

Jan. 12, 1932.

L. VINGHEROETS

1,840,547

STARTER FOR INTERNAL COMBUSTION ENGINES

Filed April 19, 1928 3 Sheets-Sheet 1

Fig. 1.

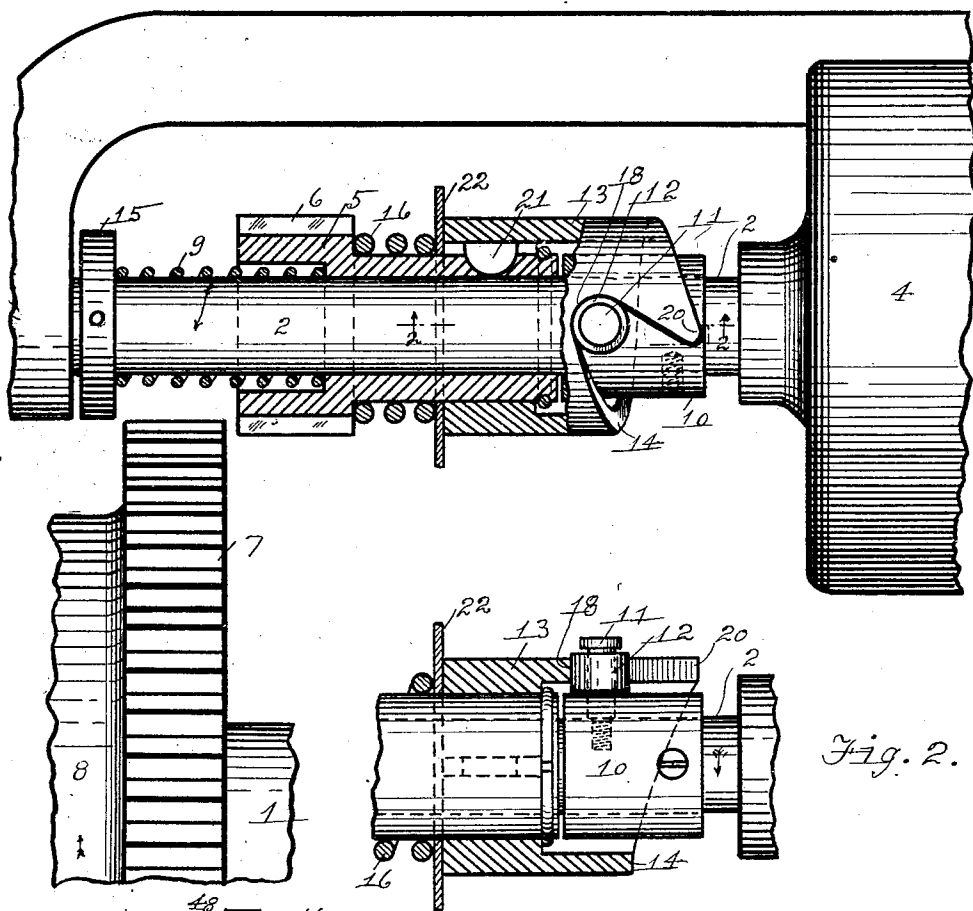


Fig. 2.

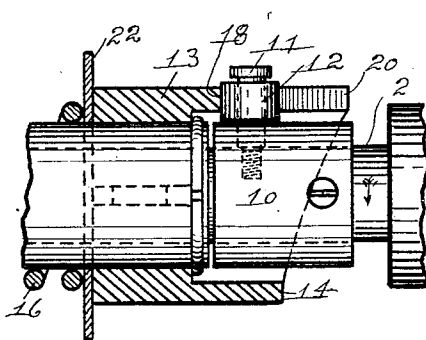
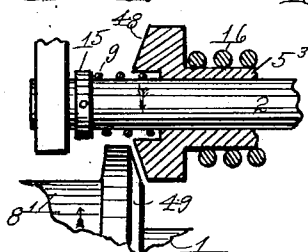


Fig. 3.



Witness:  
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Fig. 4.

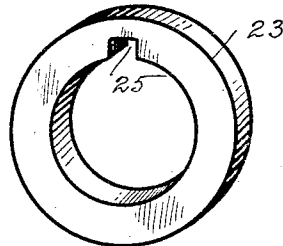
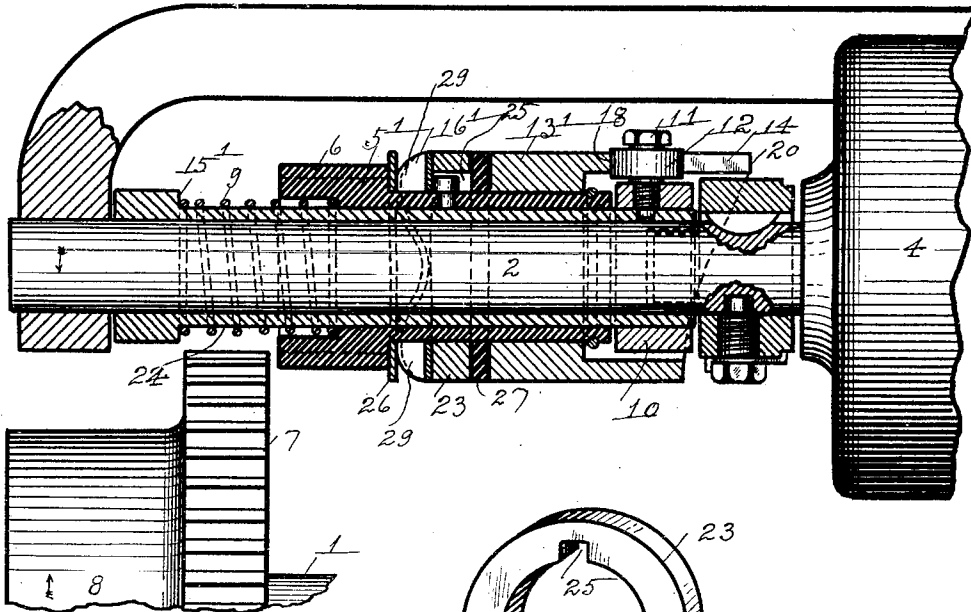


Fig. 5.

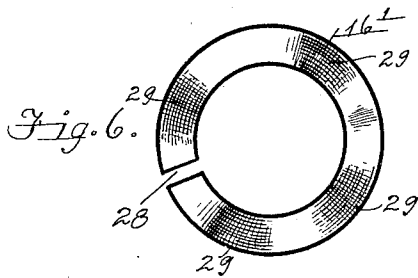


Fig. 6.

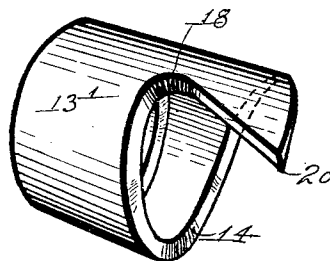


Fig. 7.

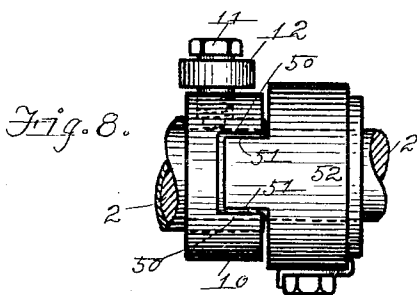


Fig. 8.

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Fig. 13.

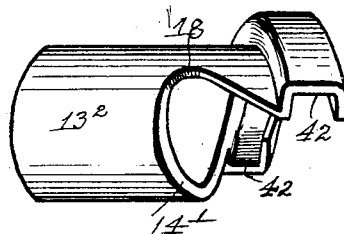
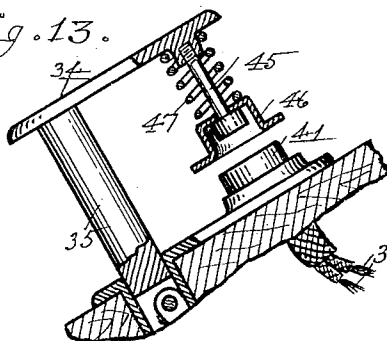


Fig. 10.

Fig. 9.

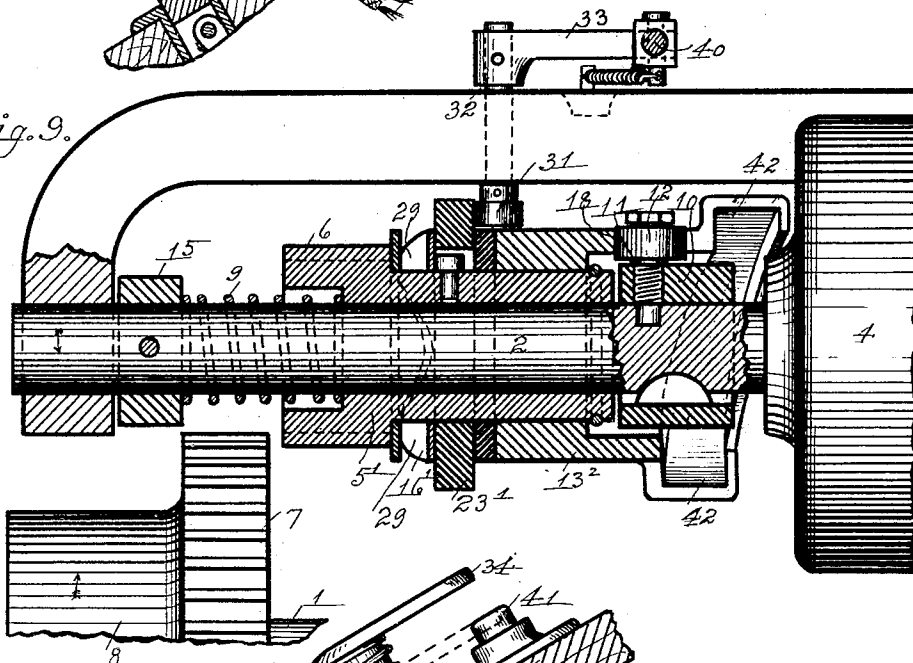
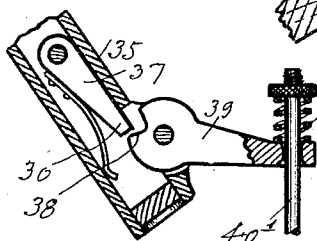


Fig. 12.



Witness:

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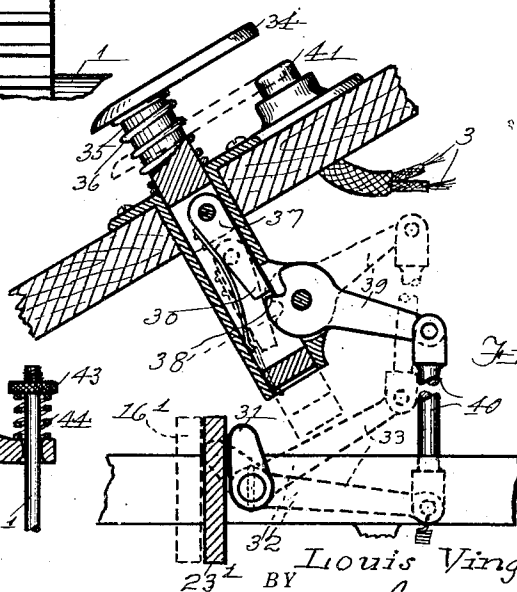


Fig. 11.

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## UNITED STATES PATENT OFFICE

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## STARTER FOR INTERNAL-COMBUSTION ENGINES

Application filed April 19, 1928. Serial No. 271,244.

The present invention relates to starters for internal-combustion engines; and its object is, generally, to provide an improved mechanism of that character; and more particularly, to provide such mechanism having means for preventing injurious effects of "back firing" in the engine; and further, to provide such mechanism comprising improved parts and arrangements thereof.

These and any other objects hereinafter appearing are attained by, and the invention finds preferable embodiment in, the structure or structures hereinafter particularly described in the body of this specification and illustrated by the accompanying drawings, in which:

Figure 1 is a plan view of a starter for internal-combustion engines and of a portion of the engine shaft and gear thereon, certain parts being shown in axial or longitudinal section;

Figure 2 is a side view of portions of the same, certain parts being shown in axial section taken on line 2—2 of Figure 1;

Figure 3 is a plan view of portions of a modified construction of the mechanism, certain parts being shown in axial section;

Figure 4 is a plan view of another modified construction of starter;

Figure 5 is a view in perspective of an annular member;

Figure 6 is a view in perspective of a split annular spring;

Figure 7 is a view in perspective of an annular element or member having an end cam winding helically about its axis;

Figure 8 is a side view of splinedly connected portions of the shaft of the starter;

Figure 9 is a plan view of another modified construction of the starter, certain parts being shown in axial section, this modified construction having independent means for effecting the engagement of the starter mechanism with the engine's shaft for rotating the same, such means being operated by a pedal or the like;

Figure 10 is a view in perspective of a modified construction of the element or member having a helical cam;

Figure 11 is a side view of means for effect-

ing the engagement of the starter mechanism with engine shaft for rotating the same, certain parts being shown in section;

Figure 12 is a side view of a modified construction of a portion of said means, certain parts being shown in section; and

Figure 13 is a side view, partially sectioned centrally, of a modified construction of a portion of said means.

In the embodiment of the invention illustrated by these drawings, a starter for an internal-combustion engine (such as an automobile engine) is shown, the engine having a shaft 1. The starter has a shaft 2 rotated by an electric motor in an electric line 3 and indicated at 4. An annular element 5 in Figure 1, or 5<sup>1</sup> in Figures 4 and 9, surrounding the starter shaft has an axial movement therealong into rotatably driving engagement with the engine shaft, i. e., into meshing engagement of the gear 6 of said element with the gear 7 of the engine shaft's fly wheel 8. This element 5, or 5<sup>1</sup>, is thus moved against the pressure of a spring 9 by the following means:

A second element, the collar 10 keyed on the starter shaft to rotate therewith has a radial spindle 11 on which freely rotates the anti-friction roll 12. A sleeve member 13 in Figures 1 and 2, or 13<sup>1</sup> in Figure 4, has an end cam 14 winding helically about its axis along which cam the roll rides up during the rotation of the starter shaft in the direction of the arrow on the left hand end of the starter shaft. The pressure of the coiled spring 9 between the stop 15 or 15<sup>1</sup> and the element 5 or 5<sup>1</sup> and that of the stiffer spring 16 or 16<sup>1</sup> between said elements and the sleeve member 13 or 13<sup>1</sup> (as well as the passive inertia of said sleeve member) causes the roll 12 riding up the came to move said sleeve member axially outward and toward the left hand side of Figures 1 and 4 and thus engage the teeth of the starter shaft's gear 6 with the teeth of the engine shaft's gear 7 and rotate the engine shaft in the direction of the arrow shown on the engine shaft's fly wheel 8. The engine now begins to operate and when the rotation of its shaft 1 becomes faster than that of the starter's shaft 2, the roll 12 trav-

els down the cam 14 and to its low point 18. The spring 9 being now permitted (by such riding of the roll down the cam) to expand, moves the element 5 or 5<sup>1</sup> axially and reversely to its hereinbefore described movement and disengages the teeth of its gear 6 from those of the gear 7 carried by the engine shaft.

If however, "back firing" of the engine occurs so that the rotative movement of the engine shaft 1 is reversed, the roll travels quickly farther up the cam, causing the element 5 or 5<sup>1</sup> to move to its extreme outward position in which it is stopped by the stop 15 or 15<sup>1</sup>, whereupon the stiffer spring 16 or 16<sup>1</sup> is compressed until the roll 12 rides farther up the cam and over its high point 20 and by the cam's abrupt drop from said high point falls suddenly to the cam's low point 18 under the pressure of the stiff spring 16 or 16<sup>1</sup>, whereupon the spring 9 presses the gears 6 and 7 out of meshing engagement.

In the construction shown in Figure 1, the sleeve member 13 is shown splined at 21 on the annular element 5 and a washer 22 intervenes between the spring 16 and said sleeve member. In the construction illustrated by Figure 4, a sleeve 24 surrounds the starter shaft and has the annular stop 15<sup>1</sup>, the sleeve member 13<sup>1</sup> being carried by said sleeve. An annular member 23 intervenes between the spring 16<sup>1</sup> and sleeve member 13<sup>1</sup> and is splined at 25 on the element 5<sup>1</sup>, washers 26, 27 of fibre or the like being shown in Figure 4. In this view the stiffer spring 16<sup>1</sup> is split at 28 and has a series of corrugations 29 each extending radially, so that the flattening of this spring tensions it.

In the constructions illustrated by Figures 1 and 4 the engagement of the gears 6 and 7 is brought about only automatically and by the action of the helical cam 14; but in the construction seen in Figure 9 (and detailed in other views) such engagement is effected by means operated independently of, or additionally to, the operation of such a cam. In said view (Figure 9) a washer 23<sup>1</sup> intervenes between the stiff spring 16<sup>1</sup> and the short arm 31 of an elbow lever 32 whose long arm 33 is swung upwardly (see Figure 11) to move the annular element 5<sup>1</sup> outwardly and cause the gears 6 and 7 to mesh, by pressing down on the pedal extremity 34 of an operating movable member, the slidable plunger 35, against the pressure of its spring 36. This member 35 has a pivotally mounted actuating pawl 37 whose extremity 30 engages a portion or notch 38 of the swingable arm 39 connected by a link 40 with the long arm 33 of the lever 32. After the element 5<sup>1</sup> has thus been moved by the pedal member 35 far enough to operatively engage the gears 6 and 7, the continued farther movement of this pedal member causes it to then press the button 41 of a circuit-closing switch in the

electric line 3 and thus cause the starter shaft to rotate after said gears are in mesh.

If the pedal is pressed down still farther (after said circuit is closed) the extremity 30 of the pawl passes beyond the portion 38 of the swingable arm 39 and out of engagement therewith so that the annular element 5<sup>1</sup> may be moved reversely to disengage said gears. This disengagement may be effected positively by the roll 12 passing beyond the inner part 14<sup>1</sup> of the helical cam on the end of the annular member or element 13<sup>2</sup> (see Fig. 10, which part 14<sup>1</sup> may have additionally to, or instead of the means shown in Fig. 11, have caused the movement of the element 5<sup>1</sup> to bring the gears 6, 7 into mesh) and into riding engagement with the outer part 42 of the cam shown in Figure 10. The link 40<sup>1</sup> may pass freely through the arm 39 and have a nut 43 between which and said arm a spring 44 is located as shown in Figure 12, to cushion the upward action of said arm.

In Figure 13 the pedal member has a rod 45 on which slides an end member 46 which presses the switch button 41 and is cushioned by a spring 47.

It is evident that the starter shaft and engine shaft may carry engaging parts other than the meshing gears 6, 7 hereinbefore described; for instance, the annular element 5<sup>3</sup> on the starter shaft may have a side surface 48 frictionally engaging the side surface 49 of the fly wheel 8<sup>1</sup> of the engine shaft as shown in Figure 3.

Figure 8 shows a splined connection at 50, 51 between the collars 10 and 52 carried by the ends of aligned portions of the starter shaft.

The invention being intended to be set forth in the claims, is not to be limited to or by details of construction of any particular embodiment thereof illustrated by the drawings or hereinbefore described.

#### I claim:

1. In a starter for internal-combustion engines: a starter shaft; an element having a stopped axial movement along said shaft into rotatably driving engagement with the engine shaft; a member rotatable with the starter shaft; a sleeve member rotatable about, and axially movable along, the axis of the starter shaft intermediate said element and first-mentioned member, one of said members having a cam winding helically about its axis and engaging the other member to press the sleeve member and said element to said element's said engagement, the cam having a drop from its high point; a spring yieldably resisting the movement of said element to its said engagement; a stiffer spring pressing said element and sleeve member apart.

2. In a starter for internal-combustion engines: a starter shaft; an element having a stopped axial movement along said shaft into rotatably driving engagement with the en-

gine shaft; a member rotatable with the starter shaft; a sleeve member rotatable about, and axially movable along, the axis of the starter shaft intermediate said element and first-mentioned member and splined on said element, one of said members having a cam winding helically about its axis and engaging the other member to press the sleeve member and said element to said element's said engagement, the cam having a drop from its high point, a spring yieldingly resisting the movement of said element to its said engagement; a stiffer spring pressing said element and sleeve member apart.

3. In a starter for internal-combustion engines: a starter shaft; a sleeve thereon having a stop; an element having an axial movement along the sleeve into rotatably driving engagement with the engine shaft and limited by the stop; a member rotatable with the starter shaft; a sleeve member rotatable about, and axially movable along, the axis of the sleeve intermediate said element and the first-mentioned member, one of said members having a cam helically winding about its axis and engaging the other member to press said sleeve member and said element to said element's said engagement, the cam having a drop from its high point; a spring yieldingly resisting the movement of said element to its said engagement; a stiffer spring pressing said element and sleeve member apart.

4. In a starter for internal-combustion engines: a starter shaft comprising aligned portions in splined relation to each other; a sleeve thereon having a stop; an element having an axial movement along the sleeve into rotatably driving engagement with the engine shaft and limited by the stop; a member rotatable with the starter shaft; a sleeve member rotatable about, and axially movable along, the axis of the sleeve intermediate said element and the first-mentioned member, one of said members having a cam helically winding about its axis and engaging the other member to press said sleeve member and said element to said element's said engagement, the cam having a drop from its high point; a spring yieldingly resisting the movement of said element to its said engagement; a stiffer spring pressing said element and said sleeve member apart.

5. In a starter for internal-combustion engines: a starter shaft; an element having an axial movement along said shaft into rotatably driving engagement with the engine shaft; means for moving said element from said engagement; a second element rotatable with the starter shaft, one of said elements carrying a cam comprising an initial portion winding helically about its axis and extending toward the cam's high point and pressing the other element to move the first-mentioned element to its said engagement and a second portion continuing from the initial

portion and dropping from said high point to permit the action of said means.

6. In a starter for internal-combustion engines: a starter shaft; an element having an axial movement along said shaft into rotatably driving engagement with the engine shaft; spring means urging said element from said engagement; a second element rotatable with the starter shaft, one of said elements carrying a cam comprising an initial portion winding helically about its axis and extending toward the cam's high point and pressing the other element to move the first-mentioned element to its said engagement and a second portion continuing from the initial portion and dropping from said high point to permit the action of said means.

7. In a starter for internal-combustion engines: a starter shaft; an element having an axial movement along said shaft into rotatably driving engagement with the engine shaft; means for moving said element from said engagement; a second element rotatable with the starter shaft, one of said elements carrying a circuitous cam comprising an initial portion winding helically about its axis and extending toward the cam's high point and pressing the other element to move the first-mentioned element to its said engagement and a second portion continuing from the initial portion and dropping from said high point to permit the action of said means.

In testimony whereof I have hereunto set my hand at Grand Rapids, Michigan, this 14th day of April, 1928.

LOUIS VINGHEROETS.