No. 742,079. PATENTED OCT. 20, 1903.

H. SPÜHL.

EXPLOSIVE MOTOR.

APPLICATION FILED MAY 13, 1903.

NO MODEL. 3 SHEETS—SHEET 1.

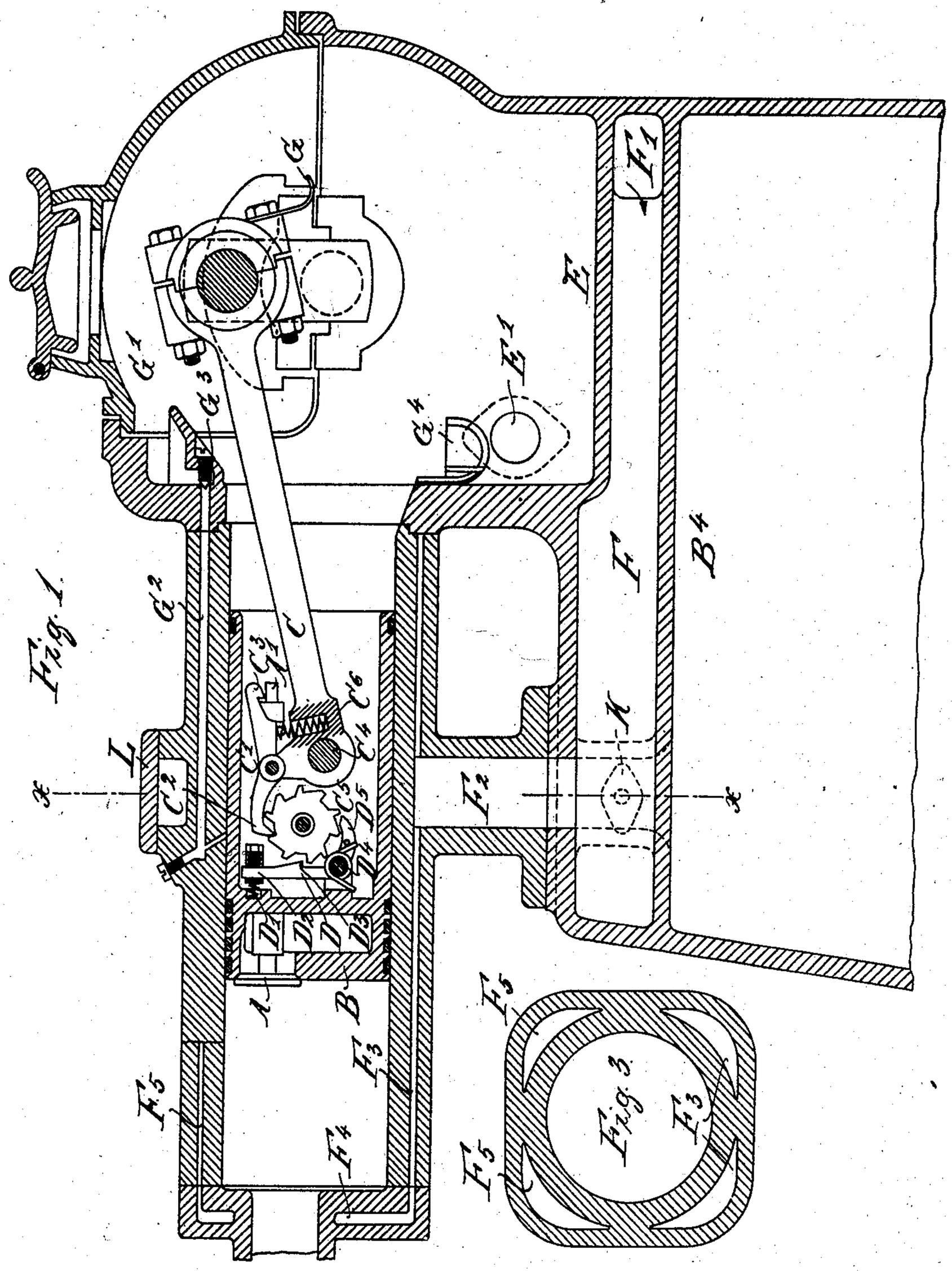


Fig. 1.

Fig. 3.

Witnesses:
Paul Wollenberg.
Paul Heinrich

Inventor:
Heinrich Spühl.
by Robert Seffler
Attorney.

No. 742,079. PATENTED OCT. 20, 1903.

H. SPÜHL.

EXPLOSIVE MOTOR.

APPLICATION FILED MAY 13, 1903.

NO MODEL. 3 SHEETS—SHEET 2.

Fig. 2.

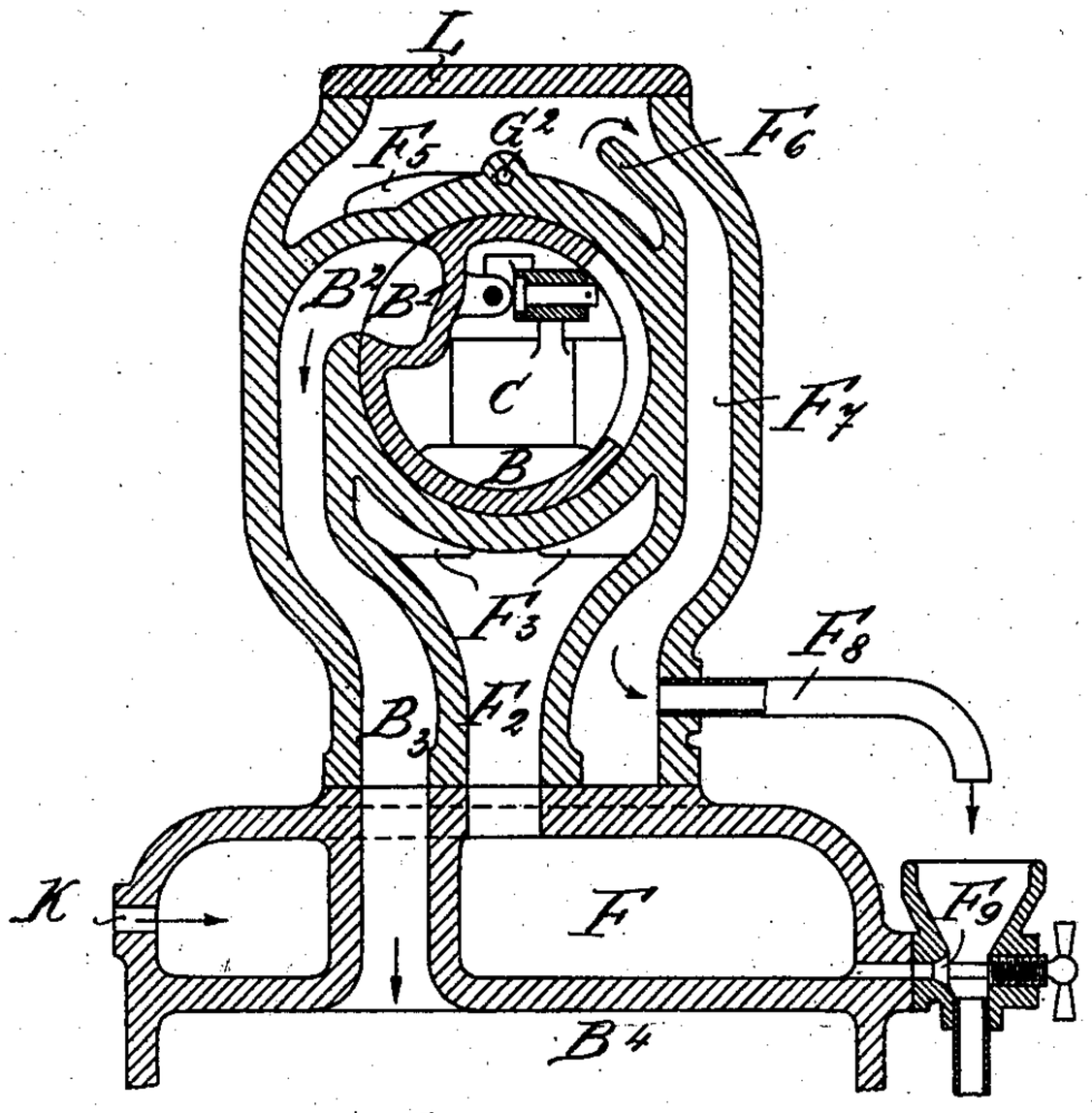
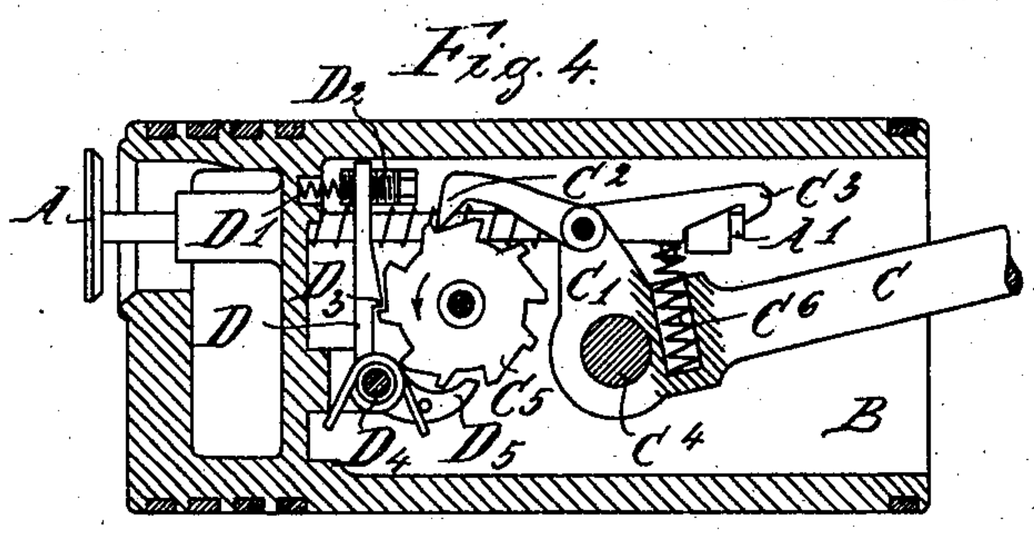


Fig. 4.



Witnesses:
Paul Wollenberg.
Paul Heinrich

Inventor.
Heinrich Spühl.
by Robert Sipler
Attorney.

No. 742,079. PATENTED OCT. 20, 1903.

H. SPÜHL.

EXPLOSIVE MOTOR.

APPLICATION FILED MAY 13, 1903.

NO MODEL. 3 SHEETS—SHEET 3.

Fig. 5.

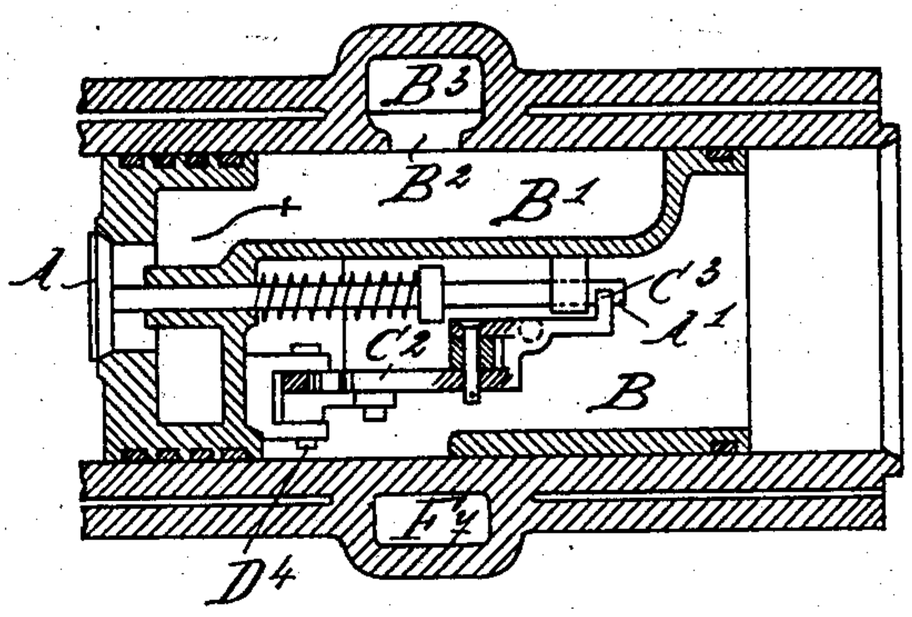
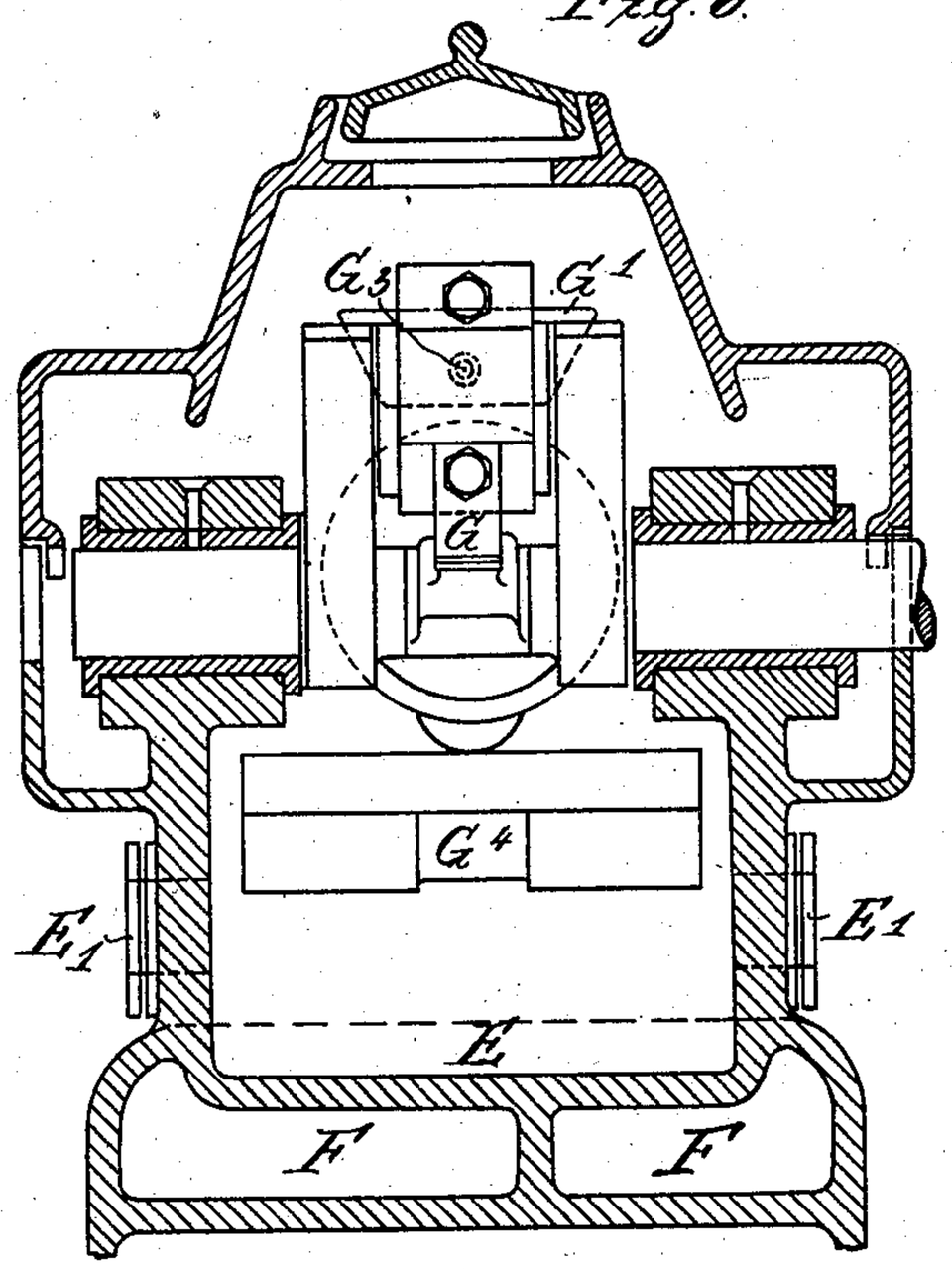


Fig. 6.



Witnesses:
Paul Heinrich
Paul Wollenberg.

Inventor:
Heinrich Spühl.
by Burnsdeifler
Attorney.

No. 742,079. Patented October 20, 1903.

UNITED STATES PATENT OFFICE.

HEINRICH SPÜHL, OF ST. GALL, SWITZERLAND.

EXPLOSIVE-MOTOR.

SPECIFICATION forming part of Letters Patent No. 742,079, dated October 20, 1903.

Application filed May 13, 1903. Serial No. 156,969. (No model)

To all whom it may concern:

Be it known that I, HEINRICH SPÜHL, a citizen of the Confederation of Switzerland, and a resident of St. Gall, in the Confederation of Switzerland, have invented certain new and useful Improvements in Explosion-Motors, of which the following is an exact specification.

My invention relates to improvements in explosion-motors, and more especially to an exhaust valve-motion for motors with four-stroke cycle.

It further relates to the regulation of such motors and to means for lubricating the same.

In order to make my invention more clear, I refer to the accompanying drawings, in which—

Figure 1 is a vertical longitudinal section of the motor. Fig. 2 is a vertical cross-section on line $x\,x$ of Fig. 1. Fig. 3 is a cross-section of the cylinder. Fig. 4 is a vertical longitudinal section of the piston with the exhaust-valve opened. Fig. 5 is a horizontal section of the cylinder and piston, and Fig. 6 is a vertical section of the crank-casing.

The igniting device, as well as the admission-valves for the air and gases or liquids, is omitted in the drawings for the sake of clearness. In the drawings the exhaust valve-motion, as well as the regulator for the motor, is situated within the piston B of the motor.

A is the exhaust-valve. As will be seen from Figs. 2 and 5, a channel B′ is provided in the piston, through which channel the exhaust-gases can escape from the cylinder through the opening B^2, the channel B^3 into the chamber B^4 forming the foundation of the motor. If the valve A is closed, no gases from the cylinder can escape. The channel B′ is longer than the stroke of the piston, as may be seen from Fig. 5, so that by the to-and-fro movement of the piston the opening B^2 cannot be closed.

In the trunk-piston B a ratchet-wheel C^5 is provided. This ratchet-wheel C^5 is turnable around a horizontal axle and possesses different teeth—that is to say, lower and higher teeth. The teeth of this ratchet-wheel engage with the click C^2. This click C^2 is connected to a click C^3, both clicks forming a double-armed lever pivoted in an arm C′, connected to the crank-rod C. The click C^2 is situated so that it can engage with the end A′ of the valve-spindle of the exhaust-valve A, Fig. 4. During the working of the motor the double click C^2 C^3 oscillates and moves the ratchet-wheel C^5 step by step forward.

As the motor to which the invention is applied is a motor with four-stroke cycle, the valve A is opened only after every second revolution of the crank. In order to attain this, the teeth of the ratchet-wheel C^5 are not equal in height, but are alternately higher and lower, as may be seen from Figs. 1 and 4. The click C^3 is situated so that it engages with the end A′ of the valve-spindle only in case the click C^2 engages with a lower tooth of the ratchet-wheel. (See Fig. 4.) As the lower and higher teeth alternate, this will be the case after each second revolution. If the click C^3 engages with the valve-spindle, this valve-spindle will be taken along by the click and the valve A will be opened.

For regulating the motor a regulator consisting of a pendulum D, Figs. 1 and 4, is provided. The pendulum D is provided with a nose D^3, which engages with the teeth of the ratchet-wheel C^5. For holding the pendulum D, which is pivoted at D^4, so that the nose D^3 of the same engages with the teeth of the ratchet-wheel C^5, a spiral spring D′ is provided, the tension of which may be regulated by means of a screw D^2, which serves at the same time for loading the pendulum. By the nose D^3 engaging with the teeth of the ratchet-wheel C^5 a turning back of this ratchet-wheel is prevented, so that this wheel will always be turned in the same direction. By the to-and-fro motion of the piston the pendulum D will be caused to swing, and it will swing mostly in the moment in which the piston arrives at the dead-point, near the cover of the cylinder—that is to say, when the click C^2 goes back in order to catch the following tooth of the ratchet-wheel C^5. If the normal number of revolutions of the motor is surpassed, the pendulum D swings far enough for setting the nose D^3 free, so that the same no longer engages with the ratchet-wheel C^5. In consequence hereof this ratchet-wheel can be turned back by the click C^2. This backward movement of the ratchet-wheel can only take place in case the click C^2 is situated in the

larger recesses between a higher and a lower tooth—that is to say, when the valve A cannot be opened by the click C^3. The device for effecting that the ratchet-wheel cannot be moved back in case the valve A is opened will be described below. By the click C^2 turning the ratchet-wheel back this ratchet-wheel will during the next revolution make the same forward movement as before—that is to say, it is by the first revolution taken forward and backward and by the second revolution the same distance forward again. Consequently the exhaust-valve A will remain closed also during the second revolution. The combustion-gases, which cannot exhaust, are consequently again compressed—that is to say, one working period of the motor misses.

In ordinary motors with four-stroke cycle the motor revolves twice after the missing of one explosion before the following explosion takes place. By the above construction of the regulator it is attained, however, that only one revolution is lost, and the second revolution is used again for sucking up and compressing the mixture, whereby the working of the machine is much better regulated.

The above-mentioned device for preventing that the valve A is held open during two successive strokes of the piston consists of a click D^5, pivoted around the axle D^4. The free end of this click D^5 is so formed that the click catches only the higher teeth of the ratchet-wheel, (see Fig. 4,) while the lower teeth can slide over the click D^5 without catching the same. (See Fig. 1.) If the click C^2 is situated before a lower tooth, the click D^5 is situated before a higher tooth. It is attained herewith that the ratchet-wheel can only move backward in case the valve A is closed.

The number of revolutions of the motor may be regulated by means of the screw D^2, by means of which the tension of the spring D′ can be adjusted.

As may be seen from Fig. 6, the lubrication of the motor takes place from the crank-casing. The lower part E of this casing serves as a reservoir for collecting the oil for lubricating the motor. On both sides of the crank-casing sight-glasses for observing the level of the oil are provided. At the end of the crank-rod a spoon-shaped receptacle G is arranged. This spoon dips during each revolution of the crank into the oil and scatters the oil in the crank-casing. Part of this oil flows into the cup G′, Figs. 1 and 6. Another part of the oil is thrown into the trunk-piston and lubricates the parts situated in this piston. The oil taken up by the cup G′ flows through the channel G^2, the cross-section of which can be regulated by means of the screw G^3, into the cylinder and serves for lubricating the piston. Before the oil which has become dirty and hot can flow back into the collecting-receptacle E it is filtered. For this purpose an oil-filter G^4 is provided, through which the oil must pass. In the receptacle E the hot oil is cooled. For this purpose the cooling-water for the cylinder, which enters at K, flows through a cooling-chamber F. In this cooling-chamber a vertical longitudinal partition is provided, which partition divides the chamber in two parts connected to one another by means of an opening F′. The cooling-water must therefore pass to and fro underneath the oil-collector, hereby cooling the oil situated within the same. From the chamber F the cooling-water flows through the channel F^2 into the lower channels F^3, connected, by means of the cylinder-cover F^4, to the upper channels F^5, hereby forming a water mantle for the cylinder. The water leaves the channel F^5 at F^6, Fig. 2, and flows through the channel F^7 and the pipe F^8. F^9 is a valve by the opening of which all the water contained in the motor can be led off. If the level of the oil in the collector E is high enough so that the crank itself dips into the oil, the spoon G is not necessary, as in this case the oil is scattered in the crank-casing by means of the crank.

Having thus fully described the nature of my invention, what I desire to secure by Letters Patent of the United States is—

1. In an explosion-motor with four-stroke cycle, the combination of a trunk-piston, an exhaust-valve situated within this piston, a double-armed click connected to the piston-rod, one arm of said click engaging with the valve-spindle, a ratchet-wheel possessing teeth of different height, the other arm of the click mentioned above engaging with the teeth of this ratchet-wheel, and means for preventing a backward movement of the ratchet-wheel, substantially as described and for the purpose set forth.

2. In an explosion-motor with four-stroke cycle, the combination of a trunk-piston, an exhaust-valve situated within this piston, a double-armed click connected to the piston-rod, one arm of said click engaging with the valve-spindle, a ratchet-wheel possessing teeth of different height, the other arm of the click mentioned above engaging with the teeth of this ratchet-wheel, and a spring-influenced pendulum provided with a nose engaging with the teeth of the ratchet-wheel and preventing a backward movement of this wheel, substantially as described and for the purpose set forth.

3. In an explosion-motor with four-stroke cycle, the combination of a trunk-piston, an exhaust-valve situated within this piston, a double-armed click connected to the piston-rod, one arm of said click engaging with the valve-spindle, a ratchet-wheel possessing teeth of different height, the other arm of the click mentioned above engaging with the teeth of this ratchet-wheel, a spring-influenced pendulum provided with a nose engaging with the teeth of the ratchet-wheel and setting

these teeth free, when the normal number of revolutions of the motor is surpassed, hereby allowing a backward movement of the ratchet-wheel, and means for preventing this backward movement, when the exhaust-valve is opened, substantially as described and for the purpose set forth.

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

HEINRICH SPÜHL.

Witnesses:

JAKOB ABDERHALDEN,

R. SCHÜTZ.