(No Model.) 4 Sheets—Sheet 1.

H. A. WEEKS & G. W. LEWIS.

GAS ENGINE.

No. 511,478. Patented Dec. 26, 1893.

Fig. 1.

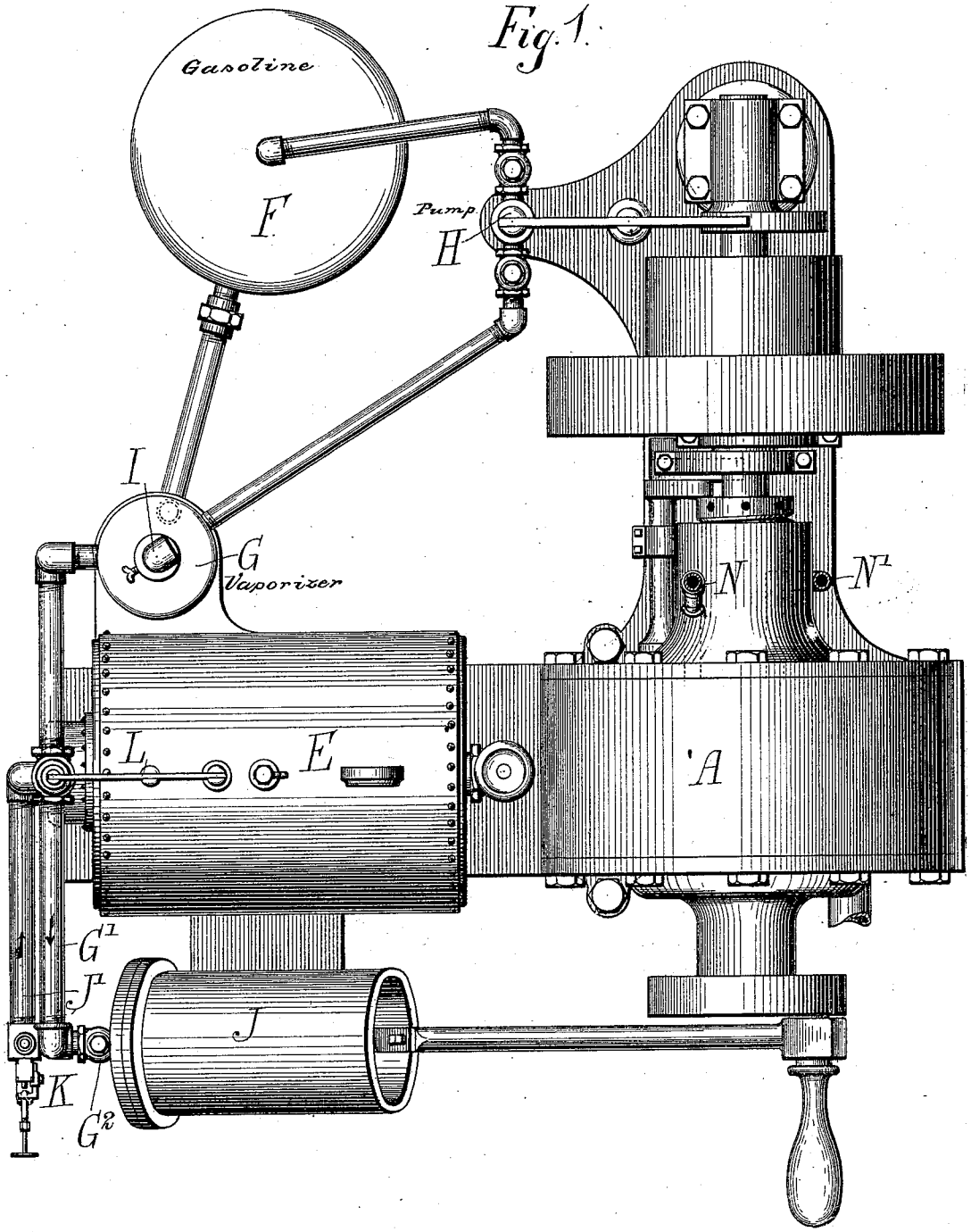

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Fig. 2.

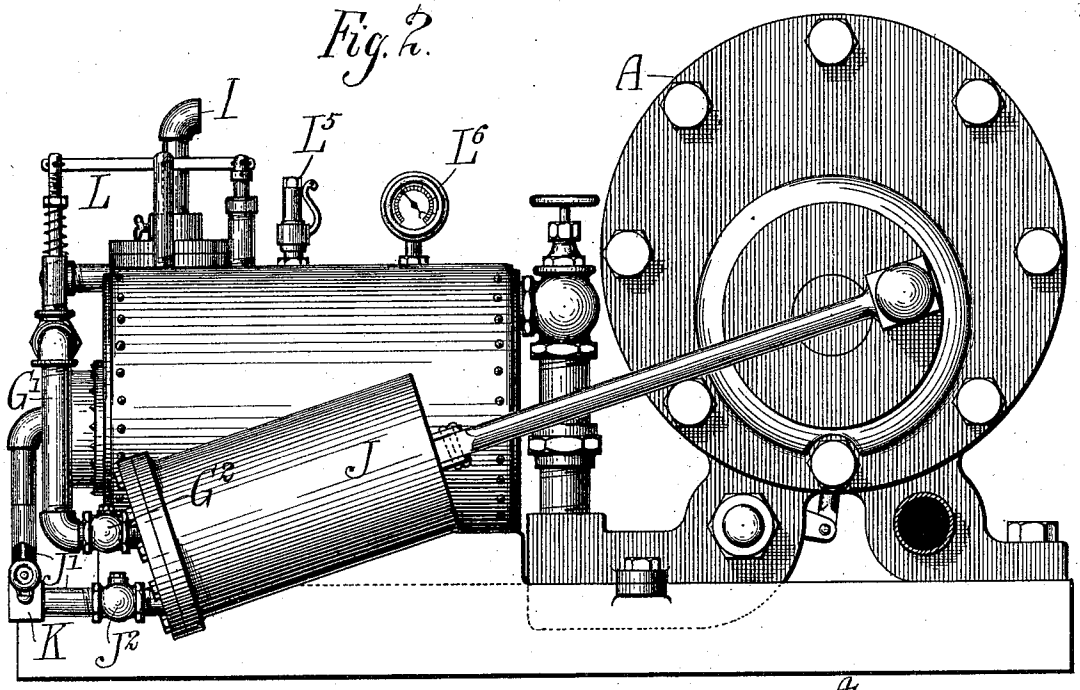
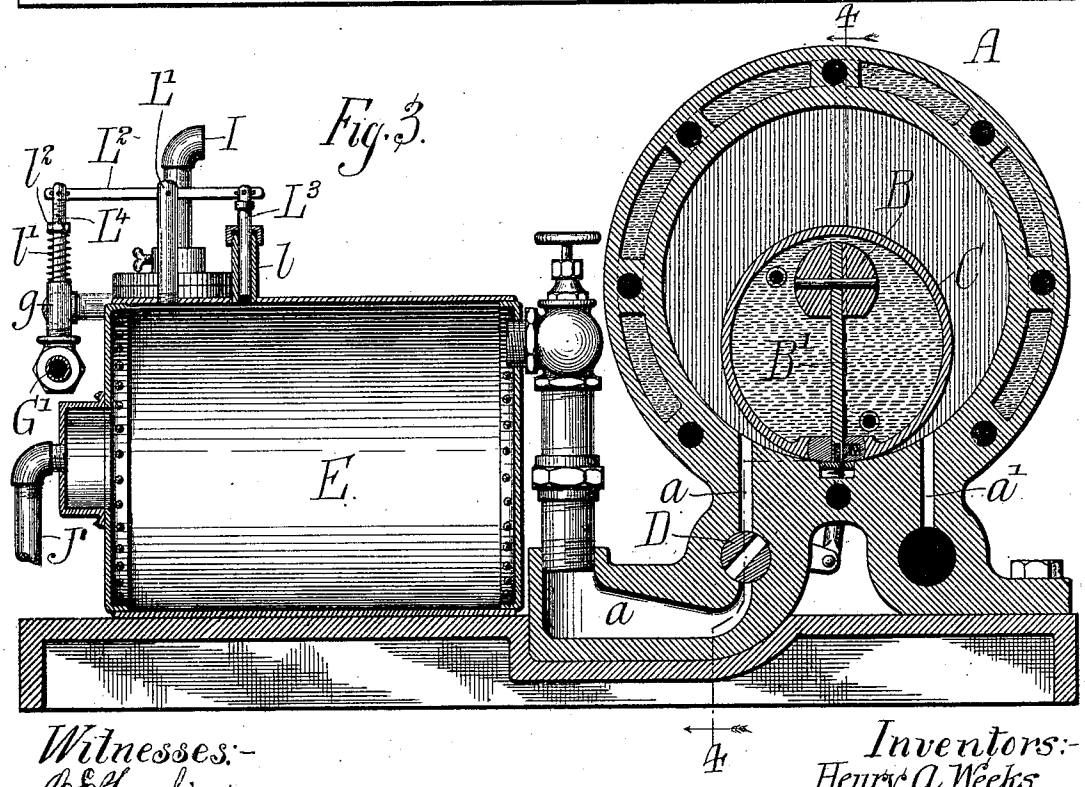


Fig. 3.



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GAS ENGINE.

No. 511,478. Patented Dec. 26, 1893.

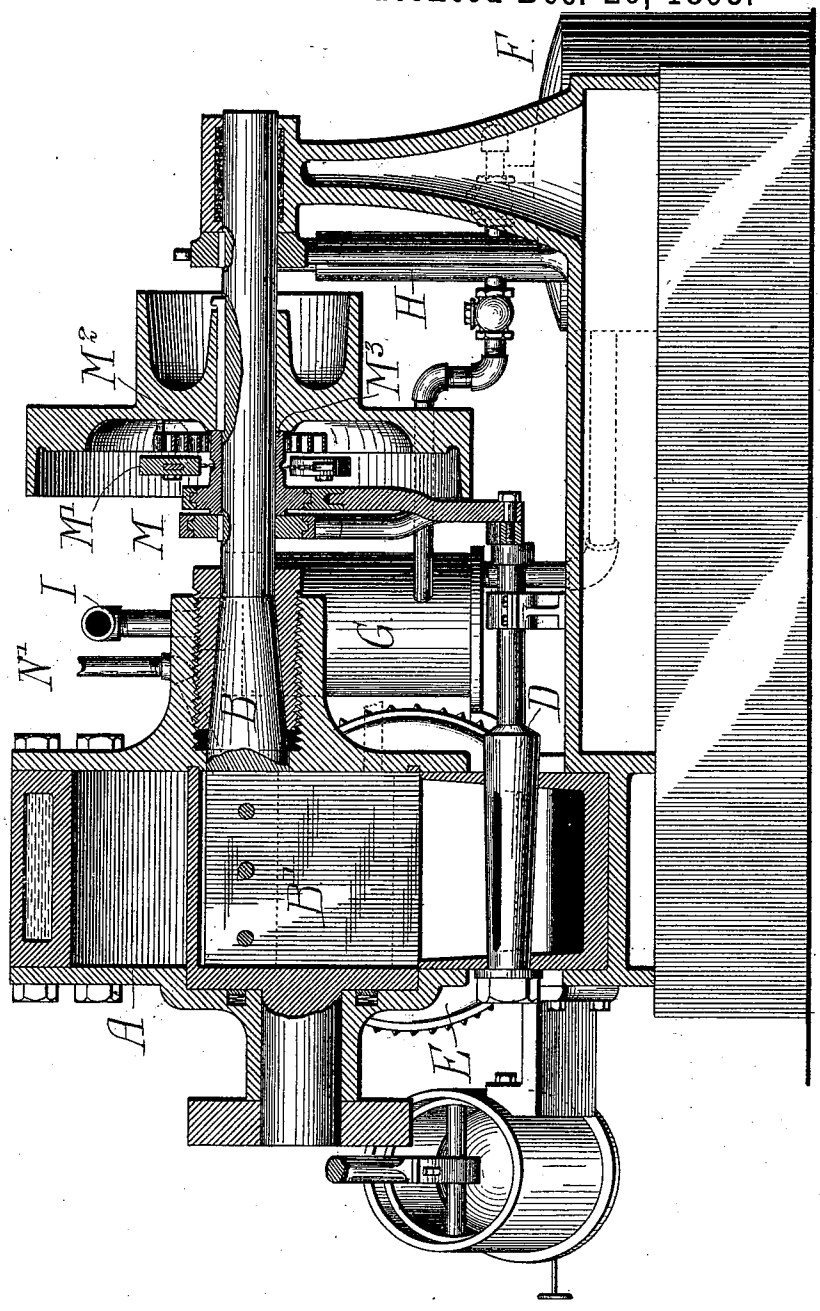

Fig. 4.

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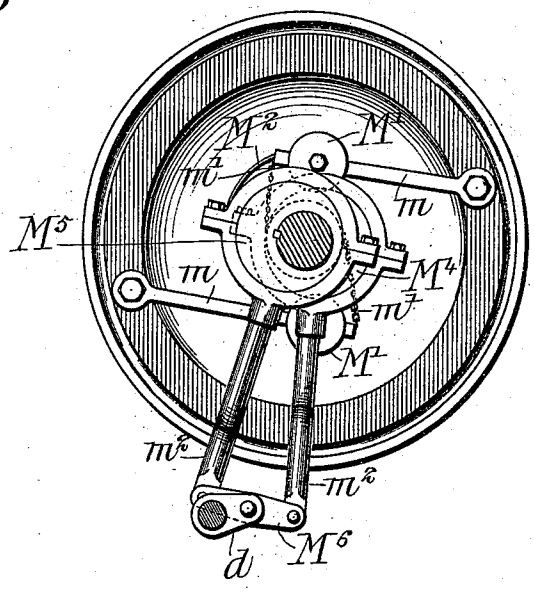
H. A. WEEKS & G. W. LEWIS.

GAS ENGINE.

No. 511,478. Patented Dec. 26, 1893.

Fig. 5.



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UNITED STATES PATENT OFFICE.

HENRY A. WEEKS AND GEORGE W. LEWIS, OF CHICAGO, ILLINOIS.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 511,478, dated December 26, 1893.

Application filed March 10, 1892. Serial No. 424,380. (No model.)

To all whom it may concern:

Be it known that we, HENRY A. WEEKS and GEORGE W. LEWIS, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Gas-Engines; and we do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates primarily to the delivery or feed of gas to the piston chamber in gas engines, and it consists, in this respect, in the provision of a reservoir or relatively large chamber in which the gas, after being expanded by explosion or ignition, is accumulated under high pressure and from which it is delivered into the piston chamber through a valved passage.

The invention also relates to automatic means for limiting the pressure in this reservoir, and to other features of construction having reference to the primary object and more distinctive feature of the invention first above mentioned.

In the accompanying drawings the engine proper is shown as being of the rotary order and of the particular construction set forth by Henry A. Weeks, one of the present patentees, in his application, Serial No. 424,378, filed simultaneously herewith, and the apparatus is otherwise shown as adapted for the use of the vapor of gasoline or other liquid hydrocarbon with air, but the invention is applicable to the use of ordinary coal gas or other gas and air and of other forms of engine proper.

Figure 1 of said drawings is a plan view of the engine provided with our improvements. Fig. 2 is a side elevation of the same. Fig. 3 is a vertical section through the reservoir and piston chamber. Fig. 4 is a vertical section in the indirect line 4—4 of Fig. 3. Fig. 5 is a vertical section transverse to the shaft, illustrating the valve-controlling mechanism.

First pointing out the elements of the Weeks rotary engine, here illustrated, A designates a cylindric piston chamber having induction and eduction ports *a a'*; B designates a rotatable shaft in the axis of the piston chamber; B' a piston secured to said shaft within the chamber A; C a hollow, rotary, cylindric sheath for the piston eccentric to and embracing the shaft B and shown as touching the inner periphery of the chamber A at a line between the ports *a a'*, and D designates a ported, oscillatory valve arranged in the induction passage *a* through which the impelling fluid is admitted to the piston chamber. Further details of the construction of this rotary engine and its mode of operation are fully set forth in the above mentioned application of Weeks.

Next pointing out in a general way the remaining elements of the entire apparatus, E designates a strong reservoir communicating with the piston chamber of the engine proper through the passage *a;* F designates a gasoline supply tank; G designates a vaporizer, which, as shown, is of the character set forth by George W. Lewis, one of the present patentees, in his pending application for patent, Serial No. 384,876, filed March 13, 1891, said vaporizer receiving gasoline from the tank F through a pump H, and taking air through a pipe I; J designates a pump taking carbureted air from the vaporizer G through a pipe G' and delivering it to the reservoir E through the pipe J'; K designates an ignition device in the passage leading from the pump J to the reservoir, and L designates the entire mechanism applied to the reservoir E and gas-and-air pipe G' for restricting the supply to said reservoir and thus preventing excessive pressure therein. M designates the mechanism for controlling the induction valve D with reference to the speed of the engine.

Describing the pressure regulating mechanism, L' designates a fixed standard to which is pivoted, between its ends, a lever L^2. At one of its extremities said lever is connected with a plunger or piston L^3 fitted to slide in a tube *l* which is open below the plunger to the interior of the reservoir, so that the end of said plunger is subject to reservoir pressure. At its opposite extremity the lever L^2 is similarly connected with an automatically opening valve in the pipe G' leading from the vaporizer to the pump, the arrangement being such that when the reservoir pressure forces the plunger L^3 upward or outward the valve in the gas or vapor pipe is closed. The vapor or gas supply being thus cut off, fur-

ther ignition and consequently further compression in the reservoir, are of course prevented. When, by use of gas from the reservoir, the reservoir pressure has been lowered below a required limit, the valve in the vapor pipe opens automatically, allowing vapor and air to pass to and from the pump and further ignition and a resulting reinforcement of the reservoir pressure take place.

The illustrated construction of the valve referred to comprises a plunger L^4 fitted to slide in an offset section *g* of the vapor-and-air pipe G′, so that, when lowered or advanced, said valve closes the passage for vapor and, when raised or retracted, opens said passage. A spring *l′* surrounding the plunger or valve rod between the open end of the offset pipe *g* and the adjustable collar l^2 on said rod, is the means shown for automatically opening the valve, though other suitable means may be employed for this purpose.

As an additional safeguard the reservoir is provided with a safety valve L^5 which will be set to open at a pressure a little higher than that at which the vapor valve is closed, so that, if the valve mechanism should for any reason fail to operate, the reservoir will have relief.

L^6 is a pressure gage by which the degree of pressure on the reservoir is indicated.

The pump J is single acting, and, as here illustrated, is operated from a crank on the journal of the piston sheath of the engine. In said engine it will be observed that the piston protrudes from the sheath increasingly during the first half revolution and decreasingly during the last half revolution, and that the power exerted upon the piston varies accordingly. The crank operating the pump is adjusted in position to bring the pump piston to the end of its active stroke when the engine piston is at its greatest protrusion from its sheath so that said pump may act the more advantageously against the pressure on the reservoir.

The ignition device may be of any preferred character or construction. That shown is of the kind in which a Bunsen burner is employed to heat a tube to incandescence. The pipe J′ leading from the pump J to the reservoir E and containing the ignition device is provided with a check valve J^2 between said device and the pump, opening from the pump. The pump induction pipe G′ is also provided with a check valve G^2 which opens toward the pump.

The valve-controlling mechanism M comprises a centrifugal shaft governor in which M′ M′ are weights attached to pivoted arms *m m*.

M^2 is a spring attached to the adjacent pulley and also to a sleeve M^3 which is mounted rotatably upon the shaft B, said shaft being peripherally connected with the weights M′ or their arms by chains *m′ m′* in such manner, as shown, that the spring M^2 opposes the centrifugal force of said weights and tends to rotate the sleeve in one direction while the weights, by outward movement, rotate it in the opposite direction. Upon the sleeve M^3 is formed an eccentric M^4 the position of which of course shifts with the sleeve according to the speed of the engine. Adjacent to the sleeve M^3 is a second eccentric M^5 fixed to the shaft B. From the straps of these eccentrics proceed rods m^2 m^2 the lower ends of which are pivoted to a transverse link M^6 and to the middle of this link is pivoted the end of a crank *d* on the axial shaft or prolongation of the valve D. The arrangement of the parts is manifestly such that in the higher speeds of the engine the valve D will be opened to a less extent or not at all, while at lower speeds said valve will be more widely opened and the supply of gas from the pressure reservoir E varied accordingly.

In the application of the rotary engine described to the use of heated gas it is proposed to circulate a cooling and lubricating liquid through the piston sheath. This is done by the provision of two pipes N N′ one of which delivers into and the other of which takes from the interior of said sheath through the head of the piston chamber with which the unheaded end of said sheath connects, as shown in Fig. 3. These pipes preferably enter the sheath at different elevations with respect to its axis to facilitate circulation by difference in temperature, though this is not essential. The relative movements of the piston and its sheath obviously produce a pumping action upon the contents of the sheath and the familiar provision of oppositely opening check valves in the pipes N N′ will result in a constant change in the contents of the sheath when the apparatus is in operation. The pipes N and N′ may be connected with any suitable receptacle or receptacles.

To put the apparatus into operation the ignition device is brought to an operative condition (according to its character) and several revolutions are given the engine by hand until the mixture of gas and air passing to the reservoir E ignites. This will practically involve the ignition of the entire contents of the reservoir in which, therefore, the pressure will at once be raised to a degree sufficient to continue the operation of the engine.

The governor mechanism M determines the supply of expanded and high pressure gas from the reservoir to the piston chamber and the pressure regulating mechanism L controls the supply to the reservoir, all in accordance with the adjustments given these parts respectively.

We claim as our invention—

1. A gas-engine, comprising a revoluble piston-shaft carrying a centrifugal governor, an oil-supply tank, an oil-pump acuated directly by the piston-shaft and communicating with the oil-tank, an exploded-gas reservoir communicating directly with the engine-cyl-

inder, a carbureted-air pump also actuated directly by the piston-shaft and communicating directly with the gas-reservoir, a vaporizer operatively interposed between the oil-pump and the air-pump, an ignitor operatively interposed between the air-pump and the gas-reservoir, and an oscillatory valve located in the passage between the reservoir and the cylinder and operatively connected to the governor upon the piston-shaft so as to be controlled thereby, substantially as set forth.

2. A gas-engine comprising a revoluble piston-shaft carrying a centrifugal governor, an oil-supply tank, an oil-pump communicating with said tank and actuated directly by the piston-shaft, an exploded-gas reservoir communicating directly with the engine cylinder, an oscillatory valve located in the passage between the reservoir and the cylinder and operatively connected to the governor upon the piston-shaft so as to be controlled thereby, a carbureted air-pump also actuated directly by the piston-shaft and communicating directly with the reservoir, a vaporizer operatively interposed between the oil-pump and the air-pump, an ignitor operatively interposed between the air-pump and the gas-reservoir, a cut-off valve operatively interposed between the vaporizer and the ignitor and closed by internal pressure of the gas-reservoir, substantially as set forth.

In testimony that we claim the foregoing as our joint invention we affix our signatures in presence of two witnesses.

HENRY A. WEEKS.
GEORGE W. LEWIS.

Witnesses:
M. E. DAYTON,
C. CLARENCE POOLE.