No. 861,205. PATENTED JULY 23, 1907.

N. CRANE.

GAS ENGINE.

APPLICATION FILED SEPT. 17, 1904.

3 SHEETS—SHEET 1.

Fig. 2.

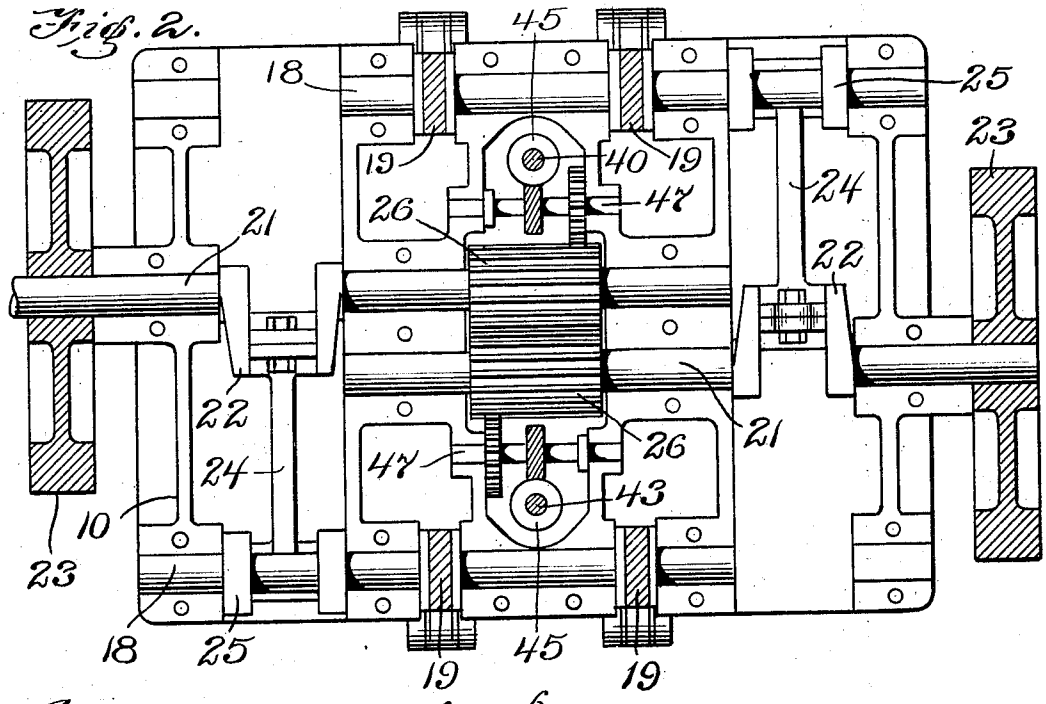
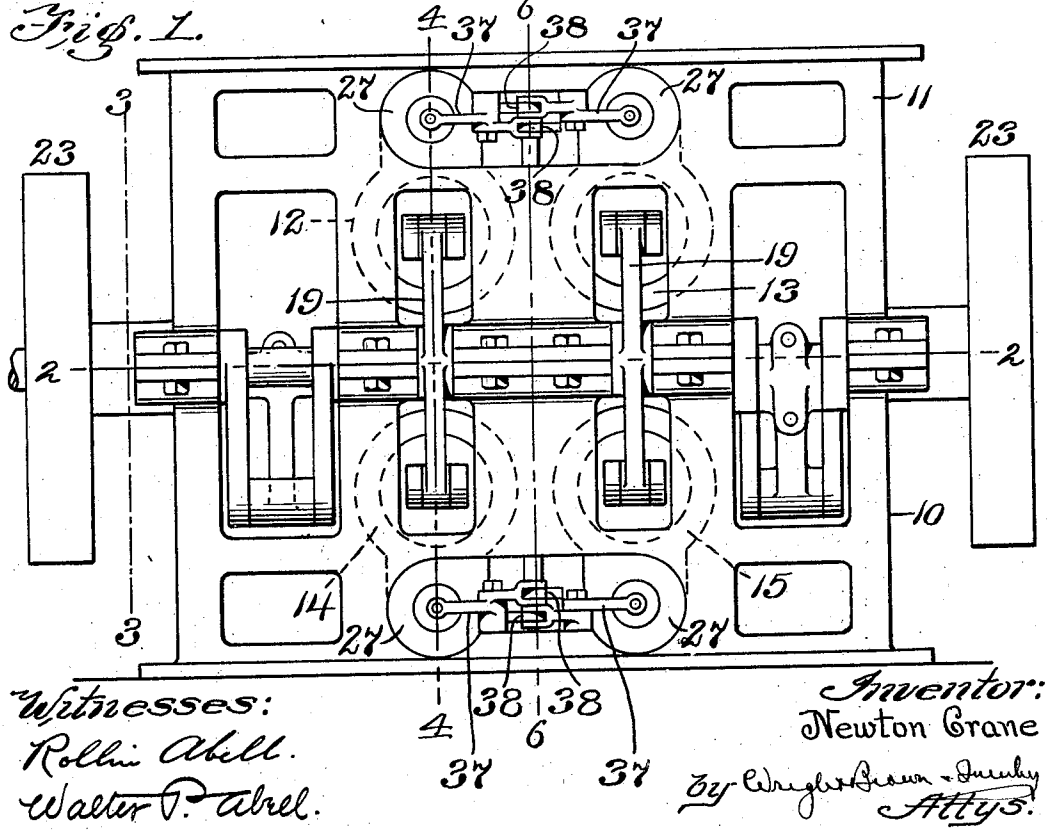


Fig. 1.



Witnesses:
Rollin Abell.
Walter P. Abel.

Inventor:
Newton Crane
By Wright Brown Quinby
Attys.

No. 861,205. PATENTED JULY 23, 1907.

N. CRANE.

GAS ENGINE.

APPLICATION FILED SEPT. 17, 1904.

3 SHEETS—SHEET 2.

Fig. 3.

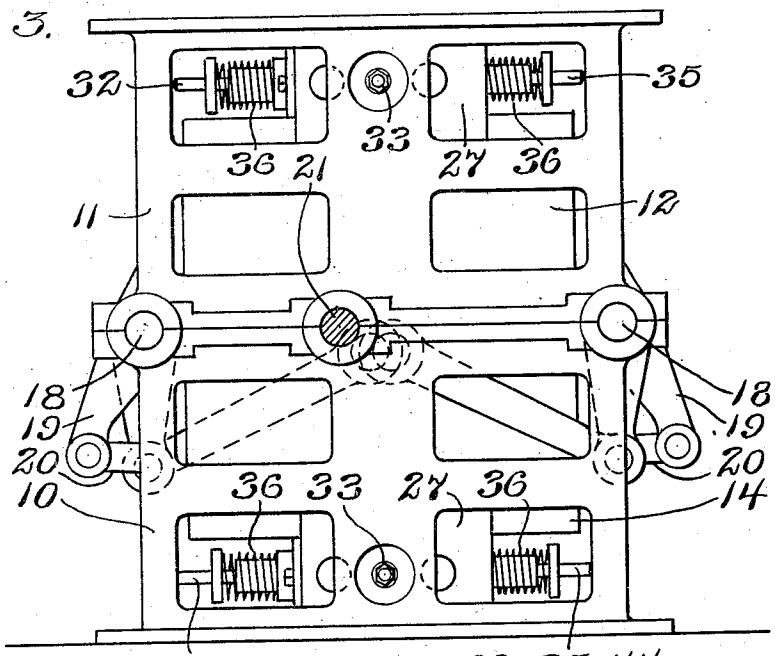
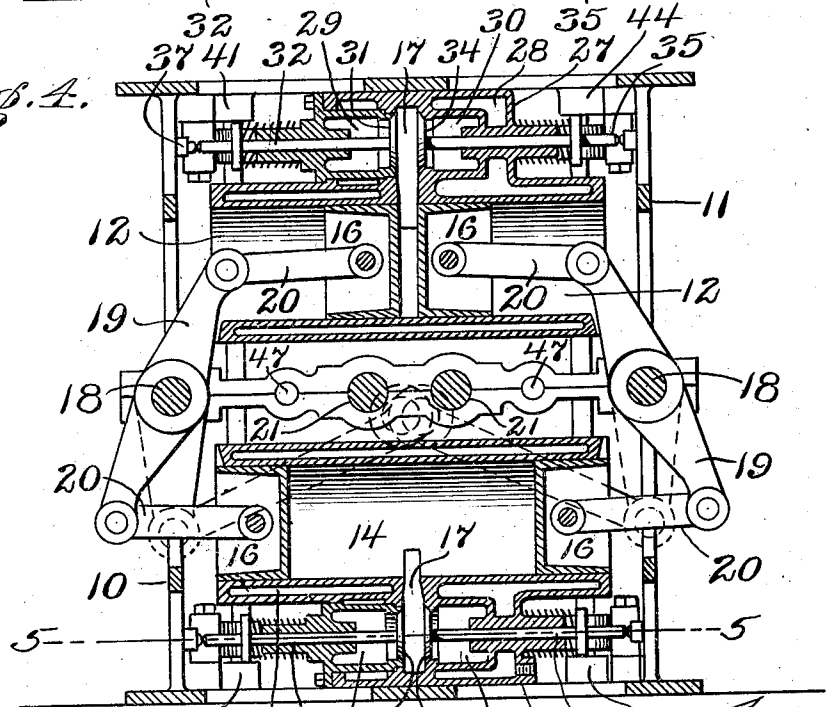


Fig. 4.



Witnesses:
Rollin Abell
Walter P. Abell.

41 32 31 34 27 44
28 29 30 35

Inventor:
Newton Crane
by Wright Brown Quinby
Attys.

No. 861,205. PATENTED JULY 23, 1907.

N. CRANE.

GAS ENGINE.

APPLICATION FILED SEPT. 17, 1904.

3 SHEETS—SHEET 3.

Fig. 5.

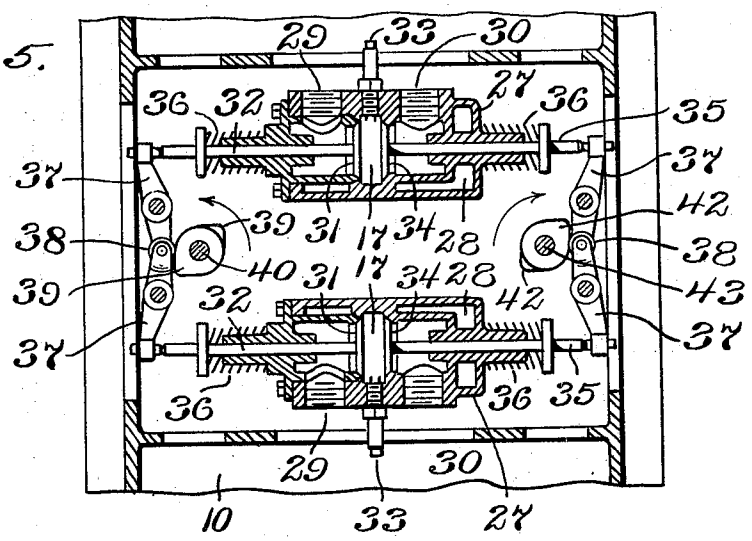
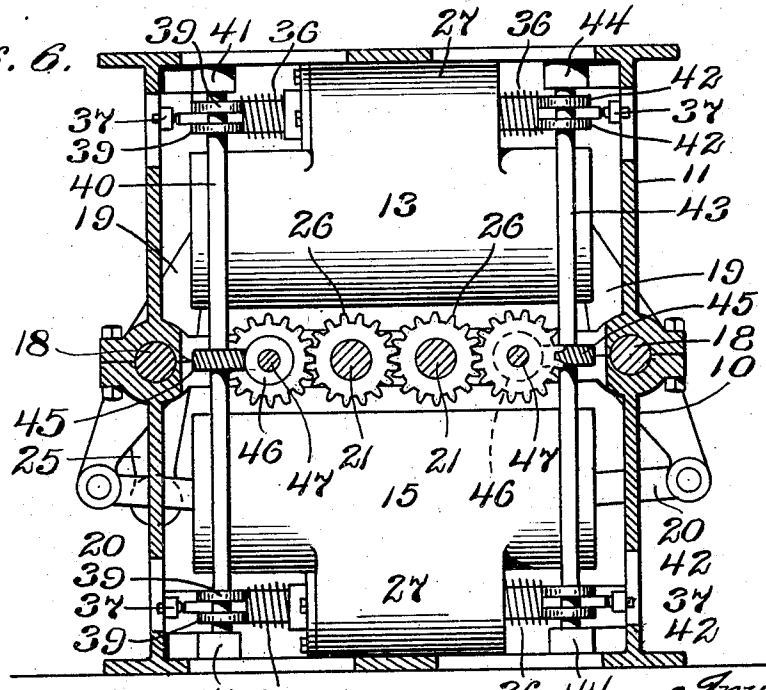


Fig. 6.



Witnesses:
Rollin Abell.
Walter P. Abell.

Inventor:
Newton Crane
by Wright Brown Quinby
Attys.

UNITED STATES PATENT OFFICE.

NEWTON CRANE, OF BOSTON, MASSACHUSETTS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO ELLIOT C. LEE, OF BROOKLINE, MASSACHUSETTS.

GAS-ENGINE.

No. 861,205. Specification of Letters Patent. Patented July 23, 1907.

Application filed September 17, 1904. Serial No. 224,373.

To all whom it may concern:

Be it known that I, NEWTON CRANE, of Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Gas-Engines, of which the following is a specification.

This invention relates to internal combustion engines, and has for its object,—first: to provide an engine of symmetrical organization in which each impulse or explosion expends itself in opposite directions rather than in one direction only, to the end that the production of vibration shall be of a minimum extent; second: to provide an engine which is mechanically balanced so as to minimize the vibrations produced by the impulses of the explosions, and by the mechanism itself; third: to provide certain improvements in the frame, valve, and gear constructions, all as hereinafter fully described and illustrated upon the drawings.

Referring to said drawings,—Figure 1 is a side elevation of an internal combustion engine. Fig. 2 is a section plan on the line 2—2 of Fig. 1, with the upper half of the frame removed. Fig. 3 is an end-view on the line 3—3 of Fig. 1. Fig. 4 is a vertical section on the line 4—4 of Fig. 1. Fig. 5 represents a horizontal section through the valve mechanism of the upper cylinders. Fig. 6 is a vertical section on the line 6—6 of Fig. 1.

The same reference characters indicate the same parts wherever they occur.

The frame is square in general appearance and composed of two divisions 10 and 11 bolted together on the horizontal median plane. The bearings or journals for the several shafts hereinafter mentioned, are formed where the upper and lower divisions of the frame are joined, so that the removal of one division uncovers all of said bearings.

In this embodiment of the invention, four individual combustion chambers or cylinders 12, 13, 14 and 15 are shown bolted to the frame. Said cylinders are parallel and constitute four units or engines of the four-cycle type, and are so arranged that two are in the upper division of the frame and two in the lower division, and so that each one in the upper division is diametrically opposite to one in the lower half. The cylinders 12, 13, 14 and 15 are double-ended, each having two pistons 16, between which the combustion or explosion occurs. Consequently, the explosion-chamber 17, of each cylinder, is midway between the ends thereof, as best illustrated in Figs. 4, 5 and 6.

18 18 are rock-shafts located on opposite sides of the frame, and journaled as heretofore stated.

19 19 are rocking beams secured to the shafts 18. Each end of each rocking beam is connected by a connecting-rod 20 to a piston 16, so that when the pistons in the lower cylinders are at one extreme of the stroke, the pistons in the upper cylinders are at the opposite extreme. By reason of this construction, and disposition of parts, the impulse in each cylinder expends its energy in opposite directions from the center, thus equalizing or balancing the said impulse; and the coupling or connecting of the upper and lower pistons as described provides for each mechanical motion, a counteracting motion in the opposite direction. The power thus generated in the cylinders is converted into oscillatory motion of the rock-shafts 18, and subsequently into continuous rotary motion, as will be described.

21 21 are rotary driving-shafts located close to and parallel to each other, and journaled, as heretofore stated, between the upper and lower divisions of the frame. Said shafts are on opposite sides of the median line of the frame, between the rock-shafts 18, and are provided with cranks 22 and momentum or fly wheels 23.

Connecting rods 24 connect the cranks 22 to rock-arms 25 affixed to the rock-shafts 18 so that the oscillation of the shafts 18 produces rotary motion of the shafts 21. The purpose of connecting the rock-shafts to individual crank-shafts is to cause the piston in one end of a cylinder to move at the same speed as the other piston, since by this construction the variation in the angularity of the rocker-arms and pitmen is the same for one piston as for the other.

It has been previously stated in connection with the pistons that for every mechanical motion in one direction is a counteracting motion in the opposite direction. This is also the case in respect to the crank-shafts 21, as will be seen. Said crank-shafts are adapted to rotate in opposite directions because of their connection through intermeshing gears 26 26, as shown in Figs. 2 and 6. In this way the motion of one crank 22, connecting rod 24, and rock-arm 25 is counterbalanced by the motion of the other crank, connecting-rod and rock-arm, in the opposite direction. Either one or both of the crank-shafts may be used for driving the mechanism for which the engine is employed.

It has been shown where the motive power is generated and how it is concentrated into rotary motion through the several mechanically-balanced connections, so I will now describe more thoroughly the operation of the combustion-chambers and the valve-operating mechanism.

The combustion chambers 17, previously referred to, are in valve-casings 27, shown here as cast integrally with the cylinders 12, 13, 14 and 15. The usual water-space 28 for cooling the engine surrounds each cylinder and valve casing, and in the casing an admission-chamber 29 and an exhaust-chamber 30 are formed. A mechanically-operated valve 31 on a stem 32 is adapted to permit and prevent the flow of gas from the admission-chamber 29 to the combustion-chamber 17, where the gas is ignited at the right time by an electric spark-

plug 33 screwed into the casing 27. A similar mechanically-operated valve 34 on a stem 35 is adapted to control the port connecting the combustion-chamber 17 and the exhaust-chamber 30, so that, together with the valve 31, it provides for the admission, compression, combustion, and exhaustion of the gas. The valves 31 and 34 are normally held against their seats by springs 36 36, and each one is opened by the action of an independently operated lever 37 upon the valve-stem 32 or 35, as the case may be.

The levers 37, as shown in Figs. 1 and 5, are arranged in couples of which two couples are in vertical alinement with each other on one side of the frame, and operate the admission valves. The other two couples are in vertical alinement with each other on the opposite side of the frame, and operate the exhaust valves. Of each couple the levers extend horizontally in opposite directions from a central point to the valve-stems which they operate, and are pivoted midway between their ends to the top and bottom plates of the frame. The inner ends of the levers overlap each other slightly, and are provided with anti-friction rolls 38 through which the levers are actuated, as hereinafter described. The levers which effect the opening of the valves 31 are actuated by cams 39 affixed to a cam-shaft 40. Said shaft stands vertically between the cylinders and at one side of the frame, and its ends are journaled in bearings 41 formed on the top and base of the frame.

The levers 37 which effect the opening of the valves 34 are similarly actuated by cams 42 affixed to a cam-shaft 43. Said shaft, like the shaft 40, stands vertically between the cylinders, but at the other end thereof, and its ends are journaled in bearings 44 on the top and base of the frame. Each of said shafts is provided with a spiral gear 45. Said gears are secured to their shafts on the horizontal plane of the shafts 18 and 21, and are in intermeshed relation with spiral gears 46 mounted upon stud-shafts 47. Said stud-shafts are journaled between the halves 10 and 11 of the frame in the same manner as the shafts 18 and 21, and carry, in addition to the spiral gears 46, spur-gears 48 which mesh with the gears 26, (Figs. 2 and 6.) The pitch of the spiral gears is such that two revolutions of the gears 46 impart one revolution to the gears 45, thus operating the valves 31 and 34 in correct time for a four-cycle movement.

Although the number of cylinders shown is four, the number is not arbitrary, except that it be an even number equally divided and connected. And while the cylinders shown are double-ended and have two pistons each, it is evident that single cylinders and pistons similarly arranged and connected might be employed without departing from the spirit and scope of the invention.

In regard to the crank-shafts it is also evident that a single shaft in the place of the two shown might be employed, sacrificing merely the compensation for variation of speed between the pistons.

Having thus explained the nature of the said invention, and described a way of constructing and using the same, although without attempting to set forth all of the forms in which it may be made, or all of the modes of its use, I declare that what I claim is:—

1. An internal combustion engine comprising two parallel crank-shafts abreast of each other, gearing connecting said shafts, a plurality of cylinders on each side of said shafts, said cylinders being parallel to each other but extending across said shafts; oppositely movable pistons in each of said cylinders, and connections between said pistons and said crank-shafts.

2. An internal combustion engine comprising a frame, two parallel rock-shafts, one on either side of said frame, two crank-shafts between and parallel to said rock-shafts, gearing connecting said crank-shafts, connections between said rock-shafts and crank-shafts, a plurality of parallel cylinders on either side of said shafts and extending laterally thereto, oppositely movable pistons in each cylinder, and connections between said pistons and rock-shafts.

3. An internal combustion engine comprising two rows of parallel cylinders, each cylinder in one row being diametrically opposite one in the other row, oppositely movable pistons in each cylinder, two crank-shafts between said rows, and connections between said pistons and crank-shafts, respectively.

4. An internal combustion engine comprising a frame or casing divisible on its median line; one or more crank-shafts journaled on said line, one or more cylinders on either side of said line, controlling valves for said cylinders, and one or more cam-shafts extending across said median line and driven by said crank-shafts for operating said valves.

5. An internal combustion engine comprising two parallel crank-shafts adapted to revolve in opposite directions, a plurality of parallel cylinders each having pistons movable in opposite directions, those movable in one direction being connected to one of said crank-shafts, and those movable in the opposite direction being connected to the other crank-shaft, and intermeshing gears connecting said crank-shafts.

In testimony whereof I have affixed my signature, in presence of two witnesses.

NEWTON CRANE.

Witnesses:
M. B. MAY,
C. C. STECHER.