No. 720,872. PATENTED FEB. 17, 1903.

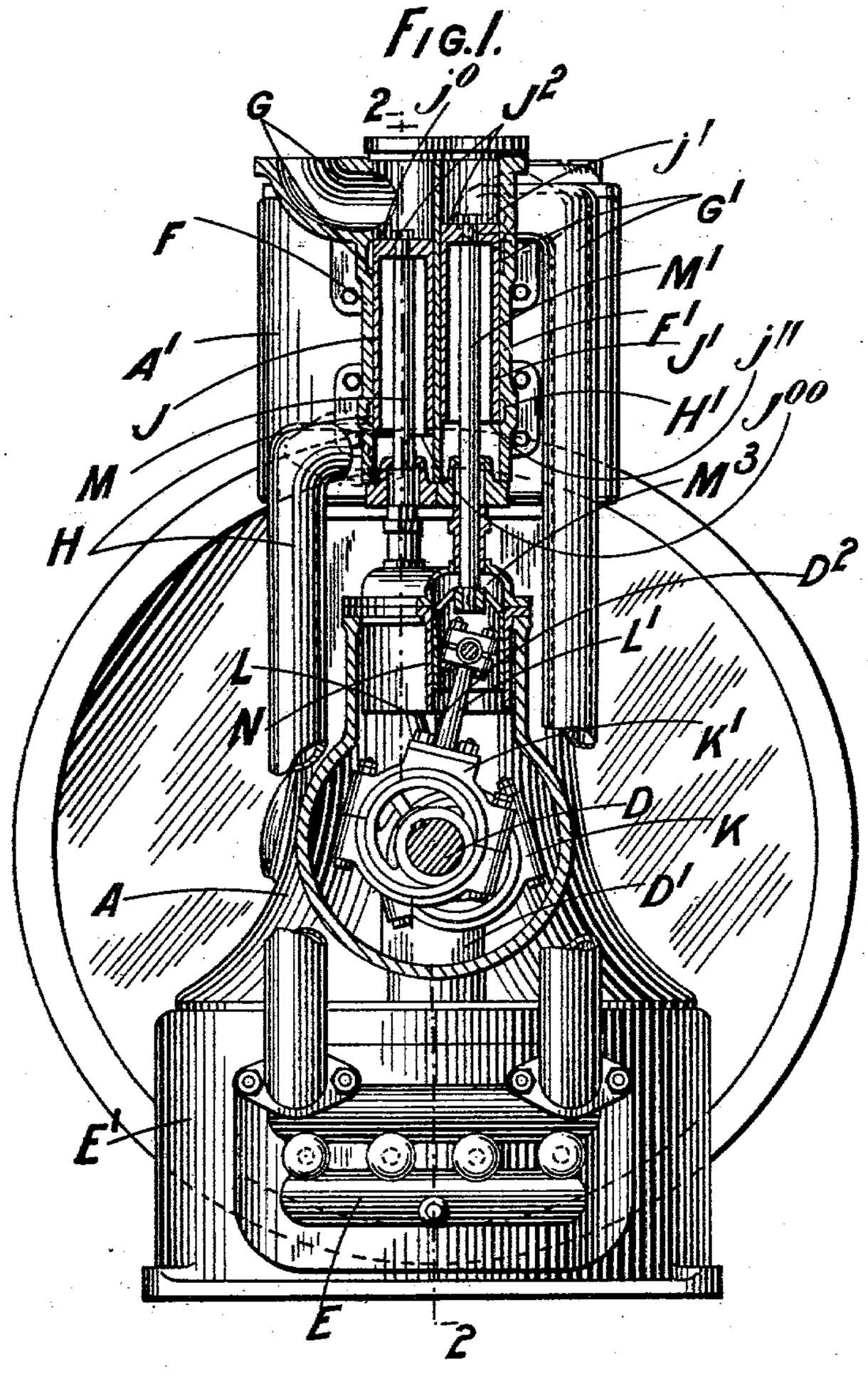
S. E. ALLEY.

GAS COMPRESSOR.

APPLICATION FILED NOV. 18, 1902.

NO MODEL. 3 SHEETS—SHEET 1.

FIG. 1.



Witnesses
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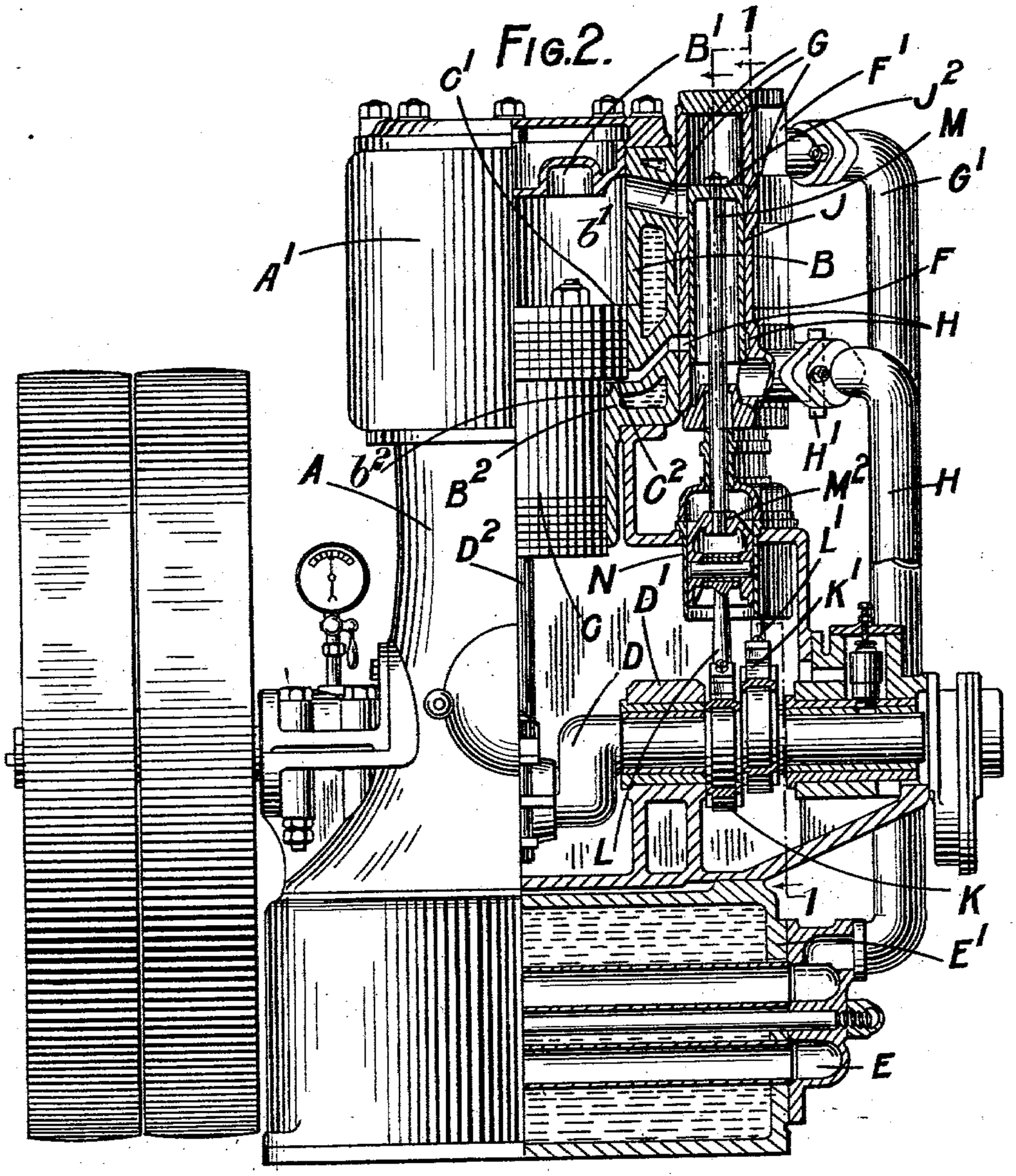
NO MODEL. 3 SHEETS—SHEET 2.

FIG. 2.



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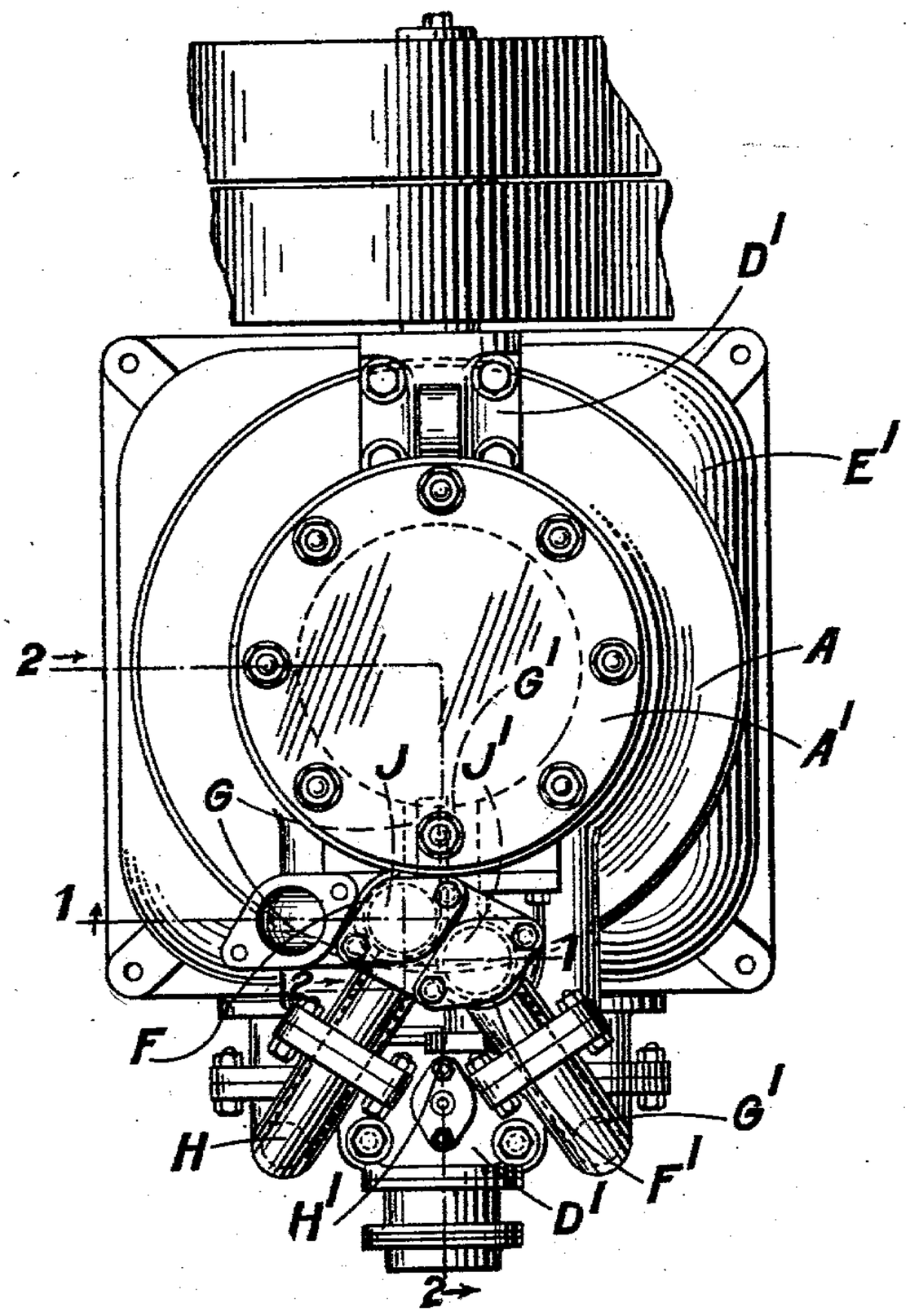
NO MODEL. 3 SHEETS—SHEET 3.

FIG. 3.



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Durant Church.

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UNITED STATES PATENT OFFICE.

STEPHEN EVANS ALLEY, OF GLASGOW, SCOTLAND.

GAS-COMPRESSOR.

SPECIFICATION forming part of Letters Patent No. 720,872, dated February 17, 1903.

Application filed November 18, 1902. Serial No. 131,872. (No model.)

To all whom it may concern:

Be it known that I, STEPHEN EVANS ALLEY, a subject of the King of Great Britain, residing at Glasgow, Scotland, have invented certain new and useful Improvements in or Relating to Gas-Compressors, of which the following is a specification.

This invention relates to air or other gas compressors of the type in which a differential piston reciprocates within a cylinder and forms therewith two or more compression-chambers, the gas being successively compressed in these chambers.

According to this invention a plurality of inlet and outlet valves is provided on the cylinder, an inlet-conduit is led from a source of air or other gas supply to one inlet-valve and thence to one of the compression-chambers, an outlet-conduit extends from that chamber to an outlet-valve and thence to an inlet-conduit leading to another inlet-valve and thence to another of the compression-chambers, and another outlet-conduit is led from that other chamber to another outlet-valve. The moving part of each valve is operatively connected with that of the other similarly-acting valve, and means are provided for opening and closing the valves in proper sequence for predetermined periods. Preferably a plurality of valve-chests is provided on the cylinder for the inlet and outlet valves. In this case an inlet-conduit is led from the source of air or other gas supply to one inlet-valve chest and thence to one of the compression-chambers, an outlet-conduit extends from that chamber to an outlet-valve chest and thence leads to an inlet-conduit, to the aforementioned inlet-valve chest, and thence to another of the compression-chambers, and another outlet-conduit is led from that other chamber to the aforementioned outlet-valve chest. A plurality of sliding valves is disposed in the chests, one in the inlet-valve chest and in the inlet-conduits of that chest and constituting a partition between said inlet-conduits and another in the outlet-valve chest in the outlet-conduits of that chest and constituting a partition between said outlet-conduits.

In the preferred form of the gas-compressor according to this invention the gas which is successively compressed in the compression-chambers of the cylinder is passed from one chamber through an intercooler and thence to another of the chambers. In this case the outlet-conduit from the first compression-chamber passes to the intercooler, and an inlet-conduit connects the intercooler with the inlet-valve chest and thence passes to the other compression-chamber.

In the accompanying drawings, illustrating a preferred form of gas-compressor according to this invention, Figure 1 is a side elevation of the compressor, partly in section, on the line 1 1 of Figs. 2 and 3. Fig. 2 is a front elevation of the compressor, half in section, on the line 2 2 of Figs. 1 and 3. Fig. 3 is a plan of the compressor, showing the positions of the valve-chests.

Like letters indicate like parts throughout the drawings.

Referring to the drawings, a frame A supports a cylinder B, having a water-jacket A′. A differential trunk-piston is disposed in the cylinder and has a trunk C and two operating-faces C′ and C^2, one of these, C′, having a greater effective area than the other, C^2. A crank-shaft D, mounted in bearings D′ in the frame A, is operatively connected with the trunk C by a connecting-rod D^2. A cylinder-cover B′, together with the greater face of the piston C′ and the cylinder, form the first compression-chamber b', and a projecting portion B^2 on the cylinder, constituting the trunk-guide, forms with the lesser face C^2 of the piston and the cylinder a second compression-chamber b^2. An intercooler comprising a series of connected gas-tight pipes E is arranged under the frame A of the compressor. The casing E′ of the intercooler serves as the base of the frame A and contains cooling-water which encircles and cools the pipes E. Two valve-chests F F′ are attached along one side of the cylinder, one of these, F, for an inlet-valve, and the other, F′, for an outlet-valve. An inlet-conduit G is provided from the source of air or gas supply to the inlet-valve chest F and thence to the first compression-chamber b'. An outlet-conduit G′ extends from the first compression-chamber b' to the outlet-valve chest F′ and thence to the intercooler E. Another inlet-conduit H connects the intercooler E with the inlet-valve chest F and thence passes to the second compression-

chamber b^2. Another outlet-conduit H′ is led from the second compression-chamber b^2 to the outlet-valve chest F′, from which the compressed air or gas is discharged. Two piston sliding valves J J′ are disposed in the valve-chests, one, J, in the inlet-valve chest F and arranged to control the two inlet-conduits G and H in that chest, the former by its upper end j^0, which travels to and fro across it, and the latter by its lower end j^{00}, which operates in like manner in relation thereto, and the other, J′, in the outlet-valve chest F′ and arranged to control the two outlet-conduits G′ and H′ in the chest by its upper and lower ends j' and j'', respectively, which travel, like the ends of the inlet-valve, to and fro across them. Each piston sliding valve is provided with a gas-tight diaphragm J^2, which enables the valve to serve also as a partition to separate the two conduits of its chest. Two eccentrics K and K′ are mounted on the crank-shaft, one, K, connected by an eccentric-rod L, cross-head M^2, and valve-spindle M to the diaphragm J^2 of the inlet piston sliding valve J, and the other eccentric, K′, connected by an eccentric-rod L′, cross-head M^3, and valve-spindle M′ to the diaphragm J^2 of the outlet piston sliding valve J′. Guides N for the cross-heads M^2 M^3 are provided on the frame A.

The operation of the compressor is as follows: As the piston moves downward the upper end j^0 of the inlet piston-valve J opens the inlet-conduit G to the first compression-chamber b', and gas enters that chamber during the downstroke of the piston. The upper end j^0 of the inlet valve-piston J then closes the inlet-conduit G, and the piston rises and compresses the gas up to a certain point when the piston-face C′ is approaching the cylinder-cover B′, when the upper end j' of the outlet piston-valve J′ opens the outlet-conduit G′. The compressed gas then passes through the conduit G′ to the intercooler E. At the same time as compression takes place in the first compression-chamber b' the under face of the piston C^2 recedes from the projection B^2. The lower end j^{00} of the inlet piston-valve J opens the inlet-conduit H, and gas passes from the intercooler E through the conduit H into the second compression-chamber b^2. When the piston is lowered, the lower end j^{00} of the inlet piston-valve J closes the inlet-conduit H, and the gas is compressed in the compression-chamber b^2 up to a certain point when the lower piston-face C^2 is approaching the projection B^2, when the lower end j'' of the outlet piston-valve J′ opens the outlet-conduit H′ and allows the compressed gas to be discharged from the second compression-chamber b^2 through the outlet-conduit H′ to a receiver or the like.

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

1. In a "stage" gas-compressor the combination of a differential trunk reciprocating piston, a cylinder containing it and divided by the piston into two compression-chambers, a crank-shaft operatively connected with that piston, an inlet-valve chest, an outlet-valve chest, both chests extending along one side of the cylinder, an intercooler comprising a series of connected gas-tight pipes, an inlet-conduit from a source of gas-supply to the inlet-valve chest and thence to one of the two said compression-chambers, an outlet-conduit from that chamber to the outlet-valve chest and thence to the intercooler, an inlet-conduit from the intercooler to the inlet-valve chest and thence to the other of said compression-chambers, an outlet-conduit from that other chamber to the outlet-valve chest, two piston sliding valves one in the inlet-valve chest and in the inlet-conduits of that chest and constituting a gas-tight partition between them and the other in the outlet-valve chest and in the outlet-conduits of that chest and constituting a gas-tight partition between them, and two eccentrics on the crank-shaft one operatively connected to the inlet-valve and the other to the outlet-valve.

2. In a "stage" gas-compressor the combination of a differential trunk reciprocating piston, a cylinder containing it and divided by the piston into two compression-chambers, a crank-shaft operatively connected with that piston, an inlet-valve chest, an outlet-valve chest, an intercooler comprising a series of connected gas-tight pipes, an inlet-conduit from a source of gas-supply to the inlet-valve chest and thence to one of the two said compression-chambers, an outlet-conduit from that chamber to the outlet-valve chest and thence to the intercooler, an inlet-conduit from the intercooler to the inlet-valve chest and thence to the other of said compression-chambers, an outlet-conduit from that other chamber to the outlet-valve chest, two piston sliding valves one in the inlet-valve chest and in the inlet-conduits of that chest and constituting a gas-tight partition between them, and two eccentrics on the crank-shaft one operatively connected to the inlet-valve and the other to the outlet-valve.

3. In a "stage" gas-compressor the combination of a differential trunk reciprocating piston, a cylinder containing it and divided by the piston into two compression-chambers, a crank-shaft operatively connected with that piston, an inlet-valve chest, an outlet-valve chest, an intercooler, an inlet-conduit from a source of gas-supply to the inlet-valve chest and thence to one of the two said compression-chambers, an outlet-conduit from that chamber to the outlet-valve chest and thence to the intercooler, an inlet-conduit from the intercooler to the inlet-valve chest and thence to the other of said compression-chambers, an outlet-conduit from that other chamber to the outlet-valve chest, two piston sliding valves, one in the inlet-valve chest and in the inlet-conduits

of that chest and constituting a gas-tight partition between them, and the other in the outlet-valve chest and in the outlet-conduits of that chest and constituting a gas-tight partition between them, and two eccentrics on the crank-shaft one operatively connected to the inlet-valve and the other to the outlet-valve.

4. In a "stage" gas-compressor the combination of a differential trunk reciprocating piston, a cylinder containing it and divided by the piston into two compression-chambers, a crank-shaft operatively connected with that piston, an inlet-valve chest, an outlet-valve chest, an inlet-conduit from a source of gas-supply to the inlet-valve chest and thence to one of the two said compression-chambers, an outlet-conduit from that chamber to the outlet-valve chest and thence to an inlet-conduit to the inlet-valve chest and thence to the other of said compression-chambers, an outlet-conduit from that other chamber to the outlet-valve chest, two piston sliding valves one in the inlet-valve chest and in the inlet-conduits of that chest and constituting a gas-tight partition between them, and the other in the outlet-valve chest and in the outlet-conduits of that chest and constituting a gas-tight partition between them, and two eccentrics on the crank-shaft one operatively connected to the inlet-valve and the other to the outlet-valve.

5. In a "stage" gas-compressor the combination with a cylinder, a differential piston therein whereby said cylinder is divided into a plurality of compression-chambers, and with means for reciprocating the piston, of a plurality of valve-chests for inlet and outlet valves, an intercooler, an inlet-conduit from a source of gas-supply to an inlet-valve chest and thence to one of the said compression-chambers, an outlet-conduit from that chamber to an outlet-valve chest and thence to the intercooler, an inlet-conduit from the intercooler to the aforementioned inlet-valve chest and thence to another of said compression-chambers, an outlet-conduit from that other chamber to the aforementioned outlet-valve chest, a plurality of sliding valves one in the inlet-valve chest in the inlet-conduits of that chest, and another in the outlet-valve chest in the outlet-conduits of that chest, and means for operating those sliding valves.

6. In a "stage" gas-compressor the combination with a cylinder, a differential piston therein whereby said cylinder is divided into a plurality of compression-chambers, and with means for reciprocating the piston, of a plurality of valve-chests for inlet and outlet valves, an inlet-conduit from a source of gas-supply to an inlet-valve chest and thence to one of the said compression-chambers, an outlet-conduit from that chamber to an outlet-valve chest and thence to an inlet-conduit to the aforementioned inlet-valve chest and thence to another of said compression-chambers, an outlet-conduit from that other chamber to the aforementioned outlet-valve chest a plurality of sliding valves one in the inlet-valve chest in the inlet-conduits of that chest, and another in the outlet-valve chest in the outlet-conduits of that chest, and means for operating those sliding valves.

7. In a "stage" gas-compressor the combination with a cylinder, a differential piston therein, whereby said cylinder is divided into a plurality of compression-chambers, and with means for reciprocating the piston, of a plurality of inlet and outlet valves, an inlet-conduit from a source of gas-supply to one inlet-valve and thence to one of the said compression-chambers, an outlet-conduit from that chamber to an outlet-valve and thence to an inlet-conduit to another inlet-valve and thence to another of said compression-chambers, an outlet-conduit from that other chamber to another outlet-valve, an operative connection between the moving part of each valve and that of the other similarly-acting valve, and means for opening and closing the valves in proper sequence for predetermined periods.

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

STEPHEN EVANS ALLEY.

Witnesses:
B. E. DUNBAR KILBURN,
WILLIAM H. BALLANTYNE.