

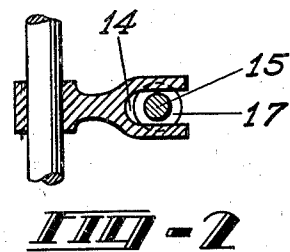
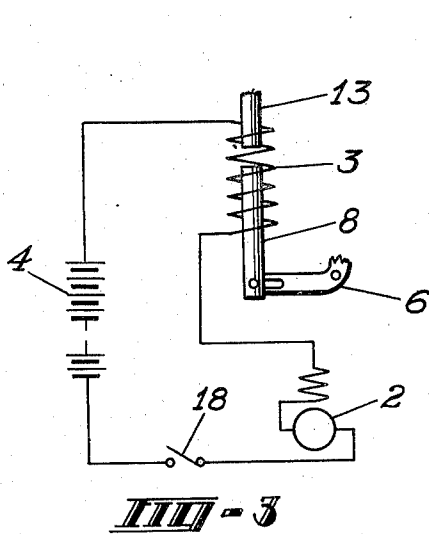
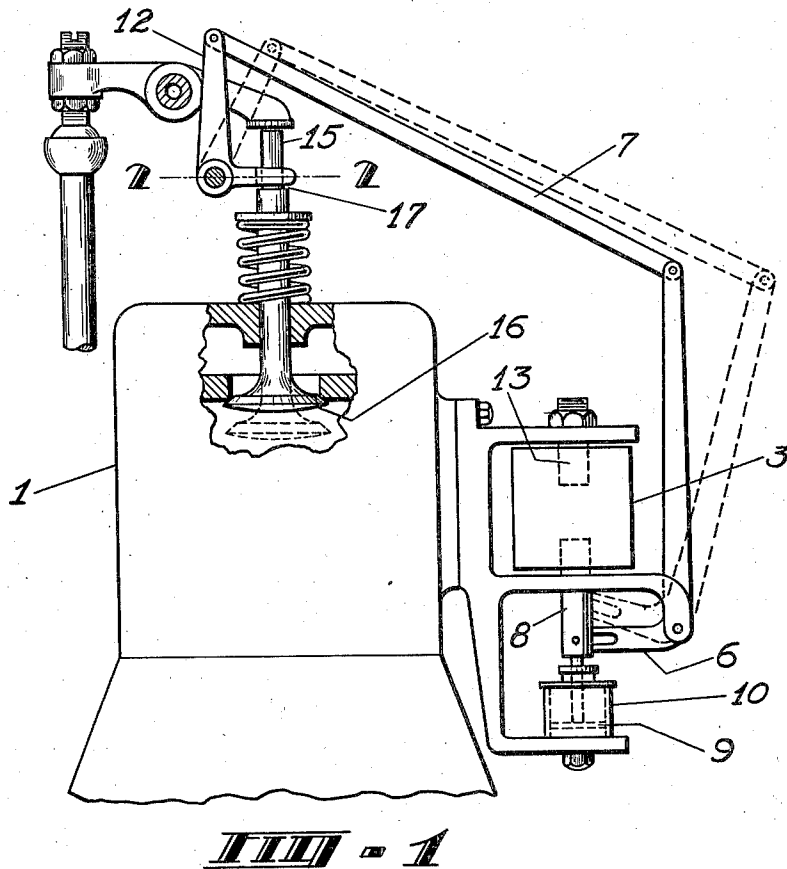
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J. V. GIL

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MEANS FOR FACILITATING STARTING OF INTERNAL COMBUSTION ENGINES

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INVENTOR.
JOSEPH V. GIL.
 BY *Lyman C. Conger*
 ATTORNEY

UNITED STATES PATENT OFFICE

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MEANS FOR FACILITATING STARTING OF
INTERNAL COMBUSTION ENGINES

Joseph V. Gil, Esher, England

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5 Claims. (Cl. 123-182)

My invention relates to means for facilitating the starting of internal combustion engines, the invention being particularly, though not necessarily exclusively, adapted to high compression engines, for example, of the compression ignition type, and the invention has for its object to facilitate the starting of such engines when employing an electric starter for such purpose.

According to the invention the rise in current which takes place when the operation of the electric starter is initiated or when the electric starter is endeavoring to overcome compression is utilized to actuate means for relieving the compression in the engine.

Thus, in accordance with the invention, the starting circuit may include means, such as a solenoid responsive to the said rise in current and serving to actuate means for relieving the engine compression.

With this and related objects in view the invention consists in the mechanism and circuits illustrated in the accompanying drawing, in which Figure 1 is a side elevation illustrating, somewhat diagrammatically, one mode of applying the invention; Figure 2, a sectional view taken along the lines 2-2 of Figure 1; and Figure 3, a diagrammatic view of the electrical circuits involved.

In carrying the invention into effect in one convenient manner as illustrated in the drawing and as applied, for example, to the starting of a high compression engine 1, which may be of the compression ignition type having an electric motor 2 for revolving the engine for starting purposes, there is provided in the circuit by which current is supplied to the electric motor a solenoid 3 which is adapted to be energized by the starting current, which solenoid may be permanently connected in the starting circuit as, for example, between a battery 4 or other source of current supply and the electric motor, which latter may or may not be coupled permanently to the engine. The circuit includes a starting switch 18 which may be manually, electrically or mechanically operated.

When current is supplied to an electric starting motor there is a rise of current due to the resistance to be overcome in turning the engine. Accordingly, the solenoid 3, when energized by this rise of current, may be employed to actuate means for relieving the compression of the engine and such compression relieving means, when a multi-cylinder engine is employed, may be effective on all or only on a number of the cylinders of the engine.

In one convenient construction the compression relieving means comprise the solenoid 3 which may be secured vertically to a conveniently fixed portion of the engine casing and be provided with a movable lower core 8 to which one arm of a bell crank lever 6 is pivotally secured, the outer end of the movable core carrying, if desired, the piston 9 of a dash pot 10 situated beneath the solenoid, the other arm of the bell crank lever being connected, through the medium of a link 7, with an arm of a bell crank lever 12, the other arm of the bell crank lever being bifurcated at 14 and adapted to receive the valve stem 15 of a valve 16. The stem is enlarged at its lower portion to form a shoulder 17 adapted to be engaged by the bell crank lever 12.

The solenoid 3 is provided, in addition to the movable core 8, with a stationary core 13, the axial position of which is adjustable with reference to the movable core 8. The dash pot 10 may be so arranged as to be effective only when the core 8 is moving out of the solenoid, that is to say, in the direction in which the compression relieving means becomes inoperative in order that the engine may experience full compression and start firing.

In operation, when current is supplied to the stationary or slowly moving motor 2 there will be a heavy current in the solenoid 3 and this will have the effect of attracting the movable core 8 so as to actuate the bell crank 6 and associated link 7, thus causing the bell crank lever 12 to engage the shoulder 17, opening the valve 16. The starting motor 2 may thus rotate the engine comparatively freely and the current supplying the motor will fall rapidly as the motor gathers speed; consequently, in due course the solenoid will be ineffective in holding the core in the attracted position, it being understood that the solenoid is of such strength as to be effective only during the period when a heavy current is flowing through it. The core 8 will thus return to its original position closing the valve 16 (which return may be retarded by the dash pot 10 as desired) thereby allowing the starting motor, with the help of the flywheel, to move the engine under full compression and so effect starting.

It is to be understood that the invention is not restricted to the details above described, which are given merely by way of example, since it would be possible to employ some other means than a solenoid for the purpose of effecting the desired operation of the compression relieving mechanism, such means being responsive to changes in the current flowing in the starter mo-

tor circuit or being indirectly under the control thereof, for example, through the medium of a relay. Further, although the compression relieving mechanism has been illustrated and described as being operative upon the normal valves of the engine, special valves or like means may be provided for achieving the desired purpose.

Other changes in said details may be made without invention and the invention, therefore, comprehends all structures and mechanisms within the scope of the appended claims.

I claim:

1. In combination, an internal combustion engine, electrical starting means therefor, and means responsive to a rise in current in said starting means for relieving the compression in the engine.

2. In combination, an internal combustion engine, electrical starting means therefor, and means responsive to the rise in current which takes place when the operation of the electric starter is initiated or when the electric starter is endeavoring to overcome compression and adapted to actuate means for relieving the compression in the engine.

3. In combination, an internal combustion engine, an electrical circuit comprising electrical starting means for said engine, and means comprising a solenoid included in said starting circuit

responsive to the rise in current which takes place when the operation of the electric starter is initiated or when the electric starter is endeavoring to overcome compression and adapted to actuate means for relieving the compression in the engine.

4. In combination, an internal combustion engine, an electrical circuit comprising electrical starting means for said engine, means comprising a solenoid included in said starting circuit responsive to the rise in current which takes place when the operation of the electric starter is initiated or when the electric starter is endeavoring to overcome compression and adapted to actuate means for relieving the compression in the engine, means for returning said compression relieving means to its original position upon falling off of said current and a dash pot adapted to delay said return movement.

5. In combination, an internal combustion engine, a compression relieving valve in said engine, electrical starting means for said engine, means responsive to a rise in current in said starting means and linkage connecting said compression relieving valve and said current responsive means whereby operation of said current responsive means causes said compression relieving valve to be opened.

JOSEPH V. GIL.