No. 752,434. PATENTED FEB. 16, 1904.

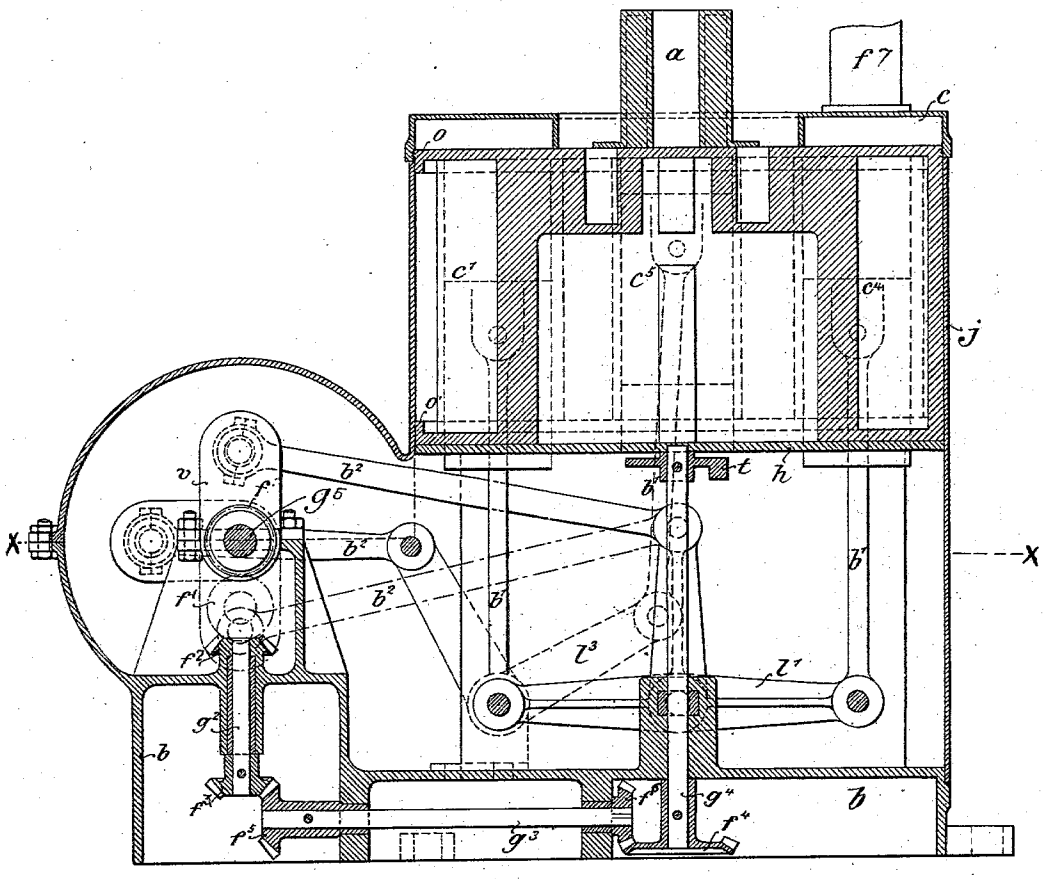
F. BALTZINGER.

EXPLOSION MOTOR.

APPLICATION FILED APR. 27, 1901.

NO MODEL. 6 SHEETS—SHEET 1.

Fig. 1.



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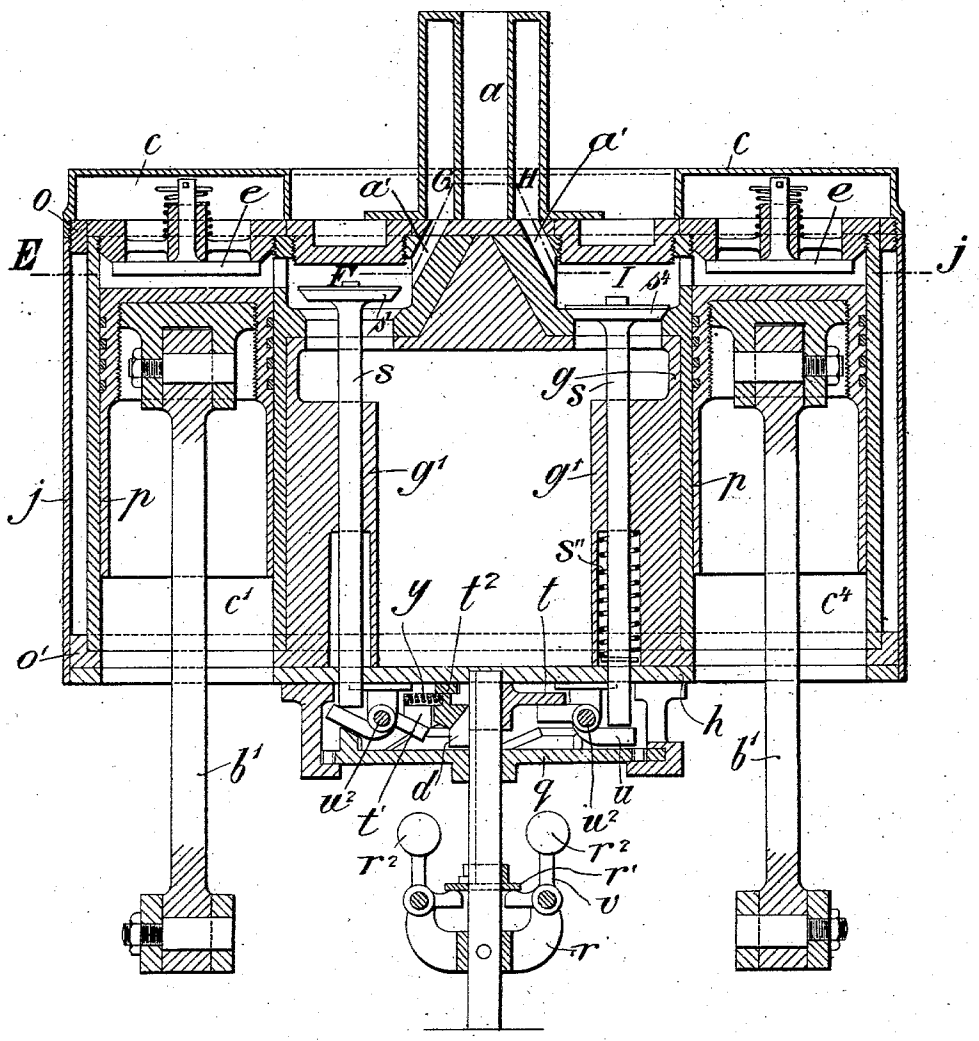
NO MODEL. 6 SHEETS—SHEET 2.

Fig. 2.



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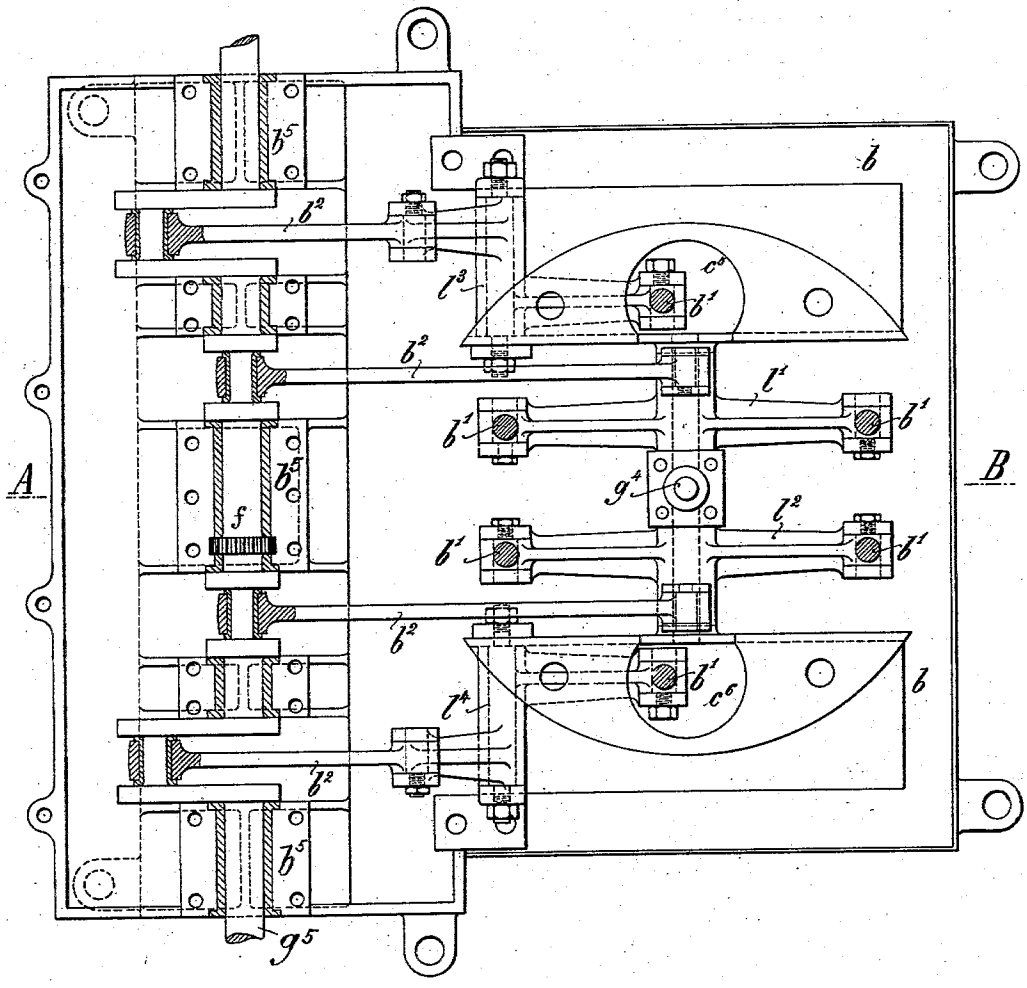
NO MODEL. 6 SHEETS—SHEET 3.

Fig. 3.



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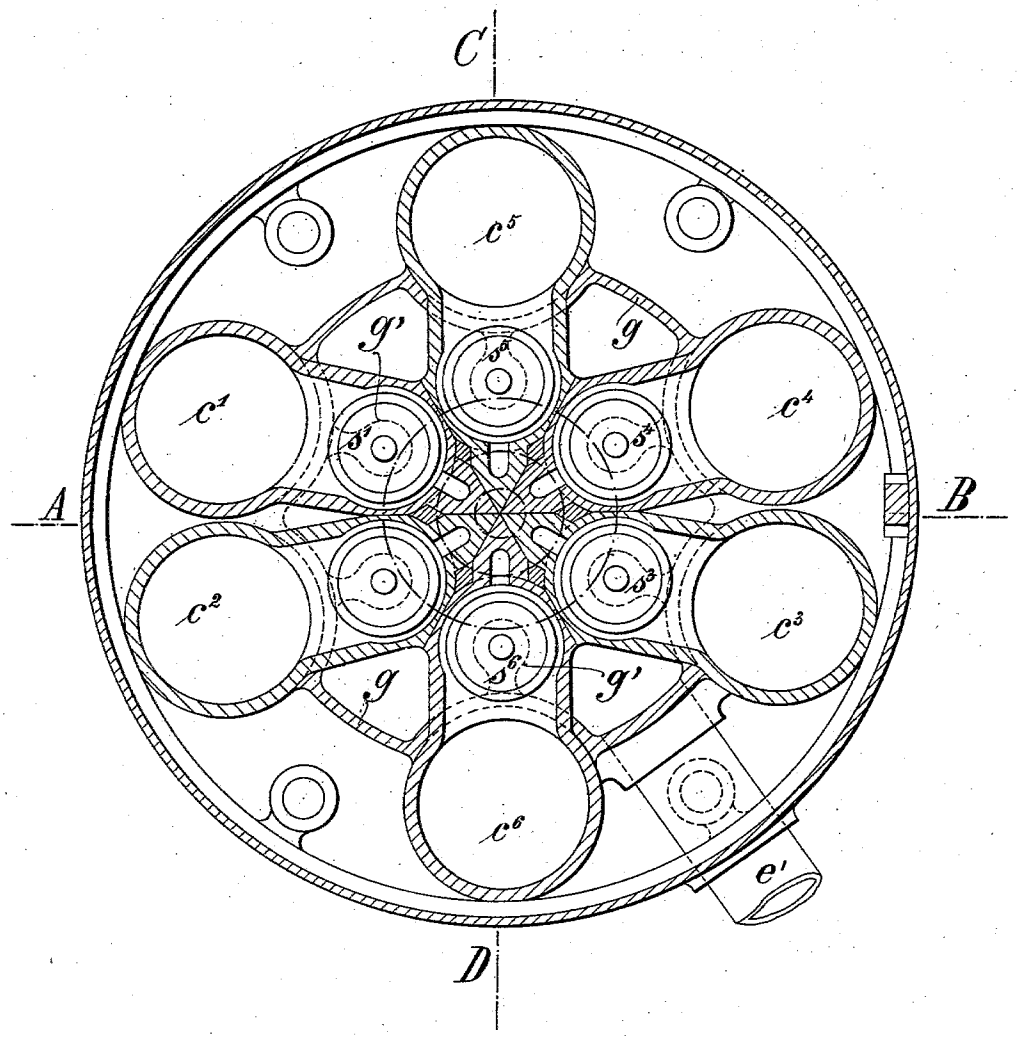
NO MODEL. 6 SHEETS—SHEET 4.

Fig. 4.



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NO MODEL. 6 SHEETS—SHEET 5.

Fig. 9.

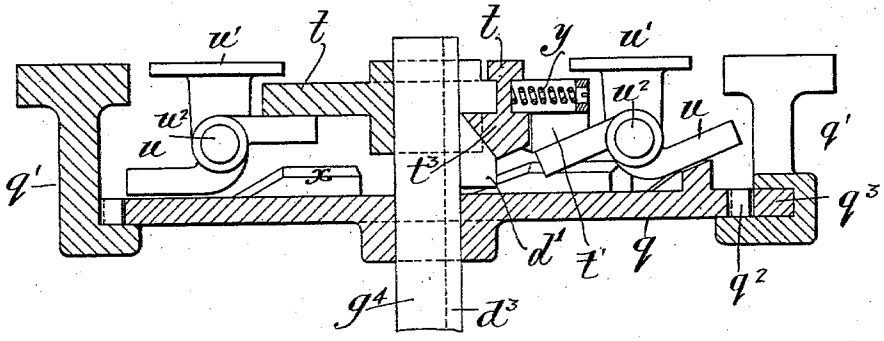


Fig. 5.

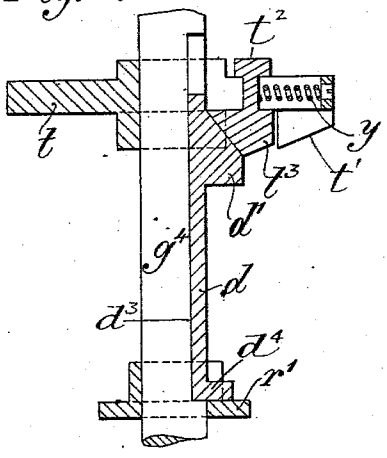
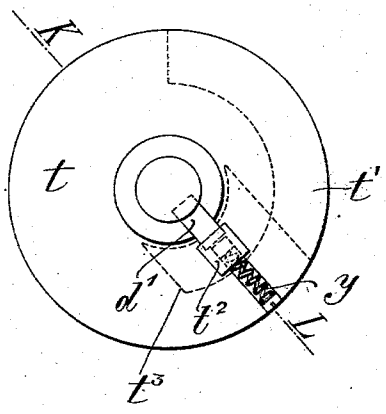


Fig. 6.



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NO MODEL. 6 SHEETS—SHEET 6.

Fig. 10.

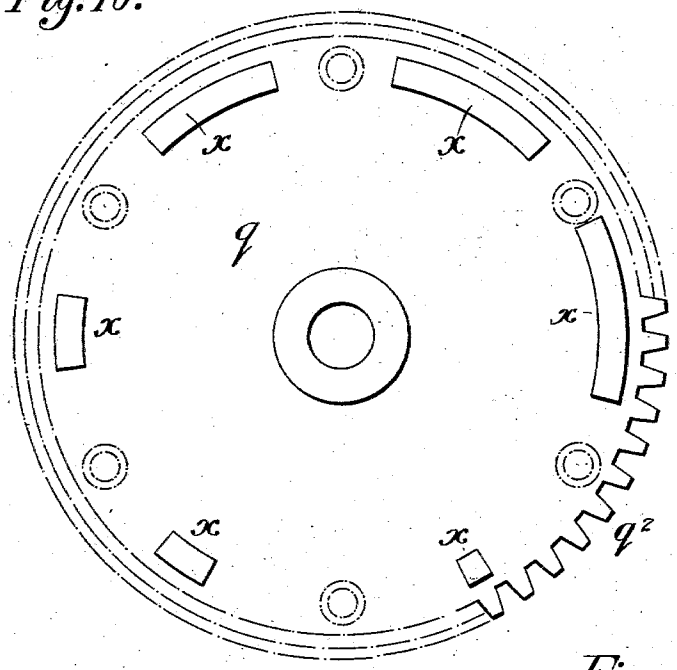


Fig. 11.

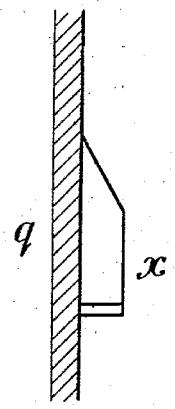


Fig. 8.

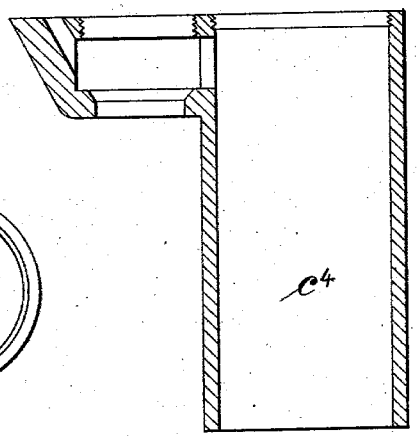
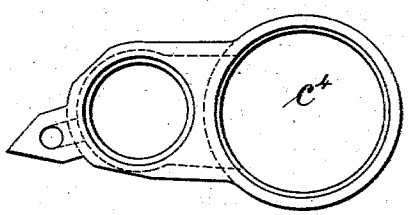


Fig. 7.



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

No. 752,434. Patented February 16, 1904.

UNITED STATES PATENT OFFICE.

FREDERIC BALTZINGER, OF MONTBÉLIARD, FRANCE.

EXPLOSION-MOTOR.

SPECIFICATION forming part of Letters Patent No. 752,434, dated February 16, 1904.

Application filed April 27, 1901. Serial No. 57,710. (No model.)

To all whom it may concern:

Be it known that I, FREDERIC BALTZINGER, a citizen of the French Republic, residing at Fleur d'Epines, Montbéliard, France, have invented certain new and useful Improvements in Explosion-Motors, of which the following is a specification.

The subject of the present invention is an explosion-motor in which the cylinders are arranged in a circle and work on a common crank-shaft.

The characteristic feature of the invention is to be found in the fact that the separate cylinders, which are made of a sufficiently tough metal, are assembled by means of a common casting, which is preferably made of a light metal—say aluminium or the like—so that by this means the whole weight of the engine is largely reduced with regard to its working power. The arrangement of these cylinders in the manner described also renders possible the simplification of the ignition thereof, so that one ignition-pipe which is common to all the cylinders is arranged in the casting carrying the cylinder, which pipe contains several openings. Similarly, this arrangement enables the exhaust-valves to be so disposed in the common casting that their valve-rods may be actuated and regulated in their movements accordingly to the work of the engine by only one cam, the castings of these exhaust-valves being arranged within a projection connected to the corresponding cylinders. The automatic suction-valves, which allow of the entering of the explosive mixture, are arranged at the upper ends of the cylinders. The duration of the opening of the exhaust-valves is regulated from one point by means of one cam, the working surface of which may be altered automatically by means of a regulator. In addition to this a special arrangement is provided on the motor, by means of which one or several cylinders may be thrown out of action to enable the effect of the motor to be varied within the widest extremes and also to accommodate the consumption of explosive mixture to any desired power. For this purpose the exhaust-valves of the particular cylinder or cylinders may be kept open during the whole time, and the arrangement allows of putting any desired number in this way out of working.

In order that my invention may be better understood, I will proceed to describe an example of construction of the same with reference to the accompanying drawings, in which similar reference characters refer to similar parts.

Figure 1 is a vertical section of an explosion-motor constructed in accordance with my invention. Fig. 2 is a vertical section showing two cylinders and their valves. Fig. 3 is a horizontal section on the line X X of Fig. 1, showing the construction of the base-plate and the arrangement of the cranks and connecting-levers. Fig. 4 is a horizontal section of the cylinders and valves on the line E F G H I J of Fig. 2. Figs. 5 and 6 represent a section and plan of a part of the governor mechanism hereinafter described. Figs. 7 and 8 represent a plan and vertical section of a single cylinder, showing the exhaust-valve seat and the ignition-opening. Fig. 9 is a longitudinal section of the plate designed for putting out of action one or more cylinders in the manner and for the purpose set forth in the following description. Fig. 10 is a plan of the disk, provided with teeth on its circumference; and Fig. 11 is a part section of Fig. 10, showing one of the projections on the surface of the disk.

In the motor illustrated in the accompanying drawings there are six cylinders c', c^2, c^3, c^4, c^5, and c^6, the relative arrangement of which will be evident from Fig. 4. The exhaust-valves s', s^2, s^3, s^4, s^5, and s^6 of these cylinders are arranged around the axis of this machine. Each of these cylinders forms, with the seat of its exhaust-valve and the ignition-opening, a single casting, as shown separately in Figs. 7 and 8, so that no joint is required for the connection of each cylinder with its respective valve-chamber and ignition-piece. The automatic suction inlet-valve e is provided at the top end of each cylinder, Fig. 2.

The cylinders are assembled by a casting of

light metal—say, for example, aluminium or the like—between two circular plates o o', connected together by a thick central tube g, Fig. 4, in such a manner that the cylinders are grouped round the said tube g, their ends being cast into the plates o o', as will be seen by reference to Figs. 1, 2, and 4. This manner of constructing and arranging the cylinder-casting will be found to largely reduce the whole weight of motors with regard to their maximum working power.

The cylinders may be provided with cooling ribs or plates of light metal (aluminium) cast on their outside, for which purpose longitudinal or circular grooves are to be previously provided on the outer surface of the cylinders, or when desired any known system of cooling the cylinders—for example, by means of cold water or the like—may be employed. For this latter purpose a cylindrical envelop j, Fig. 2, of any desired material has been provided on the outside of the cylinder-casting, which may be connected in any suitable manner to the two end plates o o' of the casting, Figs. 1 and 2, so as to obtain the necessary tightness. It will be found that in spite of the compact arrangement of the cylinders c around the center there will still remain sufficient space to enable them to be effectively cooled by water.

In the central tube g, connecting the two end plates o o', a number of inwardly-projecting pieces g' equal to the number of cylinders and cast with the cylinder-casting are provided for the purpose of guiding the rods s of the exhaust-valves s' s^2 s^3, Fig. 2, of all cylinders. The tube g is closed at the bottom by a plate h adjacent to the lower end plate o', provided with six openings, through which the respective rods s of the exhaust-valves project. On the under side of the plate h there are secured six small supports u', pivotally bearing six small bell-crank levers u upon fulcrums u^2 and so arranged around the center of the machine that the outer end of each lever u lies against the lower end of a rod s of each exhaust-valve. The inner ends of these levers u bear against a common governing-disk t, secured to a vertical shaft g^4 and provided with a raised segmental cam portion t' on its under side. The disk t is keyed on the vertical shaft g^4, which is journaled with its upper end in the plate h and with its lower end in the main frame b, Fig. 1, of the machine and is provided with a conical gear f^4, meshing with a second gear f^6. This latter being keyed on the end of a shaft g^3, the other end of which carries another gear f^5, meshing with a gear f^3 on a vertical shaft g^2, is rotated by this means and with the aid of the gearing f^2 and pinions f' and f, the latter of which may be arranged on any suitable part of the main shaft g^5 of the machine. When the shaft g^4, and with it the governing-disk t, is rotated, the bell-crank levers u, bearing against the projecting cam part t' of said governing-disk t, will be shifted from their position shown in Fig. 9 on the left hand to that shown in the same figure on the right hand. The outer ends of the said levers u will therefore be raised, so that the exhaust-valves, the rods s of which rest upon the outer ends of the levers u, may be opened at the proper time. Springs s'', arranged in enlarged openings of the piece g' and surrounding, respectively, the rods s, to which their lower ends are suitably secured, are intended to instantaneously close the exhaust-valves when the governing-disk t has reached the proper position.

In addition to the fixed projecting part t' the governing-disk t is yet provided with a movable projecting piece t^2, which is constantly pressed toward the axis of the shaft g^4 by means of a spring y to its innermost position. This movable part t^2 is guided in a radial groove provided in the disk t, and its lower enlarged portion t^3, as indicated in Fig. 6 with dotted lines, forms in its most outward position a continuation of the raised part t' on the under side of the disk t, so that that part of a revolution of the disk t during which the projection t' on its under side causes the rods s of the exhaust-valves to rest in their upper position may be varied by adding or deducting the length of the movable piece t^2. In order to automatically produce this movement of the additional piece t^2, a governor is secured to the vertical shaft g^4 below the governing-disk t. This governor essentially consists of two or more bell-crank levers v on a support-piece r, connected with the vertical shaft g^4 and provided with weights r^2 on their vertical arms. The horizontal inwardly-projecting arms of the said bell-crank levers v bear against a ring r', which is loosely mounted upon the shaft g^4 and on the upper side of which rests the flange d^4 of a connecting-rod d, provided on its upper end with a key-formed wedge d'. This connecting-rod d is preferably of rectangular section and guided in a suitable groove d^3, extending along the vertical shaft g^4. It will therefore be seen that when the number of revolutions of the main shaft g^5 exceeds a certain point previously fixed the weights r^2 of the governor are forced outward by their own centrifugal force, the ring r' will be raised by the bell-crank levers v to its highest position, and the wedge d' will therefore press the movable additional projecting piece t^2 of the governing-disk t into its most outward position, compressing the spring y, and thereby causing the exhaust-valves to rest opened during a greater part of one revolution of the governing-disk t. By this means the power of the whole machine

may be soon reduced and accidents involved by inadmissible speeds of the machine may be prevented. As soon as the speed of the machine falls the weights r^2 of the governor are drawn together, the ring r' is lowered, and the spring y by moving inwardly the projecting piece t^2 forces downward the wedge d' so far as is permitted by the flange d^2 of the guided connecting-rod d. The length of the projecting part $t' t^2$ of the disk t now being reduced to that of the rigid portion t', the machine will obtain again the former power.

The device described enables, therefore, the speed of the machine to be regulated so as to be kept always below a certain maximum number of revolutions. Although this device would be sufficient to enable the engine to be driven at a perfectly uniform speed, an additional device has been provided in order to enable the maximum power of the machine to be varied according to a variable resistance which is to be overcome by it and to accommodate the consumption of explosive mixture to any desired power. To this end one or several cylinders of this machine may be totally thrown out of action, which is done by constantly keeping the rods s of the respective exhaust-valves in their highest position. By this means the piston p of that cylinder or those cylinders is prevented from drawing in fresh explosive mixture through the respective inlet suction valve or valves e, the gases contained in the common exhaust-tube g being then used for filling the vacuum produced by the piston p. In this manner the machine is prevented from consuming more of the explosive mixture than corresponds to its reduced power and is enabled to work economically. The device serving for performing this object preferably consists of a disk q, loosely mounted upon the vertical shaft g^4 and supported in horizontal position just below the outer arms of the levers u by projecting shoulders of several arms q', secured to the under side of the plate h, Fig. 2. This disk or plate q is provided on its upper surface with a number of projections x of different length, Figs. 10 and 11, arranged around the eccenter of the said disk q, the position of said projections x with respect to that of the bell-crank levers u being such that these projections x may come into contact with the outer arms of the said levers u and may rock the latter into the same position as would be performed by the action of the projecting surfaces $t' t^2$ of the governor-disk t upon the inner arms of the same levers u. The arrangement of the projections x on the upper side of the plate q is, moreover, such as to enable one or more levers u to be rocked simultaneously by the changement of the position of the projections x with respect to these levers u, this changement being effected by revolving the disk q upon the shaft g^4. For this purpose the disk q is provided with teeth q^2 on its whole circumference, and meshing with the latter a rack q^3 is suitably arranged and provided with means—as, for instance, with a handle or the like—for moving the same in a direction tangentially to the disk q, thereby revolving the latter upon the shaft g^4 and rocking another number of levers u upon the respective pins u^2. By these projections x the inwardly-directed arms of the levers u are brought out of the way of the projecting parts $t t^2$, revolving constantly with the governing-disk t, and therefore the respective exhaust-valves will constantly be kept in their opened position.

With this device it is possible to considerably change the working power of the motor, the maximum of which is given by the whole number of its explosion-cylinders. If, for instance, it is desired to drive a motor the maximum capacity of which amounts to twenty-four horse-power with one some fraction of that power—say one-half, one-third, or even one-sixth of it—the exhaust-valves of a corresponding part of the number of cylinders, respectively, of three, four, or even five cylinders, must be kept open by a suitable adjustment of the disk q, so that, for instance, in the last case all of its projections x except the shortest one come to rock the respective levers u and to prevent the exhaust-valves of five cylinders from being shut.

This device, intended for altering the motive power of a motor within the greatest limits in the manner described, will be found to be of special utility for motor-cars and the like, inasmuch as every different power that may be required by the largely-varying resistance can be exercised by one and the same motor.

Each of the cylinders exhausts into the common central tube g, from which the exhaust-gases may escape through the the pipe e', Fig. 4.

The ignition-opening a' for each cylinder is provided above and outside the central tube g. An ignition-piece a, which may be constructed of nickel or platinum and which possesses a number of chambers equal to that of the cylinders coinciding exactly with the ignition-openings a, is arranged above the plate o, Fig. 2, and may also be provided with an additional central chamber in order to reduce the thickness of the walls and to be easily heated, so that the ignition may soon take place, and if so constructed such an ignition-tube will be found as light as those usually constructed.

It may be remarked that in spite of the compact arrangement of the cylinders and the small space occupied by the same each inlet and exhaust opening may be comparatively

large, which is a certain guarantee for the good operation and effectiveness of the motor.

Above the cylinder a shallow annular chamber is formed by a hat e, screwed to the top plate o. The inner wall of this hat e is tightly set upon the plate o, so as to prevent the escape of the gas being fed from a vaporizer through the pipe f^7, Fig. 1. This chamber thus forms the suction-chamber for the explosive mixture.

The whole cylinder-casting, with valves and means for regulating the power of the motor, is placed above and suitably secured to a frame b, Fig. 1, which primarily serves for supporting the main crank-shaft g^5 in suitable bearings b^5. Upon this frame there are pivotally mounted levers l' l^2 and l^3 l^4, the former being provided with three, the latter with only two, arms. The levers l^3 l^4 are connected with one arm to the piston-rods b' of the cylinders c^5 and c^6, their other arm being in rigid connection with the respective crank of the main shaft g^5 by means of connecting-rods b^2. Similarly, the horizontal arms of the levers l' and l^2 are connected with the piston-rods b' of the cylinders c' c^2 c^3 c^4, while the two remaining arms are also connected with the crank-shaft g^5 by means of rod b^2. By this arrangement the vertical movement of the pistons b of all cylinders may be transmitted to the main shaft without the necessity of providing this latter with a number of cranks equal to that of the cylinders, so that the dimensions of the machine may be reduced.

As will be seen by reference to Fig. 1, the motion transferred to the levers l' l^2 by the pistons c' c^2 c^3 c^4 is transmitted by the vertical arms of said levers to the main crank-shaft g^5. With this arrangement the operation of the engine is extremely smooth. The shocks caused by the explosions are absorbed, so that the crank-shaft is subject to considerably less strain. As the bearings are likewise subject to less strain than in other constructions, it is possible to use a material which is lighter and possesses a higher resistance. By reason of this connection of the pistons to the crank-shaft the total height in the case of a vertical motor and the total length in the case of a horizontal one is considerably reduced. It will be found that this arrangement possesses all the advantages of the vertical and horizontal types without their disadvantages, such as the loosening of the screws, which is accompanied with great danger in the case of motor-cars and the straining of the support, which has many unpleasant consequences.

In consequence of the construction of the motor compacted in a single frame very much less space is occupied, and the motor can be put to work at any desired place without requiring any tedious fitting, &c. The motor can indeed be used for any purpose whatever. It can be removed, for instance, from one motor-car to another and can be used in winter for illuminating purposes and in summer for driving a car. By the addition of the two cylinders c^5 and c^6 a dead-point is entirely avoided in driving the crank-shaft, as one of these two cylinders will always be in the middle of its working stroke when the other four cylinders are in position corresponding to the dead-points of their cranks. As a consequence a very small fly-wheel need only be used for neutralizing the slight shocks received by the levers at each explosion. With the arrangement of six cylinders so as to operate on a single crank in the manner described three cylinders will be acting at each revolution of the crank, so that the motor can be driven with as high a velocity if not higher than a single-cylinder engine. While producing an equal power, the cylinder-bores are much smaller and the total weight is much less than is the case with a single-cylinder engine.

The whole frame b, together with all the mechanism—that is, the toothed wheels, levers, and rods—are inclosed in a casing, into which the pistons dip, being in this way lubricated, as the casing is filled with oil. The motor is especially designed for mineral oils or benzin; but it can, however, if a special vaporizer is provided likewise be driven by heavy petroleum. Further, common illuminating-gas may be employed for driving the motor when stationary without altering the general arrangement.

What I claim, and desire to secure by Letters Patent of the United States, is—

1. An explosion-engine comprising a cylinder and frame of two different kinds of metal, the cylinder being cast into the metal of the frame, whereby intimate contact for cooling purposes and a light construction are obtained.

2. An explosion-engine comprising a plurality of cylinders cast into a single frame of aluminium, substantially as described.

3. In an explosion-motor the combination of several cylinders, three-armed levers fulcrumed below said cylinders, piston-rods connecting the pistons of said cylinders with two arms of said levers, connecting-rods connecting the third arms of said levers to different cranks of a common crank-shaft, substantially as, and for the purpose, set forth.

4. In an explosion-motor the combination of several cylinders, three-armed levers fulcrumed underneath said cylinders, piston-rods connecting the pistons of several of said cylinders to two arms of said levers, connecting-rods connecting the third arms of said levers to different cranks of a common crank-shaft, bell-cranked levers likewise fulcrumed underneath said cylinders, connecting-rods connecting the pistons of several such cylinders to one arm of said bell-crank levers, connecting-

rods connecting the other arms of said levers to different cranks of said common crank-shaft, substantially as, and for the purpose, set forth.

5. In an explosion-motor the combination of several cylinders, a single casting uniting said cylinders in a single block, gas-inlet and exhaust valves arranged in said block, means for operating said exhaust-valves from a single rotating shaft, and means for putting one or more of said exhaust-valves into the exhaust position by hand, substantially as, and for the purpose, set forth.

In testimony whereof I have hereunto set my hand in the presence of two witnesses.

FREDERIC BALTZINGER.

Witnesses:

GRET, EMILE,

BLEYER, CHARLES.