11, 1901.

In the invention above referred to four compressing-cylinders were equidistantly spaced around and inclosed within a circular frame, which frame was provided with annular spaces or passages for the reception of compressed air and for cooling purposes, respectively. The central line of all the cylinders converged in one plane on a single crank-pin, so that the crank end of the four connecting-rods were cut away radially at their adjoining edges just sufficient to clear each other in the various angular positions assumed in working. Consequently the bearing-surface of each rod end upon the crank-pin was less than one-fourth of its circumference, all the rods being kept in place by one or more inclosing sockets, caps, or rings.

By this invention the crank-pin is lengthened, and the connecting-rod ends are circumferentially increased where they bear on the crank-pin by arranging the cylinders with their connecting-rods axially upon two parallel planes wide enough apart to give the required bearing area to the connecting-rod ends or their brasses, also inclosed by sockets, caps, or rings. The frame containing water and air chambers is also widened, owing to the "staggering" or axial displacement of the cylinders on two planes, and in single-stage compressors a pilot-piston is projected into the air-chamber and suitable non-return valves are provided.

In the further description of this invention reference is made to the accompanying drawings, in which—

Figure 1 is a section through the frame of a single-stage air-compressor, the opposite cylinders, together with their pilot-pistons, being shown in elevation. The axial lines of the two cylinders are arranged on two planes at some distance apart, both planes converging upon an elongated crank-pin, the cylinders being thus staggered in relation to each other. Fig. 2 is a section through the center of one of the cylinders of Fig. 1, with an end elevation of its connecting-rod Fig. 3 is a similar section to Fig. 1, taken through the circular frame of a four-cylinder two-stage air-compressor, but with one of the cylinders and double piston shown in section. Figs. 4 and 5 are respectively a section through and plan of one of the air-valves employed.

In the drawings, *a* is an elongated crank-pin, arranged to receive the end of a connecting-rod *b* from each main piston either directly upon the pin *a* or upon a bronze bushing *c*, which encircles the pin. In Fig. 3 the axial line of the two cylinders *d* and *e* are on one plane, while the axial line of the other two cylinders *f* and *g* are upon another plane, as will be seen by the cutting away of the innermost wall *h* of the frame on the central line between cylinders *d* and *e* and to a less degree between the cylinders *f g*. This relative axial displacement or staggering is further plainly indicated in Fig. 1, the axial line of the cylinder *d* being directed upon the outer end of the crank-pin *a*, while the axial line of cylinder *f* converges upon the pin next to the crank-arm *a'*.

The crank-pin end of the connecting-rod *b* bears upon the pin *a* or bush *c* to the extent of a quarter of the circle, which is much wider than is practicable with the usual arrangement of two, three, or four cylinders, with their rods, when they converge upon a single crank-pin, owing to the angular motion of the rod upon the pin restricting the bearing-surface of the rod end to a very small arc of the pin's circumference. Consequently the wear and liability to break down is much reduced by this invention and a higher rate of speed revolution is also possible. An inclosing ring-strap *i* in two halves bolted together is made to centrally inclose the flange extensions of two rod ends *b b* with similar rings *i* at the two ends of the pin *a*, and an oil thrower or lubricator *j* is shown as screwed to the outer end of the crank-pin in Fig. 1. It is to be understood that although the two opposite cylinders *d* and *f* are shown as axially displaced on two planes or staggered they may be in line and on the same plane with each other without

departing from the nature of this invention, provided the other two cylinders *e* and *g* are staggered or axially displaced in relation to the first-named pair. In thus arranging cylinders on two planes within the circular chambered frame formed by the metal division-walls *h*, *k*, and *l* and their connecting-walls ample space is afforded by the increased area within the frame to form an efficient water-jacket or cooling-chamber *m* and an air-receiver chamber *n*. The chamber *m* surrounds the working portion of the cylinders, and with a water-supply circulating through it the cylinders are effectually cooled, thus increasing the efficiency in compressing air.

The initial supply of air for compression is drawn from the central or crank chamber a^2 through ports a^3 into the cylinders and, if subjected to more than one stage of compression, from one cylinder into another. The air as compressed passes from the cylinders through suitable non-return valves, such as are shown in Figs. 4 and 5, placed in the spaces indicated by *o*, Figs. 2 and 3, in the known manner. The air is delivered into the air-receiving chamber *n* under its required pressure, and within this chamber an open-ended extension *p* of each cylinder is projected, having a pilot-piston *p'* extending from the main piston and exposed to the air-pressure in the chamber *n*. The air-pressure on the end of the pilot-piston is communicated through the main piston *q* and connecting-rod *b* to keep the end of the rod tight upon the crank-pin *a* or bush *c*, thus exerting a constant thrust upon the said parts to take up any lost motion through wear and insure quiet and steady running at high speeds. Large and small holes *n'*, shown in the drawings as leading outward from the air-receiver chamber *n*, are intended for pipe connections to convey the compressed air where required.

The non-return valve (shown in Figs. 4 and 5) consists of a body-casting of gun-metal *r*, turned on the outside with a band *r'*, bored and faced at the bottom to receive and form a double seating for a lifting-valve *s*, kept in place by a spiral spring *t*, held down under a screwed cap *u* with air-passages, as shown. These valves are placed in bored-out spaces *o*, as previously mentioned, and as the valve *s* lifts a double passage is provided for the air to escape by.

What I claim is—

1. In an air-compressor, the combination of a circular-shaped frame having a cooling-chamber *m*, an air-receiver chamber *n*, and walls *h*, *k* and *l*; a plurality of main cylinders radially seated in the walls *h* and *k* on two planes within the chamber *m*; an open-ended pilot-cylinder extending from each main cylinder into the air-chamber *n*, a central revoluble crank-shaft and elongated crank-pin; a piston common to each main and pilot cylinder, and a pivoted connecting-rod bearing upon said crank-pin and adapted to transmit its motion to each of said pistons, substantially as described.

2. In an air-compressor, the combination of a circular-shaped frame having a cooling-chamber *m*, an air-receiver chamber *n*, and walls *h*, *k* and *l*; a plurality of combined main and pilot cylinders radially seated in the walls *h* and *k* on two planes; a central revoluble crank-shaft and elongated crank-pin, a compound piston in each of said combined cylinders, a connecting-rod pivoted at one end in each piston, and converging axially upon said crank-pin at the other; and a communicating channel from said chamber *n* to said pilot-cylinders, whereby the pistons therein are subject to continuous air-pressure, thus maintaining constant thrust through the connecting-rods upon the crank-pin, substantially as and for the purpose described.

3. In an air-compressor, the combination of a circular-shaped frame having a cooling-chamber *m*, an air-receiver *n* and walls *h*, *k* and *l*, with a plurality of combined main and pilot cylinders radially seated in the walls *h* and *k* upon different planes, so that an unsymmetrical cooling-space surrounds the main body of each cylinder, the ends of the pilot-cylinders being exposed to the pressure from the air-chamber, and a cover seated in the wall *l*, symmetrically surrounding each pilot-cylinder in the air-chamber *n*, substantially as and for the purpose described.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

WILLIAM REAVELL.

Witnesses:

H. J. BROCKWELL,

E. C. BALHARRY