M. E. KELLER.

ENGINE.

APPLICATION FILED JULY 3, 1907.

900,101.

Patented Oct. 6, 1908.

2 SHEETS—SHEET 1.

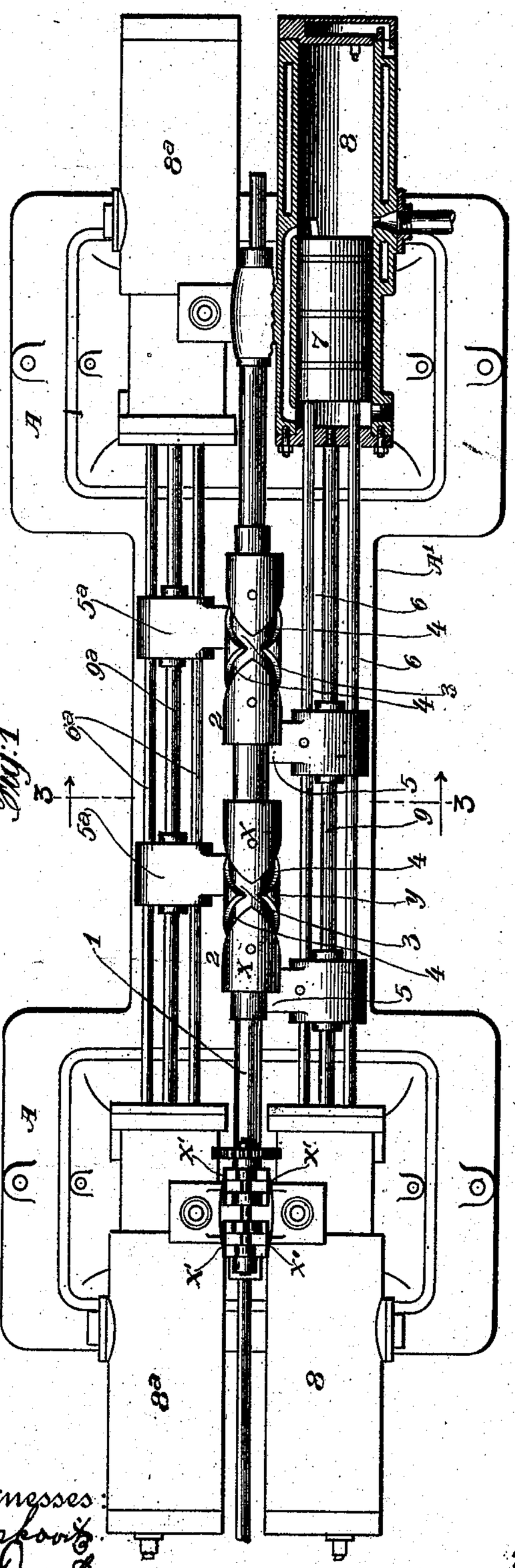

Fig. 1.

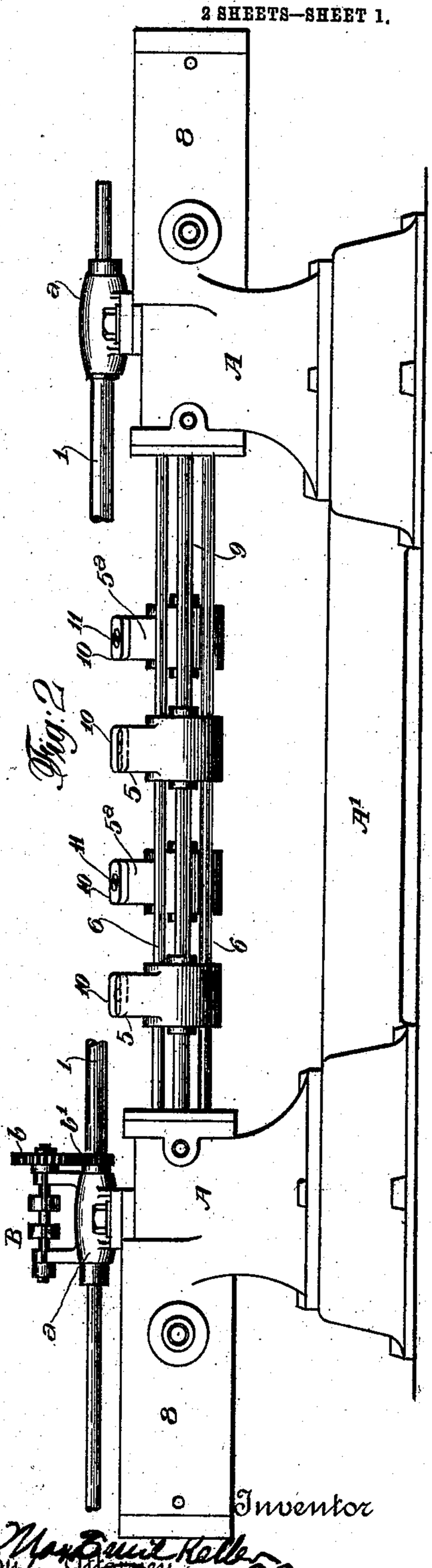

Fig. 2.

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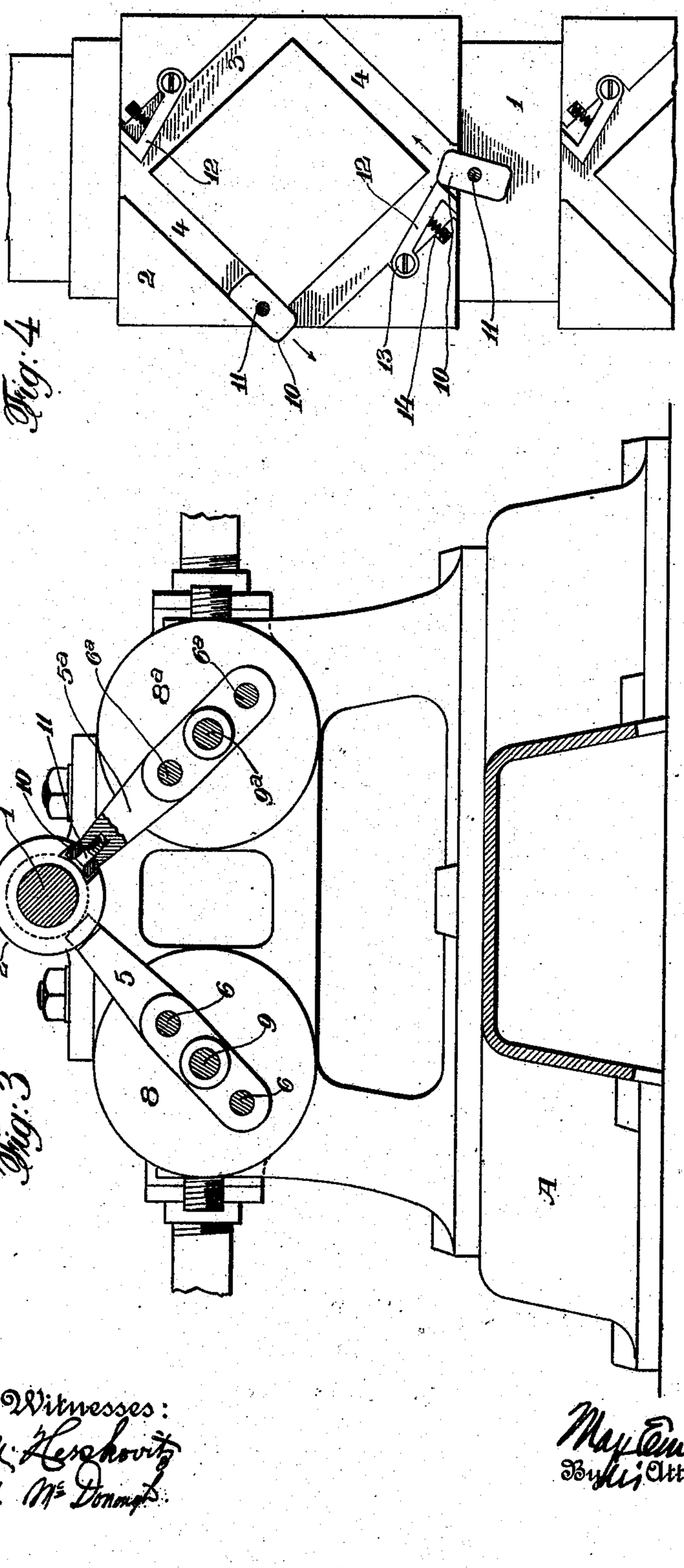

Fig. 4

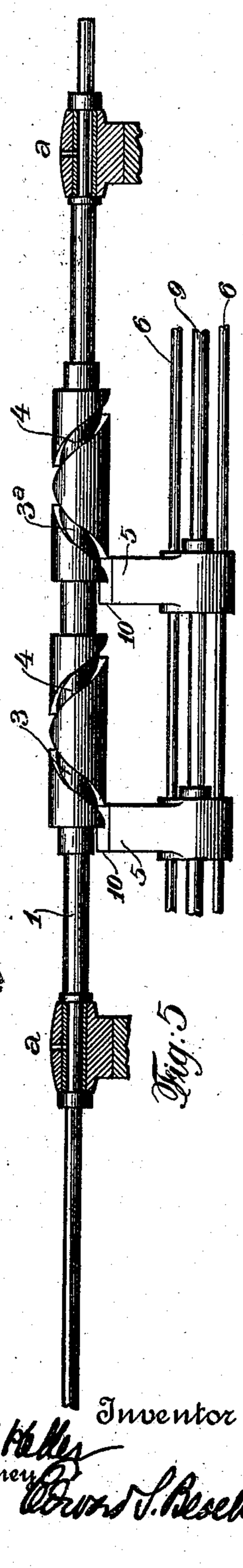

Fig. 5

Fig. 3

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UNITED STATES PATENT OFFICE.

MAX EMIL KELLER, OF NEW YORK, N. Y., ASSIGNOR OF ONE-HALF TO CHARLES F. SPOTSWOOD, OF NEW YORK, N. Y.

ENGINE.

No. 900,101. Specification of Letters Patent. Patented Oct. 6, 1908.

Application filed July 3, 1907. Serial No. 382,014.

To all whom it may concern:

Be it known that I MAX EMIL KELLER, a subject of the German Emperor, residing at New York city, in the county of New York and State of New York, have invented certain new and useful Improvements in Engines, of which the following is a specification, reference being had therein to the accompanying drawings.

My invention relates to engines, and involves, generically considered, the combination, with a rotatable power shaft which is peripherally provided with one or more sets of reverse spiral grooves that intersect between their ends, of one or more shaft-actuators working in a set or sets of said grooves and reciprocated in a fixed path or paths by one or more pistons by which the shaft-actuator or actuators are carried. The pistons may be reciprocated by water, steam, gas explosions, or other motive power.

The object of my invention is to produce a compact, practical and economical engine working on the principle aforesaid.

Referring to the drawings, illustrating the principle of my invention and the best mode now known to me of applying that principle, Figure 1 is a top-plan view, and Fig. 2 a front elevation, of an embodiment of my invention in one form of gas-actuated engine; Fig. 3 is a transverse section, at line 3—3, of Fig. 1; Fig. 4 is a plan development of enlargements of the power shaft. Fig. 5 is a front elevation of the power shaft detached from the engine, and provided with two sets of grooves in two enlargements of the shaft, and working with two shaft-actuators fixed on piston rods.

The driven or main-shaft of that form of engine herein described is intended to represent, for all purposes of my invention, generically considered, any driven power shaft or axle of any and every kind of mechanism in which my invention may be usefully and practically embodied; for example, said shaft here represented as the main-shaft of an organized engine suitable for installation in a machine-shop, may be the propeller-shaft of a ship or the axle of a locomotive or automobile.

In the drawings, A, A are pedestals connected by a base-plate A′, the upper ends of the pedestals being provided with suitable bearings *a* for power shaft 1. The grooves here referred to may be formed, if the diameter of the shaft is large enough to permit the grooves to be therein formed without weakening it, directly in the body of the shaft, but are preferably formed in enlargements of the shaft, which may have one or more sets of the grooves, and therefore one or more of the enlargements 2, which are annular.

In the present construction, each enlargement 2 is provided with a spiral groove 3, which begins at one end of the enlargement and extends to the other end thereof. Each enlargement is also provided with a reverse spiral groove 4, which otherwise corresponds to groove 3, beginning at one end of the enlargement and extending to the other end thereof. These reverse spiral grooves 3 and 4 constitute one set, and intersect one with another midway between their ends, and communicate with or run into one another at their ends.

As a matter of mechanical convenience, each groove containing enlargement 2 is readily produced by applying approximately triangular end-plates *x*, *x*, and an intermediate rectangular plate *y*, to the shaft 1, all three of the plates being bent about the shaft and secured thereto in any suitable manner, with their opposed edges removed one from another to form the intersecting and intercommunicating grooves 3 and 4.

One or more (preferably a plurality,) piston-rods 6 are each provided with a lug or shaft-actuator 5 which slidably fits in the grooves 3 and 4, the endwise reciprocation of the piston-rods moving the lugs 5 so as to impart continuous and uniform rotary movement to the shaft 1.

While a single piston-rod, with one shaft-actuator carried thereby, and working in one set of grooves 3 and 4, will suffice, I prefer to provide a plurality of sets of the intersecting and intercommunicating grooves, and a pair of shaft-actuators for each set of grooves, there being, in the form of my invention shown, four shaft-actuators, two of which, on the front side of the engine, are indicated by 5, while the other two, on the rear side of the engine, are indicated by 5^a, 5^a. Each shaft-actuator fits into and works in a set of grooves 3 and 4; and, traveling from one to the other end of, say a groove 3, is there deflected into the other groove 4, and working back through that

groove to the opposite end thereof, gives the shaft 1 its complete rotation. The successive pushes and pulls of the shaft-actuator or actuators in said set of grooves effect the continuous rotation of the shaft; and by using a plurality of shaft-actuators, suitably disposed on opposite sides of the shaft, and working at different predetermined and proper points of the different sets of grooves, the rotation of the shaft is steadily and continuously effected.

In the preferred construction, the front shaft-actuators 5 are fixed on a pair of piston-rods 6, each of which, at corresponding ends, is attached to a piston 7 in a cylinder 8, and each of which, at its opposite ends, is attached to another piston 7 in another cylinder 8. The opposed ends of the piston cylinders, in this particular construction, are connected by a brace-rod 9 on which the hubs of the actuators 5, 5 are each slidably mounted. Consequently, movement of one or both pistons 7 in the same direction carries the actuators 5 in that direction and compels them to impart rotative movement to the shaft. On the rear side of the present form of engine, shaft-actuators 5^a, 5^a are similarly mounted on similar piston-rods 6^a, connecting the opposite pistons of the opposite piston cylinders 8^a, the ends of which are connected together by the brace-rod 9^a on which the hubs of the shaft-actuators 5^a are slidably mounted. By the use of a pair of piston-rods for each actuator or each pair of actuators, and by the use of the brace-rod on which they are mounted, strength and rigidity are given to the engine. The piston cylinders 8, 8 and 8^a, 8^a, in the form of my invention shown, are cylinders of an ordinary two-cycle gas engine, which, together with its mode of operation, will be readily understood by all skilled in the art, the engine being provided with a proper and well-known timing-device B provided with brushes x', and a gear b which meshes with a gear b' on shaft 1, which in this case has two rotations to one rotation of gear b. All this will be readily understood by all skilled in the art, without particular description.

Referring, now, to Fig. 4, the oscillating shoes 10 are secured to the outer ends of the shaft-actuators by pintles 11, the shoes being of a thickness equal to the depth of the grooves 3 and 4, and being a sliding fit therein. The shoes are approximately rectangular in plan, and are longer than the width of the grooves 3 and 4 (which are of equal width,) so that when a shoe comes to the intersection of the grooves, the rearward end portion of the shoe is retained in its proper groove, while its forward end portion is passing into the farther portion of the same groove. Consequently, the shoe is kept in its proper groove, and prevented from jamming in the wrong groove, where the grooves intersect between their end portions.

When a shoe reaches the communicating groove ends (which in the present form open out at the end walls of the enlargements), it passes partially out of the grooves, and being then turned from groove 3 on its pivot into the position shown in Fig. 4 (at the end of an enlargement 2) is then in position to continue into groove 4.

The turning of the shoes is automatically accomplished by switches 12 which lie in the grooves near their communicating ends, being pivoted at 13 in the side-walls thereof, as shown, and held in the paths of the shoes by springs 14. The free ends of the switches are near the points where the grooves run into one another, and when a shoe comes into contact with the inner side of a switch, at its butt end portion, the switch is pressed aside, against its spring, until the rear end of the shoe passes the switch, when the switch springs back into the groove for cooperation with the next approaching shoe. As the pintle of a shoe passes the free end of the switch, the movement of the latter towards the middle of the groove, turns the shoe so that it is free to travel from one groove into another.

Fig. 4 is a plan development of the enlargements of the shaft provided with grooves of the character stated, and shows the shaft-actuator switches with which the grooves are provided where they run into one another at the ends of the grooves, and also shows, in different positions, the oscillating shoes with which the groove-engaging ends of the shaft-actuators are provided for the two-fold purpose (1) of keeping each actuator, when it reaches the intersection of the grooves between the ends thereof, in the particular groove in which it is then moving, and consequently preventing the actuator shoe from trying to pass into the other intersecting groove, and so running in the wrong groove; and (2) of deflecting the actuators, when they reach the communicating ends of the grooves, from the particular groove in which each shoe is then running into the other communicating groove. I have before indicated my preference for a plurality of shaft-actuators. The reason of this is that when two or more shaft-actuators are working in the grooves and are one in advance of another, as shown, they give support to the shaft at different points against lateral strains and effect a steadiness of the rotating shaft that is very desirable. Another reason for the plurality of the shaft-actuators is that the power exerted by them, in pushing or pulling, is distributed on the shaft, and thus enhances the uniformity and steadiness of its rotation. As shown, the two shaft-actuators 5, 5 and the two shaft-actuators 5^a, 5^a having their

working ends so disposed that when the actuators 5, 5 are at the ends of the respective grooves in which they work and are about to change from one groove into another, the other shaft-actuators 5^a, 5^a are each between the ends of the particular grooves in which they are moving, and consequently then and thereby exert their full effective push or pull on the walls of the groove and keep the shaft in constant rotation. Of course, when the shaft-actuators 5^a, 5^a are at the ends of grooves, the other shaft-actuators 5, 5 are in the intermediate position between the ends of the grooves, and serve to keep the shaft in its desired continuous rotation. Therefore I prefer that each portion of shaft 1 which is provided with the intersecting spiral grooves should have at least one shaft-actuator 5 and one shaft-actuator 5^a, one in advance of the other, so that when one of them comes to the end of the groove and is about to change from one groove into another, the other actuator may be working intermediately the groove ends and thereby prevent the lost motion which would occur if only one actuator were used for one set of the intersecting spiral grooves. In the form of my invention herein set forth, shaft 1 has two enlargements, each containing intersecting spiral grooves, and for the grooves of each enlargement a pair of actuators, one in advance of the other, is supplied. But the shaft may have only one or more than two of the enlargements as required or preferred, and the intersecting grooves of each enlargement may be engaged by as many shaft-actuators as are found admissible or desirable. Of course, the grooves may be produced, if desired, by cutting or otherwise forming them in the body of shaft 1, but in order not to weaken the shaft by such construction of the grooves, I prefer to strengthen it by producing the grooves by the described arrangement of the plates x, x and y as already described. By this construction, the shaft is bound and strengthened, and if a fracture is present in the shaft under the plates, the shaft is not likely to break at the said fracture.

An important and novel feature of my invention lies in the fact that the shaft-actuators, (and each shaft-actuator separately considered,) at each stroke of the piston give a complete rotation to the shaft; another is due to the fact that each shaft-actuator, at each endwise stroke of the piston, traverses the whole length of the intersecting spiral grooves of the shaft. So far as I am informed, I am the first to provide a power-shaft with reverse intersecting spiral grooves, and to drive the shaft continuously, at one full revolution to each stroke of a piston, by a direct connection of the piston with the said grooves, whereby the rectilinear movement of each stroke of the piston is converted into a complete rotation of the power-shaft.

The switches and shoes set forth are examples of many forms of practical devices for automatically effecting the passage of the shaft-actuators through their proper grooves, where the latter intersect, and for automatically switching the shaft-actuators from one groove into another where the grooves run one into another; but the switches and shoes may be dispensed with in some constructions if desired.

What I claim is:—

1. The combination of a rotatable power-shaft or axle provided with reverse, spiral grooves which intersect between their ends and run into each other at their end portions, with a piston-rod, piston and shaft-actuator carried by the piston-rod and working in said grooves and compelling one complete rotation of the shaft at each longitudinal movement of the piston; means to prevent the shaft-actuator from running out of its proper groove where the grooves intersect; and means to switch the shaft-actuator from one groove into the other where the grooves communicate at their end portions with said switches.

2. The combination of a pair of pedestals provided with bearings for a work-shaft; said bearings; a work-shaft mounted in said bearings and provided with a plurality of sets of reverse, spiral grooves which intersect between their ends and communicate at their end portions; two pairs of piston-cylinders attached to said pedestals, a piston-rod connecting the pistons of each pair of piston-cylinders, and a plurality of shaft-actuators one in advance of another and fixed on each piston-rod and engaging said grooves.

3. The combination of a pair of pedestals provided with bearings for a shaft; said bearings; a shaft mounted in said bearings and provided with a plurality of sets of reverse, spiral grooves which intersect between their ends and communicate at their end portions; two pairs of piston-cylinders; pistons supported by said pedestals; a piston-rod connecting the pistons of each pair of piston-cylinders; a plurality of shaft-actuators one in advance of the other, fixed on each piston-rod and engaging said grooves; and brace-rods connecting the piston-cylinder weights, the shaft-actuators being slidably mounted on said brace-rods.

4. The combination of a power-shaft or axle having reverse, spiral grooves which intersect between their ends and run into each other at their end portions, with a piston-cylinder, its piston and piston-rod; and an actuator adapted to engage said grooves and provided at its therein engaging end with an oscillating shoe.

5. The combination of a power-shaft or axle having reverse, spiral grooves which intersect between their ends and run into each other at their end portions, with a piston-cylinder, its piston and piston-rod; an actuator adapted to engage said grooves and provided at its therein engaging end with an oscillating shoe; and switches mounted in said grooves, one where the grooves run into each other at one end portion and the other in said groove where the grooves run into each other at their other end portion.

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

MAX EMIL KELLER.

Witnesses:

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M. HERSKOVITZ.