

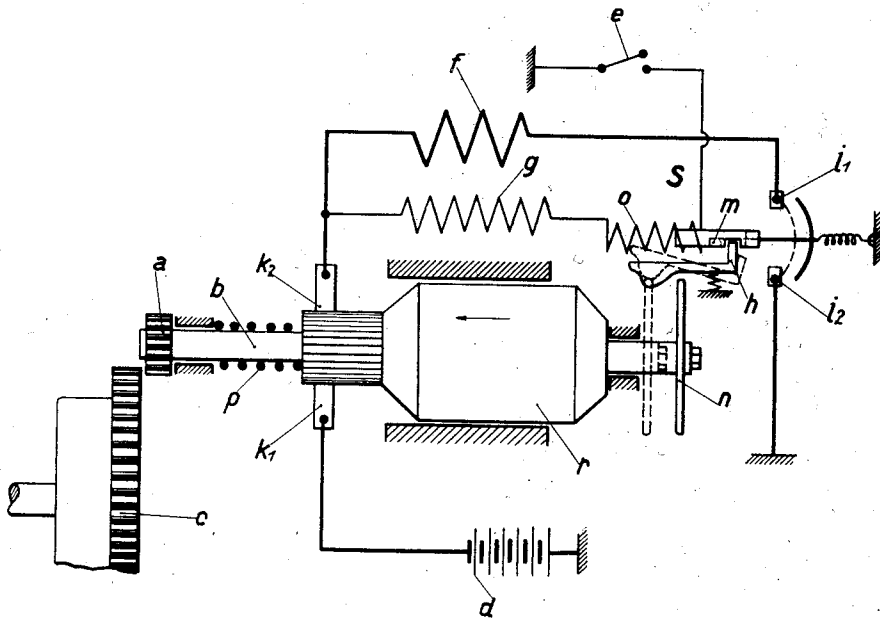
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STARTING DEVICE FOR INTERNAL COMBUSTION ENGINES

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UNITED STATES PATENT OFFICE.

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STARTING DEVICE FOR INTERNAL-COMBUSTION ENGINES.

Application filed August 11, 1921. Serial No. 491,569.

To all whom it may concern:

Be it known that ERNST FRIEDRICH, a subject of Germany, residing at and whose post-office address is Eduard Pfeiffer-Strasse 117, Stuttgart, Germany, has invented certain new and useful Improved Starting Devices for Internal-Combustion Engines, for which I have filed applications in Germany, Sept. 22, 1919; Austria, Aug. 26, 1920; Switzerland, Aug. 26, 1920; Sweden, Aug. 27, 1920; Czechoslovakia, Sept. 9, 1920; Italy, Sept. 15, 1920; Netherlands, Sept. 16, 1920; Belgium, Sept. 16, 1920; France, Sept. 20, 1920; and Great Britain, Sept. 22, 1920, and of which the following is a specification.

This invention relates to electromotoric starting devices of the kind described and shown in the pending United States application Serial Number 318,808, filed August 20, 1919, patented May 2, 1922, Patent No. 1,414,653, and intended for use in connection with internal combustion engines. Such starting devices are, as a rule, coupled with the shaft of the internal combustion engine by a toothed gearing, and work with two switching stages. In the first stage, the starting electromotor is driven slowly and with weak torque for facilitating the meshing of its axially displaceable coupling member (pinion) with the associate coupling member (toothed fly-wheel rim) of the internal combustion engine; in the second stage, which takes place after the coupling members have engaged each other, the motor is driven quicker and with stronger torque. According to the starting device described and shown in said pending application, the resistance, with aid of which the differentiated manner of operation is obtained, forms a portion of the exciting coil of the starting motor.

As with other starting devices, where, for instance, in the first stage a shunt is laid around the armature of the starting motor and a special series resistance is provided, so also the novel arrangement allows of letting switching from the first stage to the second proceed automatically, viz., with aid of an electromagnetic switch which is actuated by the coupling motion of the coupling member of the starting motor.

Now, the present invention consists firstly, in making the excitation of this electromagnetic switch controlled solely by the starting switch (push button) so that the switch is

traversed by the weaker current of the first stage hereinbefore referred to; secondly, in preventing by suitable means the switch from effecting the switching from the first stage to the second before the pinion of the starting motor has meshed with the toothed fly-wheel rim of the internal combustion engine. The desired dependency of the switch in question upon the starting switch is obtained, for instance, by laying the coil of the former switch directly in the circuit of the starting motor.

Compared with starting devices with electromagnetic switch traversed by current only after the pinion has been shoved into coupling position, the novel device offers the great advantage that no special safety means preventing a spontaneous repetition of the starting procedure after the starting of the internal combustion engine are required, such repetition being prevented by the starting device itself.

An especially simple and reliably operating form of construction of the invention consists in mechanically locking the armature of the electromagnetic switch, that locking being directly or indirectly released by the pinion only after a certain distinct displacement of this latter.

In order to make my invention more clear, I refer to the accompanying drawing, in which a combination and arrangement of parts embodying it is diagrammatically illustrated.

The shaft *b* of the armature *r* has affixed to it a pinion *a*. The shaft with the armature may be longitudinally displaced in its bearings. A spring *p* is provided between one of the bearings and the armature and displaces this latter, in its position of rest, in such a direction as to position the pinion *a* out of mesh with the toothed rim *c* of the fly wheel of the internal combustion engine. *e* is a hand-operated switch, preferably a push-button. By closing it, current flows from the battery *d* over the brush *k*₁ through the armature *r*, over the brush *k*₂ through the portion *g* of the exciting winding of the starting motor and the winding *o* of the electromagnetic switch *S*, over the hand-switch *e* and the earth back to the battery *d*. The armature is now attracted and drawn into the exciting field and is at the same time slowly turned because the portion *g* of the exciting winding which has a high resistance

lies in series with the armature winding. Owing to this manner of operation the pinion *a* meshes easily and free of jerks with the toothed rim *c*.

5 Simultaneously with the field winding *g* the winding *o* of the switch *S* has also been excited, it is true, but for the present, the switch cannot attract its armature *m* because this is prevented from any alteration of its
10 position by a pawl *h*.

As soon, however, as the motor armature has been drawn for a certain length into the exciting field, a disk *n* affixed to the rear end of the armature shaft *b* pushes against the
15 pawl *h* and alters, while the longitudinal motion of the armature proceeds, its position in such a manner that the switch armature is released and is now able to follow the magnetic attraction of the winding *o*. Owing to this motion, the switch connects the
20 contacts *i*₁ and *i*₂ with each other and the battery current flows now from the brush *k*₂ also through the main exciting winding *f* and over said contacts to the earth. But as
25 the resistance of the winding *f* is considerably lesser than the resistance of the winding *g*, the motor armature, owing to the two portions *f* and *g* of the exciting winding having been connected in parallel, is fed
30 with a strong current so that it exerts a powerful turning moment upon the fly-wheel of the internal combustion engine, the toothed fly-wheel rim of which is now in complete mesh with the pinion *a*.

35 Although the motor armature may axially sway while the hand switch is closed, still, the starting procedure cannot spontaneously repeat because the winding *o* of the switch *S*, owing to its being located in the circuit of
40 the starting motor, remains excited only as long as the hand switch is closed, and the motor armature *r*, during its return motion, is not able at all to exert any influence upon the switch *S* and, thus, upon the starting
45 circuit.

Having now described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. A two stage electromagnetic starting
50 device for internal combustion engines, comprising, in combination an electromotor having a longitudinally displaceable armature and armature shaft; a coupling member at the shaft end and a complementary
55 coupling member in driving engagement with the internal combustion engine; a starting switch; an electromagnetic switch, the excitation of which is controlled solely by said starting switch; a mechanical locking
60 device adapted to prevent the armature of the said electromagnetic switch from effecting the switching from the first stage to the second before said two coupling members have engaged each other, and mechanical
65 means for releasing said locking device, said

means being adapted to be actuated by the longitudinal motion of the motor armature shaft.

2. A two stage electromagnetic starting device for internal combustion engines, comprising, in combination: an electromotor having a longitudinally displaceable armature and armature shaft; a coupling member at the shaft end and a complementary coupling member in driving engagement with the internal combustion engine; a first and second stage field winding for the motor; a starting switch; an electromagnetic switch having its winding in series with the first stage field winding of said motor for cutting in the second stage field winding; and means adapted to prevent said electromagnetic switch from effecting the switching from the first stage to the second before said two coupling members have engaged each other.

3. A two stage electromagnetic starting device for internal combustion engines, comprising, in combination: an electromotor having a longitudinally displaceable armature and armature shaft; a coupling member at the shaft end and a complementary coupling member in driving engagement with the internal combustion engine; a starting switch; an electromagnetic switch, the excitation of which is controlled solely by said starting switch and which has a solenoid core forming the movable member; a pawl adapted to lock said core in its outer position; a contact-closing means connected with the core; and means affixed to the motor armature shaft and adapted to release the pawl, substantially and for the purpose as described.

4. A two stage electromagnetic starting device for internal combustion engines, comprising, in combination: an electromotor having a longitudinally displaceable armature and armature shaft; a coupling member at the shaft end and a complementary coupling member for the internal combustion engine; a starting switch; an electromagnetic switch, the excitation of which is controlled solely by said starting switch; a mechanical locking device adapted to prevent the armature of the said electromagnetic switch from effecting the switching from the first stage to the second before said two coupling members have engaged each other, and mechanical means for releasing said locking device, said means being adapted to be actuated by the longitudinal motion of the motor armature shaft.

5. A two stage electromagnetic starting device for internal combustion engines, comprising, in combination: an electromotor having a longitudinally displaceable armature and armature shaft; a coupling member at the shaft end and a complementary coupling member for the internal combustion

tion engine; a starting switch; an electromagnetic switch, the excitation of which is controlled solely by said starting switch; a solenoid core forming the moveable member of said electromagnetic switch; a pawl adapted to lock said core in its outer position; a contact-closing means connected with the core; and means affixed to the motor armature shaft and adapted to release the pawl, substantially and for the purpose as described.

6. A two stage electromagnetic starting device for internal combustion engines comprising in combination an electric motor having a longitudinal displaceable armature shaft; a coupling member at the shaft end, a complementary coupling member for the engine, first and second stage field windings for the motor, a starting switch controlling the circuit of said first stage winding, an electromagnetic switch energized in the circuit of said first stage winding, and

interlocking means permitting a closing movement of said electromagnetic switch only during engagement of the coupling members while permitting opening movement of the said switch at all times.

7. In a two stage starting device of the type described, the combination, with the starting motor and complementary clutch members, of an electromagnetic switch for the motor, means for energizing the same and interlocking means between said switch and clutch member permitting a closing movement of the switch only during engagement of the clutch members while permitting opening movement of the switch at all times.

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

ERNST FRIEDRICH.

Witnesses:

ALFRED MCZER.
HELMA PANDER.