H. B. & C. G. WHITEHEAD.

STARTING MECHANISM FOR INTERNAL COMBUSTION ENGINES.

APPLICATION FILED DEC. 12, 1910.

991,577.

Patented May 9, 1911.

2 SHEETS—SHEET 1.

FIG. 1.

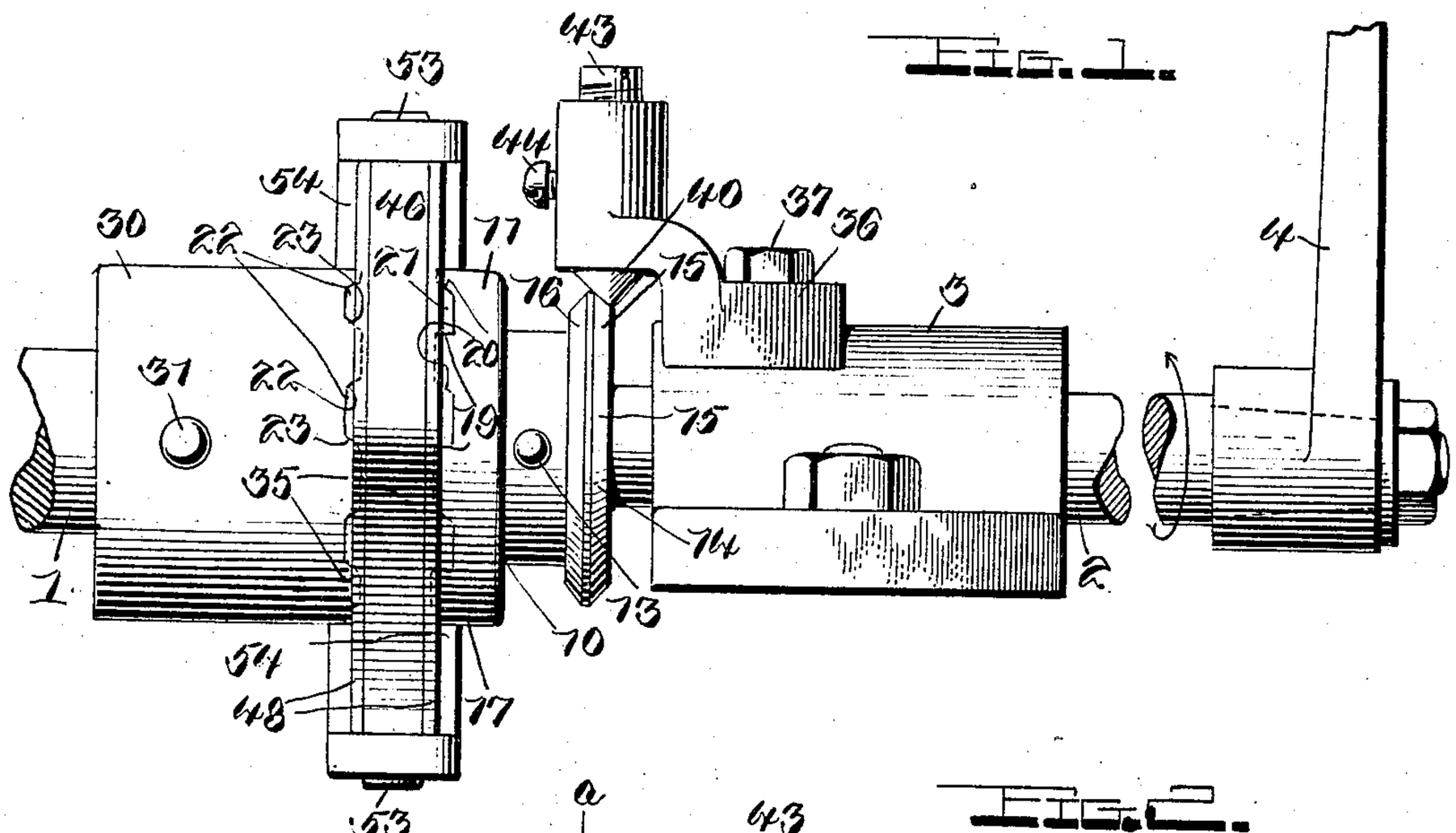
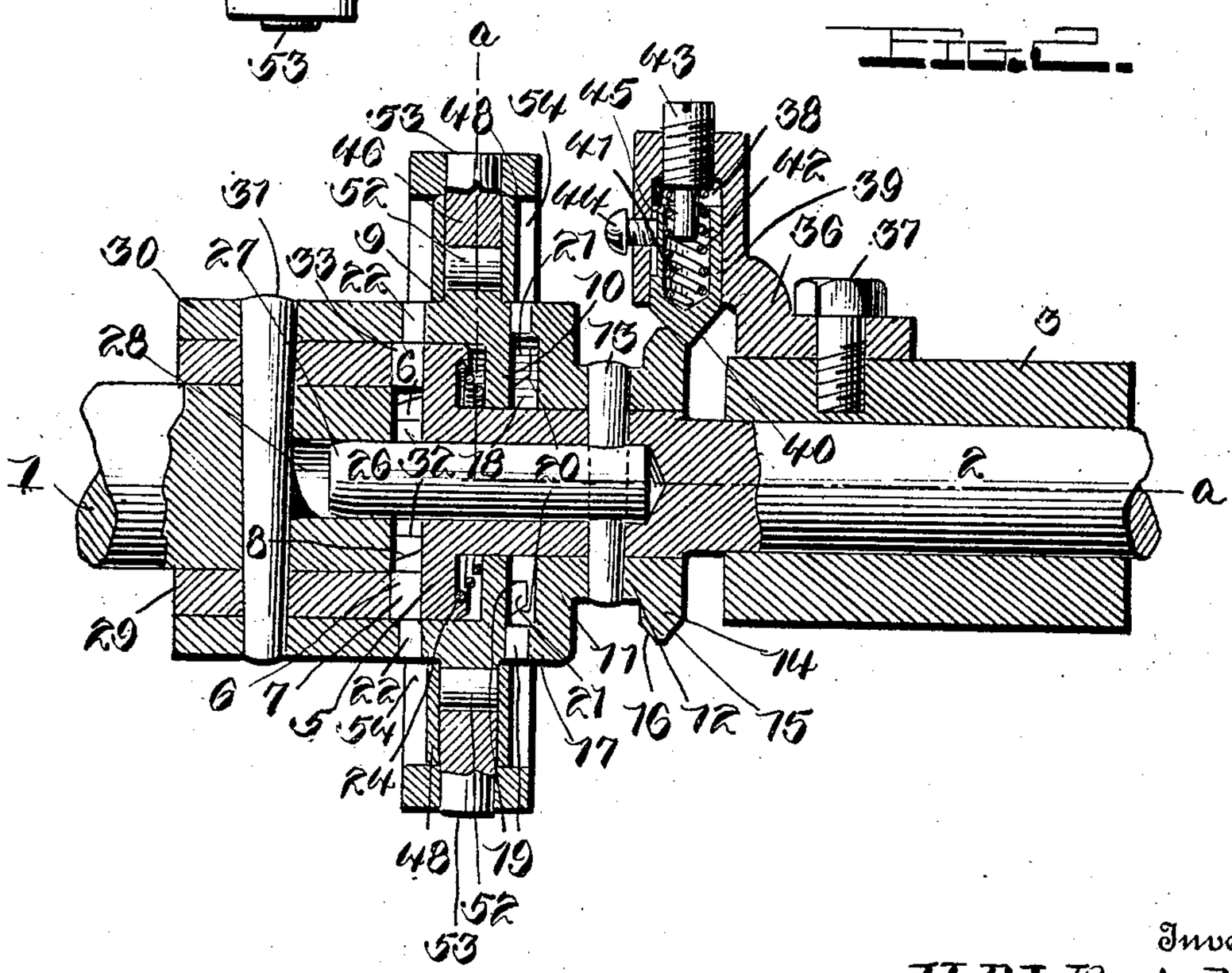


FIG. 2.



Witnesses

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2 SHEETS—SHEET 2.

FIG. 3.

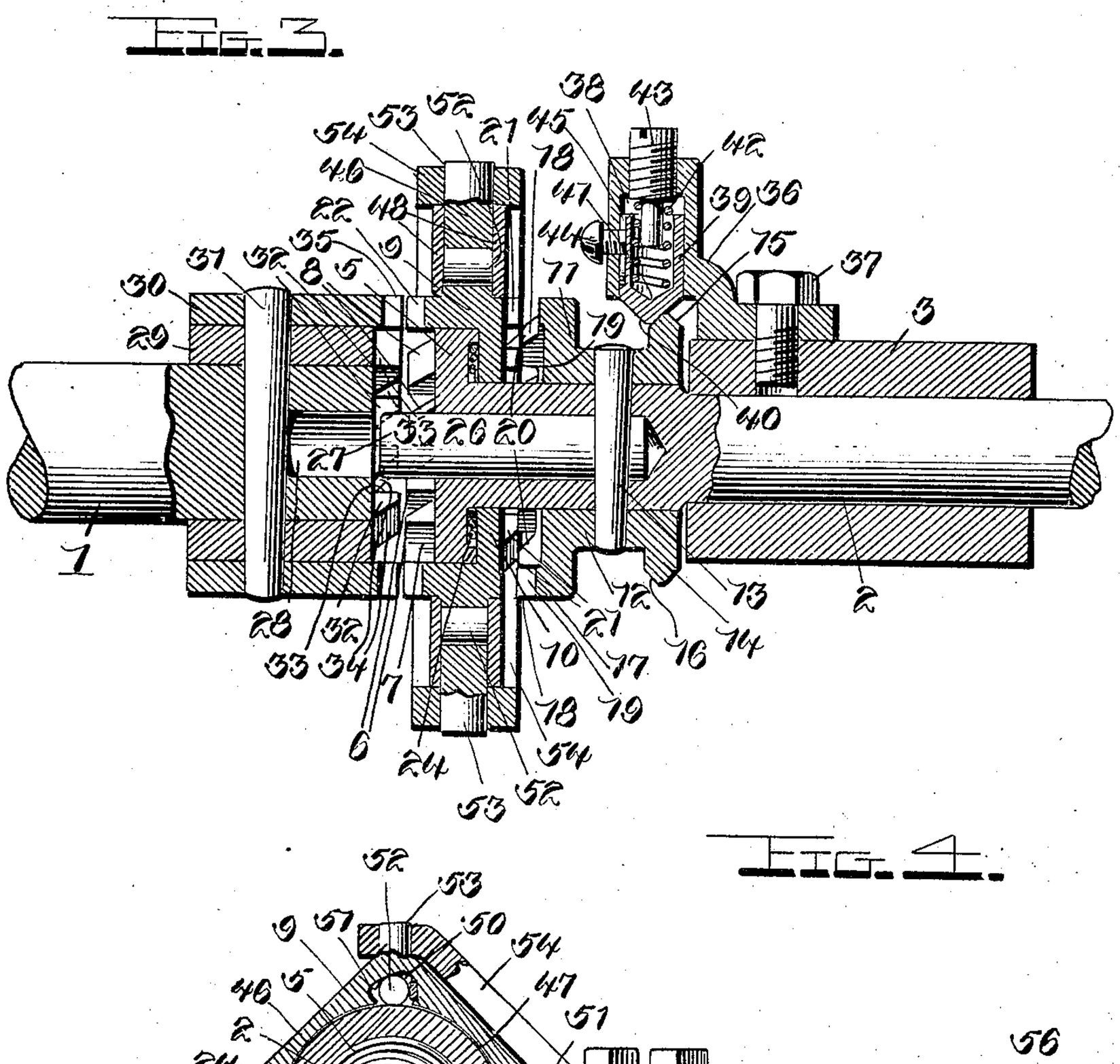
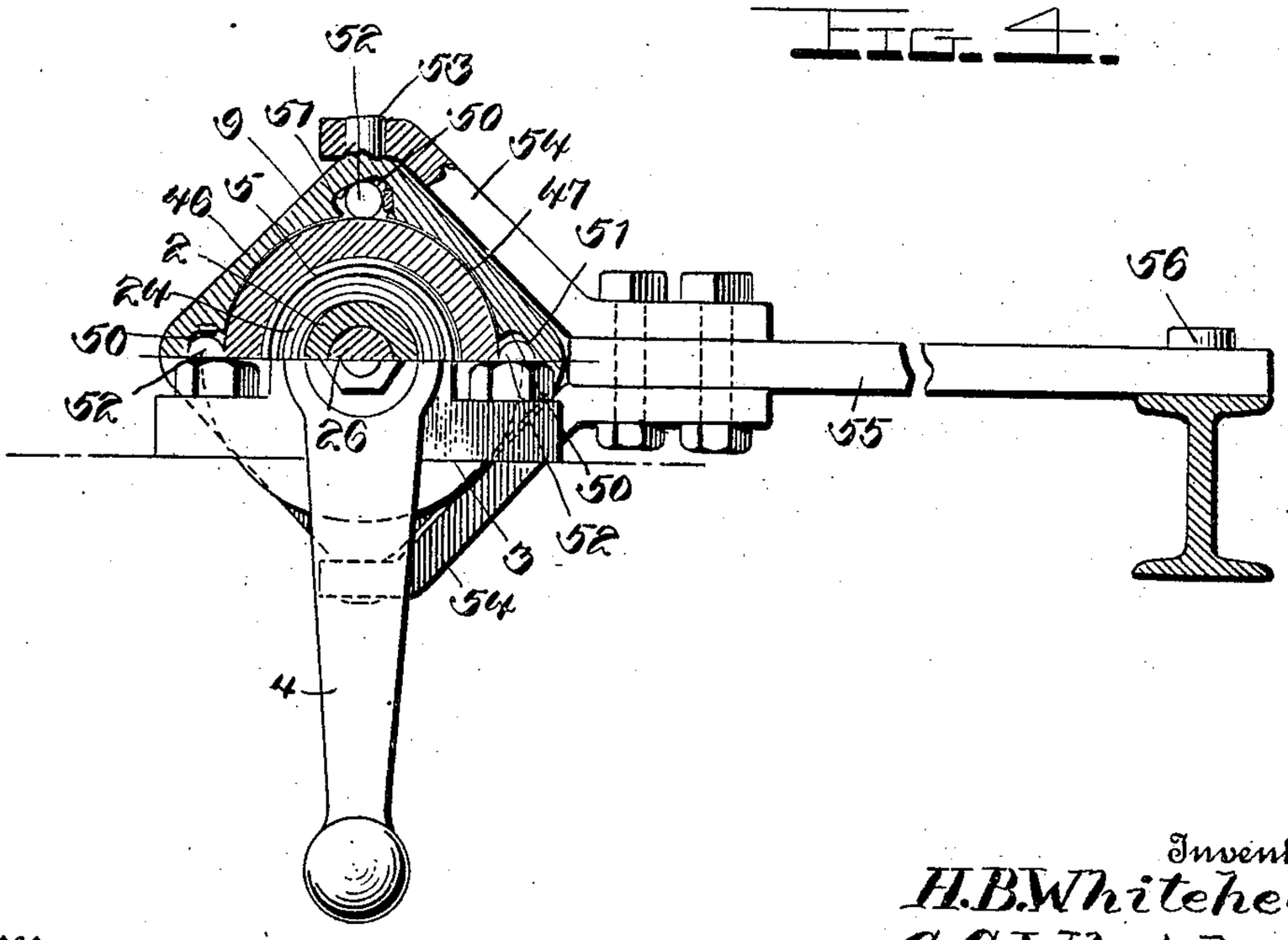


FIG. 4.



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UNITED STATES PATENT OFFICE.

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STARTING MECHANISM FOR INTERNAL-COMBUSTION ENGINES.

991,577. Specification of Letters Patent. **Patented May 9, 1911.**

Application filed December 12, 1910. Serial No. 596,795.

To all whom it may concern:

Be it known that we, HENRY B. WHITEHEAD and CHARLES G. WHITEHEAD, citizens of the United States, residing at Memphis, in the county of Shelby and State of Tennessee, have invented certain new and useful Improvements in Starting Mechanism for Internal-Combustion Engines, of which the following is a specification, reference being had to the accompanying drawings.

Our invention is an improved starting mechanism for internal combustion engines in which a hand crank is employed for initially turning the engine shaft and starting the engine in operation, the object of our invention being to provide an improved mechanism of this class which in the event of reverse rotation of the engine shaft occasioned by "back firing" serves to automatically disconnect the hand crank from the engine shaft so as to prevent the operator from being injured, the invention consisting in the construction, combination and arrangement of devices, hereinafter described and claimed.

In the accompanying drawings—Figure 1 is a side elevation of a starting mechanism constructed in accordance with our invention. Fig. 2 is a vertical central sectional view of the same. Fig. 3 is a similar view with the parts in another position. Fig. 4 is partly an end elevation, and partly a vertical sectional view on the plane indicated by the line *a*—*a* of Fig. 2.

The engine shaft is here indicated at 1. In accordance with our invention, we provide a starting shaft 2, which is in line with and spaced from the outer end of the engine shaft and is here shown as mounted in a bearing 3, which in practice, will be fixed or secured on any suitable support. At the outer end of the starting shaft is a hand crank 4, by means of which the starting shaft may be rotated. The starting shaft is provided at its inner end with a clutch head 5, provided on its outer side with clutch teeth 6, each of which has its front side, 7, straight, and its rear side 8 inclined or beveled. A locking clutch ring 9 is mounted on the periphery of the clutch head 5, and the said clutch ring is here shown as provided on its inner side with a hub web 10 which has its bearing on the inner portion of the starting shaft 2, the clutch ring being normally free to turn on the clutch head 5, and on the inner end portion of the starting shaft. A clutch element 11 is here shown as comprising a tubular sleeve 12 fitted on the shaft 2 at a point near but spaced from the clutch head 5 and secured to the shaft by a cross pin 13, a locking annulus 14 at the outer end of the said ring 12, and provided with oppositely beveled faces 15, 16 and an annulus 17 at the inner end of the said sleeve, which annulus is provided with clutch teeth 18, each of which has a straight front face or shoulder 19 at right angles to the said annulus or clutch element, and an inclined rear face. It will be seen that the clutch element 11 is locked to the shaft 2 for rotation therewith. The clutch ring 9 is provided on the side opposed to the clutch element 11 with clutch teeth 21 which correspond in size and shape with the teeth 18 of the clutch element 11, and the said clutch ring is provided on the opposite side with clutch teeth 22 each of which has its front and rear sides oppositely inclined or beveled as at 22, 23, and converging outwardly. The clutch ring 9 while free to turn on the starting shaft 2 is normally held with its clutch teeth 21 in engaged position with reference to the clutch teeth 18 of the clutch element 11 by means of a spring 24 which is disposed in the space between the hub member of the clutch ring 9 and the clutch head 5, one end of the said spring being seated in a recess with which the said clutch head 5 is provided.

A guide pin 26 has its major portion disposed in a bore in the inner end of the starting shaft 2, the said guide pin being secured to the said shaft for rotation therewith by the cross pin 13, and the inner end portion of the guide pin projects from the clutch head 5 and has a tapered point 27 adapted to facilitate engagement of the said guide pin with a bore or socket 28 in the outer end of the engine shaft 1. The engine shaft is provided at its outer end with a pair of annular concentrically disposed clutch elements 29, 30, which are here shown as secured to the engine shaft and to each other, by means of a cross pin 31, which extends through the said clutch elements and also through the engine shaft. The inner clutch element 29 which is disposed opposite the clutch head 5, is provided with clutch teeth 32 which correspond with the teeth 6 of the clutch head 5, and each of which is provided with a straight rear face 33, and an inclined front face 34. The outer clutch element 30

which is opposed to the clutch ring 9, is provided with clutch teeth 35 which correspond with the teeth 22 of said clutch ring and the front and rear sides of which are inclined as shown. The depth of the teeth of the clutch ring of the clutch element 11, and clutch element 30 is only about half that of the coacting clutch teeth 6, of the clutch head 5, and 32 of clutch element 29.

On the bearing 3 we show a bracket 36, secured thereto by a bolt 37 and provided with a radial bore 38 open at its inner end, and in which bore is a slidable cylindrical stop 39 provided with an inverted conical or tapered point 40 which may engage either the face 15 or the face 16 of the locking annulus 14. The said stop 39 is provided with a bore 41 open at its inner end in which is located a spring 42, one end of which bears against the head of the said stop, the other end of the spring bearing against an adjusting screw 43 which operates in a threaded opening at the outer end of the bracket. A screw 44 is in a threaded opening in one side of the bracket, the inner end of the said screw engaging a groove 45 in one side of the stop 39. The shaft 2 is movable longitudinally so that the clutch head 5 and clutch ring 9 may be respectively engaged with the clutch elements 29, 30, or disengaged therefrom, and the locking annulus 14 being movable with the said starting shaft 2, the spring actuated stop 39 by coaction with the said locking annulus will serve to hold the shaft 2 against casual displacement either when its clutch elements are engaged with or disengaged from those of the engine shaft.

We provide in connection with the clutch ring 9, means to permit the same to rotate in the desired direction, of the rotation of the engine shaft and prevent the same from rotating in the reverse direction. Within the scope of our invention any suitable means may be employed for this purpose.

For the purposes of this specification, we show a locking yoke 46, which is a plate substantially rectangular in form and provided with a central circular opening 47 in which the clutch ring is disposed, and is revoluble in one direction. On opposite sides of the said yoke are annular flange plates 48 which bear against opposite sides of the peripheral portion of the clutch ring 9, and the said yoke is provided at suitable points with recesses 50, open on their inner sides, and each provided with an inclined outer side 51, which is tangential to a circle of greater diameter than and concentric with the said clutch ring. In each of these recesses 50 is mounted a locking roller 52. It will be observed that by reason of the fact that the recesses 50 are wider at the ends toward which the clutch ring 9 turns with the engine shaft, than at the reverse ends of said recesses, the said rollers 52 are enabled by the inclined or tangential outer sides 51 of said recesses to move radially with respect to and from the said clutch ring 9 to permit said clutch ring to turn in the desired direction of the engine shaft and that in the event the engine shaft should turn in the reverse direction, and start to rotate the ring 9 therewith, in such reverse direction, the tangential sides 51 of said recesses will force the rollers 52 inwardly and bind the same on the periphery of the clutch ring 9 so as to effectually lock the latter and prevent reverse rotation thereof.

The yoke 46 is pivotally mounted as at 53 between the fork arms 54 of an arm 55, which is radial with respect to the engine shaft, and the outer end of which is pivotally mounted as at 56, or otherwise mounted on a suitable fixed support, so as to prevent said arm 55 from turning or rotating with the engine shaft and permit the same to move laterally with respect to itself, and longitudinally with respect to the engine shaft.

The operation of our invention is as follows: Normally the clutch ring 9 has its teeth 21 engaged with the teeth 18 of the clutch element 11 by the action of the spring 24, and the starting shaft 2 is moved outwardly from the engine shaft so as to disengage the clutch head 5, and the clutch ring 9, from the clutch elements 29, 30, of the engine shaft, the stop 39 being engaged with the inner beveled face 16 of the locking annulus 14. This also disengages the guide pin 26 from the socket 28 of the engine shaft. To start the engine or crank the same, the operator by grasping the hand crank 4 first moves the starting shaft 2 inwardly so as to cause the guide pin 26 to enter the socket 28, and engage the teeth of the clutch head 5, and clutch ring 9 with those of the clutch elements 29, 30 of the engine shaft, and cause the stop 39 to engage the outer inclined face 15 of the locking annulus 14, and he then turns the shaft 2 by means of the hand crank in the direction indicated by the arrow in Fig. 1, which is the required direction of rotation of the engine shaft, and by reason of the engagement of the clutch elements of the starting shaft and the engine shaft, the latter is therefore turned with and by the starting shaft. Assuming that the engine shaft after being thus started rotates by the operation of the engine, in the required direction, the coacting beveled faces 8 of the teeth of the clutch head 5 and of the teeth 32 of the clutch element 29 force the clutch ring 9 out of clutched engagement with the clutch element 30, and the teeth 6 and 32 of the clutch elements 5 and 29 out of clutched engagement with the engine shaft, and the engine shaft is free to run independently of the

starting shaft. If, when starting the engine shaft, the engine shaft should start to turn reversely to the required direction, by the back firing of the engine, the clutch ring 9 is instantly caught by the rollers 52 and locked against reverse rotation. The reverse angular movement of the engine shaft with reference to the clutch ring 9 then causes the inclined or cam sides of the teeth 21 and 22 of the clutch ring 9, acting on the inclined sides of the clutch element 30 and teeth 18 of the clutch element 11, to move the said ring 9 laterally together with the clutch head 5, the clutch element 11 and the starting shaft 2, a sufficient distance to cause the teeth 22 to become disengaged from the teeth 35 and clutch teeth 6, to become disengaged from clutch teeth 32. These actions are all simultaneous. The teeth 21 and 22 of the clutch element 9 are only about half the depth of the clutch teeth 6 and 32, but as the teeth 21 and 22 both act to move the shaft 2 in the same direction, they move the clutch head 5 a sufficient distance to disengage the teeth 6 and 32 and hence the starting shaft is prevented from turning reversely with the engine shaft and danger of injury to the operator is entirely obviated.

We claim:—

1. In combination with an engine shaft having clutch elements respectively provided with a series of concentrically disposed clutch teeth, the teeth of one series having cam faces on both front and rear sides, and those of the other series having locking faces on one side, and cam faces on the reverse side; a starting shaft in line with and movable toward and from the engine shaft, said starting shaft being provided with a clutch head having clutch teeth which coact and correspond with those of the last named series of clutch teeth of the engine shaft, said starting shaft being also provided with a second clutch element fast thereto and having clutch teeth each of which has a locking face on one side, and a cam face on the reverse side; a shiftable clutch element revoluble on the clutch head of the starting shaft, and also movable laterally thereon, and longitudinally with respect to the starting shaft, said shiftable clutch element having clutch teeth on one side opposed to and corresponding in shape with the front and rear cam sided teeth of the engine shaft clutch element, and provided on the other side with clutch teeth opposed to and corresponding with those of the second clutch element of the starting shaft, means to permit the said shiftable clutch element to turn in one direction and prevent the same from turning in the reverse direction and means to turn said shaft.

2. In combination with an engine shaft having clutch elements, respectively provided with a series of concentrically disposed clutch teeth, the teeth of one series having cam faces on both front and rear sides, and those of the other series having locking faces on one side, and cam faces on the reverse side; a starting shaft in line with and movable toward and from the engine shaft, said starting shaft being provided with a clutch head having clutch teeth to coact and correspond with those of the last named series of clutch teeth of the engine shaft, said starting shaft being also provided with a second clutch element fast thereto and having clutch teeth each of which has a locking face on one side, and a cam face on the reverse side; a shiftable clutch element revoluble on the clutch head of the starting shaft, and also movable laterally thereon, and longitudinally with respect to the starting shaft, said shiftable clutch element having clutch teeth on one side opposed to and corresponding in shape with the front and rear cam sided teeth of the engine shaft clutch element, and provided on the other side with clutch teeth opposed to and corresponding with those of the second clutch element of the starting shaft, means to permit the said shiftable clutch element to turn in one direction and prevent the same from turning in the reverse direction, a spring acting to normally engage the shiftable clutch element with the second clutch element of the starting shaft and means to turn said shaft.

3. In combination with an engine shaft having clutch elements respectively provided with a series of concentrically disposed clutch teeth, the teeth of one series having cam faces on both front and rear sides, and those of the other series having locking faces on one side, and cam faces on the reverse side; a starting shaft in line with and movable toward and from the engine shaft, said starting shaft being provided with a clutch head having clutch teeth which coact and correspond with those of the last named series of clutch teeth of the engine shaft, said starting shaft being also provided with a second clutch element fast thereto and having clutch teeth each of which has a locking face on one side, and a cam face on the reverse side; a shiftable clutch element revoluble on the clutch head of the starting shaft, and also movable laterally thereon, and longitudinally with respect to the starting shaft, said shiftable clutch element having clutch teeth on one side opposed to and corresponding in shape with the front and rear cam sided teeth of the engine shaft clutch element, and provided on the other side with clutch teeth opposed to and corresponding with those of the second clutch element of the starting shaft, means to permit the said shiftable clutch element to turn in one direction and prevent the same from turning in the re-

verse direction, the said shafts being respectively provided at their opposing ends with a guide pin, and a socket bore for the reception of the same and means to turn said shaft.

4. In combination with an engine shaft having clutch elements, respectively provided with a series of concentrically disposed clutch teeth; the teeth of one series having cam faces on both front and rear sides, and those of the other series having locking faces on one side, and cam faces on the reverse side; a starting shaft in line with and movable toward and from the engine shaft, said starting shaft being provided with a clutch head having clutch teeth which coact and correspond with those of the last named series of clutch teeth of the engine shaft, said starting shaft being also provided with a second clutch element fast thereto and having clutch teeth each of which has a locking face on one side, and a cam face on the reverse side; a shiftable clutch element revoluble on the clutch head of the starting shaft, and also movable laterally thereon, and longitudinally with respect to the starting shaft, said shiftable clutch element having clutch teeth on one side opposed to and corresponding in shape with the front and rear cam sided teeth of the engine shaft clutch element, and provided on the other side with clutch teeth opposed to and corresponding with those of the second clutch element of the starting shaft, means to permit the said shiftable clutch element to turn in one direction and prevent the same from turning in the reverse direction, means including a yieldable element to lock the starting shaft at both limits of the longitudinal movement thereof and means to turn said shaft.

5. In combination with an engine shaft having clutch elements respectively provided with a series of concentrically disposed clutch teeth, the teeth of one series having cam faces on both front and rear sides, and those of the other series having locking faces on one side, and cam faces on the reverse side; a starting shaft in line with and movable toward and from the engine shaft, said starting shaft being provided with a clutch head having clutch teeth which coact and correspond with those of the last named series of clutch teeth of the engine shaft, said starting shaft being also provided with a second clutch element fast thereto and having clutch teeth each of which has a locking face on one side and a cam face on the reverse side; a shiftable clutch element revoluble on the clutch head of the starting shaft, and also movable laterally thereon, and longitudinally with respect to the starting shaft, said shiftable clutch element having clutch teeth on one side opposed to and corresponding in shape with the front and rear cam sided teeth of the engine shaft clutch element, and provided on the other side with clutch teeth opposed to and corresponding with those of the second clutch element of the starting shaft, means to permit the said shiftable clutch element to turn in one direction and prevent the same from turning in the reverse direction, and including a yoke element in which said shiftable clutch element is mounted to revolve in one direction, said yoke element having recesses each provided with a cam face, friction rollers in said recesses bearing between said cam faces, and the periphery of said shiftable clutch element, an arm mounted for transverse movement and to which the said yoke element is pivotally connected and means to turn said shaft.

In testimony whereof we hereunto affix our signatures in the presence of two witnesses.

HENRY B. WHITEHEAD.
CHARLES G. WHITEHEAD.

Witnesses:
LEON W. BONDURONT,
THOMAS J. BURTON.