E. BERLINER.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED MAR 31, 1909.

928,842.

Patented July 20, 1909.

2 SHEETS—SHEET 1.

Fig. 1. Fig. 4.

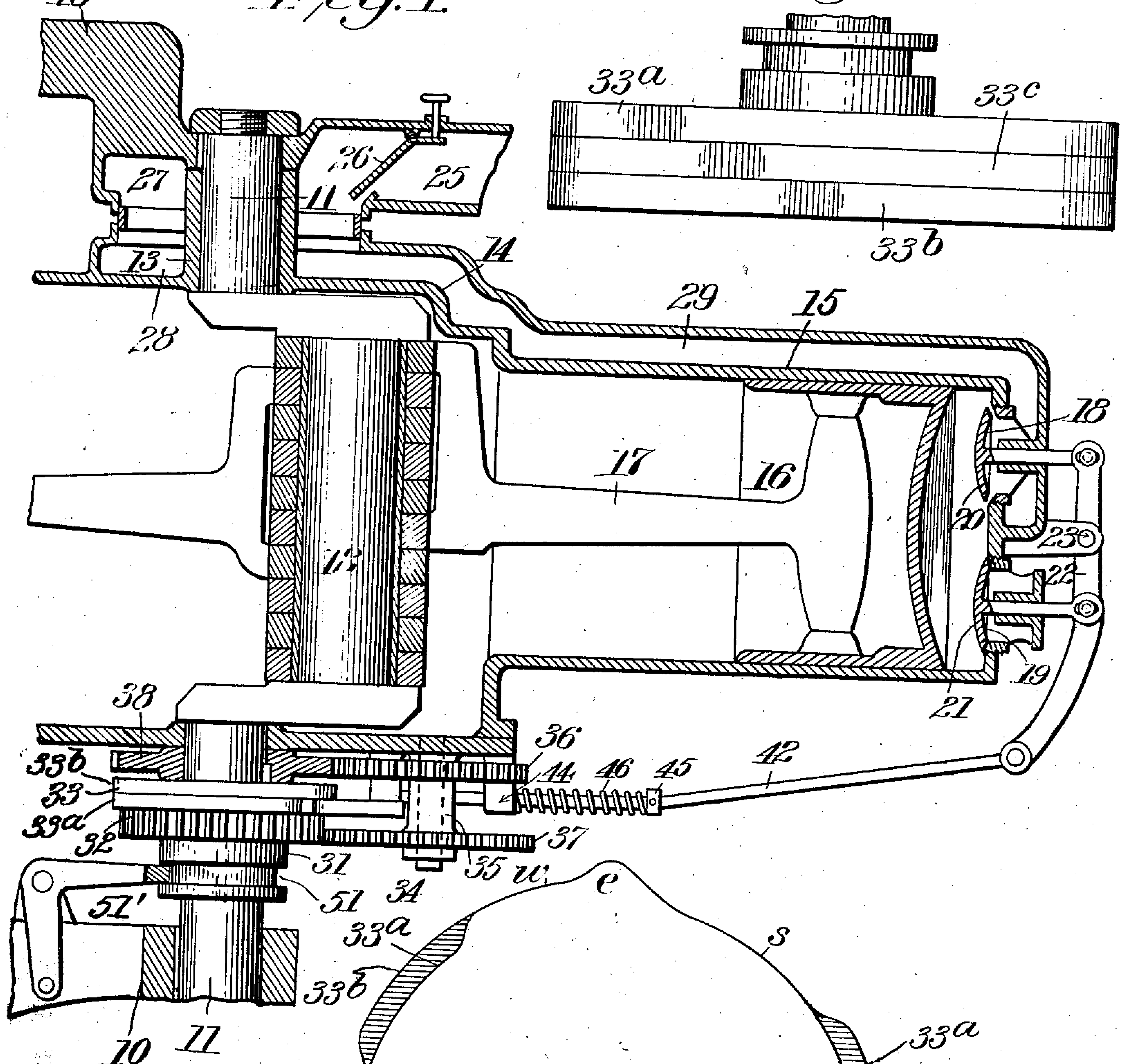
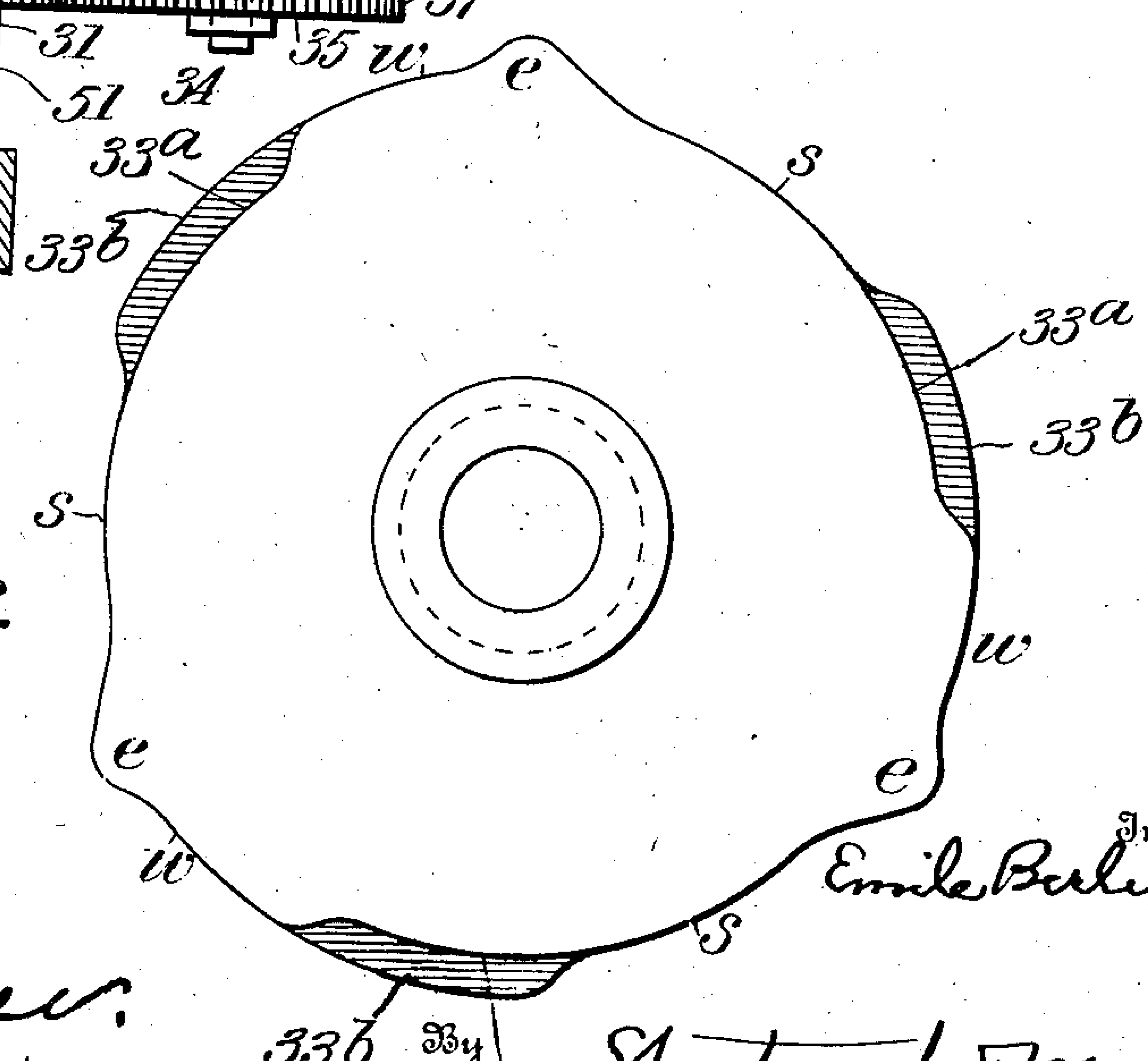


Fig. 3.



Witnesses

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2 SHEETS—SHEET 2.

Fig. 2.

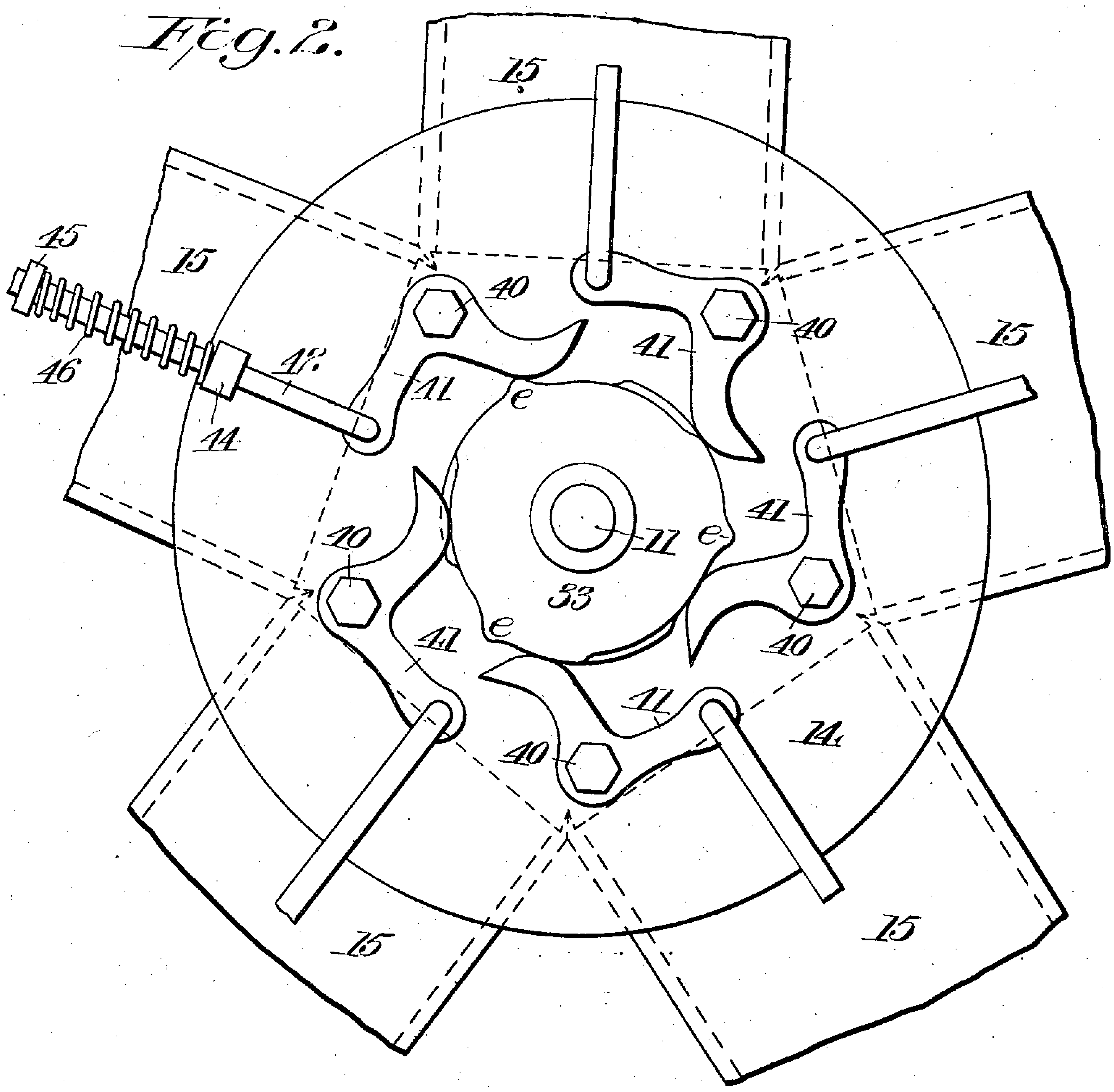


Fig. 6.

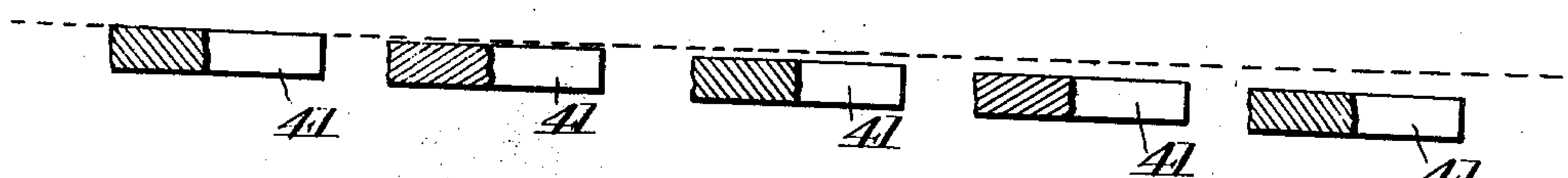
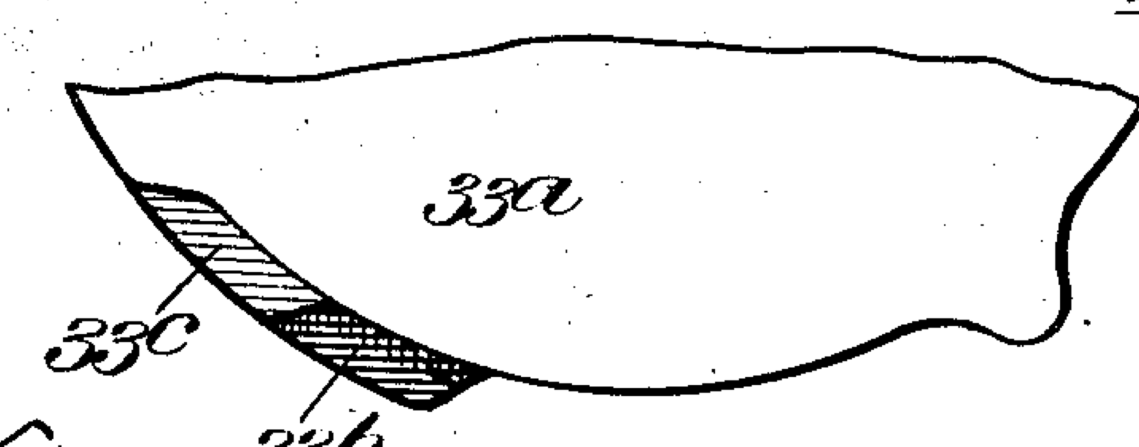


Fig. 5.



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UNITED STATES PATENT OFFICE.

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INTERNAL-COMBUSTION ENGINE.

No. 928,842. Specification of Letters Patent. Patented July 20, 1909.

Application filed March 31, 1909. Serial No. 487,033.

To all whom it may concern:

Be it known that I, EMILE BERLINER, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a description, reference being had to the accompanying drawing, and to the letters and figures of reference marked thereon.

This invention relates to internal combustion engines of that type in which a full charge of explosive mixture is drawn into the cylinder on the suction stroke and the speed and power are controlled by permitting any desired portion of the charge to return past the inlet valve during the compression stroke, the quantity retained being compressed and determining the power.

The principal object of the invention is to provide an improved form of valve-operating and controlling cam having a plurality of cam surfaces, any of which may be readily brought into operative relation with the valve rods or similar transmission devices for the purpose of varying the point at which compression commences, and thus varying the power and speed of the engine.

With these and other objects in view, the invention consists in the novel construction and arrangement of parts hereinafter described, illustrated in the accompanying drawings, and particularly pointed out in the appended claims, it being understood that various changes in the details of construction and proportion of parts may be made without departing from the invention.

In the accompanying drawings:—Figure 1 is a vertical section through one of the cylinders and crank case of an engine embodying the invention. Fig. 2 is a plan view of a portion of the engine, the crank shaft being shown in section. Fig. 3 is a detail plan view on an enlarged scale of the multiple cam for operating the valves. Fig. 4 is a side elevation showing a cam provided with three actuating faces. Fig. 5 is a face view of a portion of the same. Fig. 6 is a view in the nature of a diagram, showing the manner in which the shoes are arranged to facilitate change in position of the cam surfaces without danger of breakage.

Similar reference characters are employed to designate corresponding parts throughout the several figures of the drawings.

The engine shown in the present case is of the five cylinder vertical shaft type, but the illustration is merely typical inasmuch as the invention may be applied to engines arranged in any manner and provided with any desired number of cylinders.

The frame or base 10 carries a fixed crank shaft 11 having a centrally disposed crank pin 12 and mounted for rotation on the shaft are the hollow hub members 13 of a crank casing 14. From the casing radiate a number of cylinders 15, five in the present instance, and in each of these is a trunk piston 16 connected to the crank pin by a pitman 17. At the outer end of each cylinder are inlet and exhaust ports 18, 19 respectively and these are under the control of inwardly opening valves 20, 21, the stems of which are connected to a common operating lever 22, that is pivoted on a standard 23 carried by the head of the piston.

Leading from a carbureter or other source of supply is an inlet pipe 25 having a suitable throttle valve 26. This pipe communicates with a central chamber 27 formed in one of the frame members and said chamber in turn communicates with a main annular supply chamber 28 from which lead passages 29 to all of the inlet ports of the several cylinders.

Mounted loosely on the stationary shaft 11 and free for rotative and longitudinal movement thereon is a sleeve 31 to which is secured a gear wheel 32 and this sleeve also carries the multiple valve-opening cam 33 which forms the principal feature of the present invention.

Projecting from the crank casing is a stud shaft 34 on which is mounted a revoluble sleeve 35 carrying two gear-wheels 36 and 37, the latter gear being in constant mesh with the gear wheel 32, while the gear 36 is in constant mesh with the gear wheel 38 that is rigidly secured to the crank shaft in any suitable way. The gear wheels 32 and 37 are of equal diameter. The gear wheel 36 is preferably of smaller diameter than the gear wheel 38 so that for five complete revolutions of the cylinders or casing, the operating cam, carried by the gear wheel 32, will have made six complete revolutions or one revolution relative to the casing. The multiple cam therefore, will rotate in the same direction as the casing but at a slightly greater speed, and will bring the operating cams carried thereby into coöperation with the valve rod of first one cylinder and then another.

Projecting from the crank casing is an anular series of studs 40 on which are pivoted ell crank levers 41, one arm of each lever forming a shoe or rider bearing against the periphery of the valve operating cam while the other is connected to a rod 42 which leads up to the valve lever 22. Each rod 42 passes through a guiding opening in a boss 44 projecting from the casing and beyond the boss each rod carries an adjustable collar 45. Between the collar and boss the rod carries a helical compression spring 46 which tends to maintain the shoe of the bell crank lever in constant engagement with the periphery of the multiple cam.

The cam is divided into as many different actuating portions as may be necessary to secure the desired changes in speed and power, thus, where only high and low speed and power are desired, there are but two surfaces 33^a and 33^b, as shown in Figs. 1 and 3. Where an intermediate speed and power is desired a third actuating surface 33^c is added as shown in Figs. 4 and 5, but the number may be further increased if desired. Each cam surface in the present instance is divided into the three sections, the divisional lines of which may be represented by the exhaust points *e* in Fig. 3 and the cam contour is precisely the same between each of these points. Each section of the cam has its actuating surfaces on three radii of different extent presenting the faces *e*, *s*, *w* (Fig. 3). The portion *s* of the cam is at least twice the length of the portion *w* and in operation, taking one section only as an example it is assumed that the shoe of the bell crank lever has passed out of engagement with one of the high points *e* representing exhaust and that the piston is at the limit of its exhaust stroke.

As the parts move and the lever passes from the point *e* the bell crank lever will move inward and the valve rod will move inward thereby causing the closing of the exhaust valve and the opening of the inlet valve. The inlet valve will remain open during the whole of the suction stroke during which time the lever will have traversed about one half the length of the surface *s*. The compression stroke now commences and the inlet valve will remain open during each portion of this stroke as may be desired, that is until the lever rides up on the surface *w* and when this occurs the lever is actuated in such a manner as to close the inlet valve, while the exhaust remains closed under the force of compressed gases in the cylinder. At the completion of the compression stroke, the charge is ignited in any ordinary manner and at the end of the working stroke the lever rides over the surface *e* to open the exhaust, thus completing the cycle of operation.

It will be understood from the foregoing that the amount of explosive charge retained and compressed within the cylinder depends on the length of the cam surface *s*. If this surface is short, the inlet valve will be closed immediately after the starting of the compression stroke so that the full charge will be retained and compressed and the full power of the engine will be brought into play. If on the other hand, this surface is of considerable length the inlet valve will remain open for the greater portion of the compression stroke so that a large portion of the gases inducted into the cylinder on the suction stroke will be forced back through the inlet port to the central chamber in readiness to supply the next cylinder. The remaining portion of the charge will be compressed and the power and speed of the engine will be materially reduced. In order therefore to vary the speed and power it is necessary that the multiple cam be provided with a number of sections bearing surfaces *s* of different lengths and that the cam be shiftable to bring any section into operative relation with the shoes of the levers. In Fig. 1, only two sections 33^a and 33^b are shown one for high speed and the other for low speed.

To accomplish the shifting of the cam, the collar 31 is provided with an annular groove 51 into which enters a forked lever 51′ that may be operated from a suitable hand lever, a governor or other device and either section of the cam may thus be brought into operative position and the speed and power varied. When an intermediate speed is desired a third section is added as shown in Figs. 4 and 5, or a greater number of sections may be employed where necessary. In shifting the cam there is some danger of the levers catching on the higher portions of the next adjacent cam section and to avoid this the shoes are disposed in slightly helical relation as shown in Fig. 6, so that there will be a gradual screw like movement which will prevent breakage.

Having thus particularly described my invention, what I claim as new and desire to secure by Letters Patent is:—

1. An explosive engine comprising a mixing chamber, and an explosive chamber, an inlet valve controlling the passage between said chambers, an exhaust valve for the explosive chamber, a stationary shaft, a casing carrying the cylinders and revolubly mounted on said shaft, and a multiple cam having a plurality of cam sections common to both said valves, with means for shifting them longitudinally of said shaft to cause one or another of said cam sections to act upon the valves, whereby the period of time the inlet valve is held open during the compression stroke of the engine is varied.

2. An explosive engine comprising a mixing chamber and an explosive chamber, an inlet valve controlling the passage between

said chambers, an exhaust valve for the explosive chamber, a series of cam sections common to both said valves and means for shifting the cam sections bodily together to cause one or another to operate the valves.

3. In an internal combustion engine, a stationary shaft, a crank casing revolubly mounted thereon, cylinders extending from the casing, inlet and exhaust valves for each cylinder, a gear carried by the crank shaft projecting from the crank casing, a pair of planetary gears carried thereby, one of which meshes with the concentric gear, a multiple valve operating cam carried by the stationary shaft and arranged for revoluble and longitudinal movement thereon, a gear carried by the cam and intermeshing with the second planetary gear, bell crank levers pivoted on the crank casing and engaging said cam, and valve operating rods extending from said levers.

4. In an internal combustion engine of the class described, cylinders, inlet and exhaust valves for said cylinders, a multiple valve-operating cam having a plurality of sections of different contour and a set of shoes or riders for said cam disposed on slightly helical lines.

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

EMILE BERLINER.

Witnesses:

A. M. Parkins,

C. L. Sturtevant.