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STARTER DEVICE FOR INTERNAL COMBUSTION ENGINES

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Fig.1

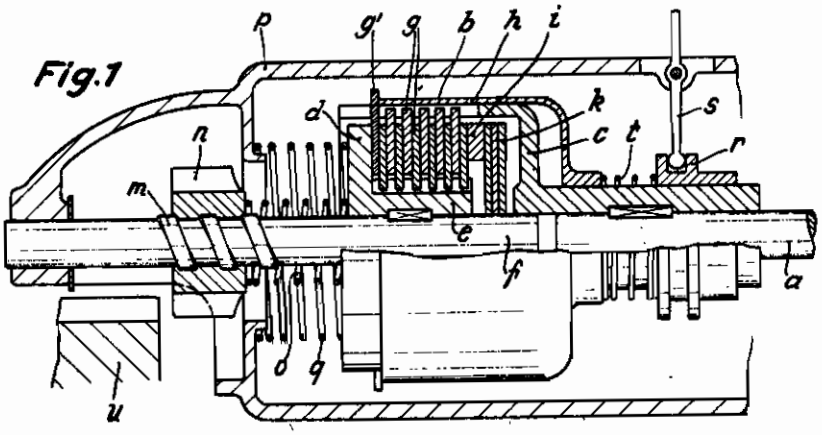


Fig.2

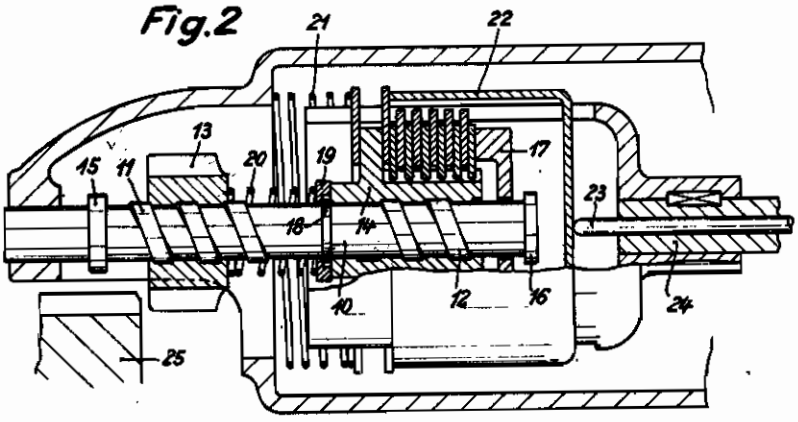
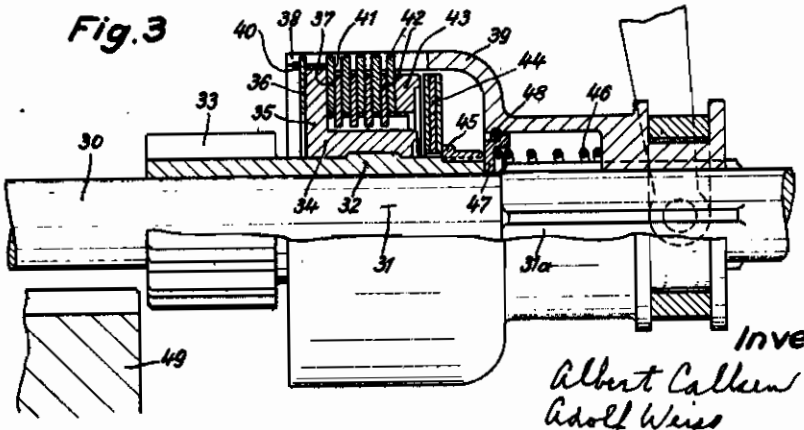


Fig.3



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STARTER DEVICE FOR INTERNAL COMBUSTION ENGINES

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This invention relates to starter devices for internal combustion engines, of the type in which the driving member, for example, a pinion, is connected with the driving shaft of the starter by a friction clutch having a screwable pressing member and effecting a positive driving connection only after the driving member has come into mesh with the driven member, said driving member being engaged arbitrarily with the driven member, for instance, the toothed rim of the fly wheel of an internal combustion engine, by hand or by a mechanically operating thrust force, such as, an electro-magnet.

In starter devices of the kind referred to, and generally in starters having a pinion to be meshed with a toothed wheel, the teeth of the pinion may happen to come into a face to face position with the teeth of the toothed wheel and it may be locked in this position, it being difficult to release the pinion from such locked position. The most common remedy, which, however, is by no means satisfactory, consists in that the pinion is withdrawn by force, by switching in the starter motor, through the engaging lever, and then thrown into mesh under action of a pressure spring which is loaded by the engaging lever. This, however, involves violent action and therefore is detrimental for the pinion and the toothed wheel, the withdrawal oftentimes being even impossible, if the pinion and the toothed wheel are already damaged.

According to another proposition, the locked pinion and the driving shaft are relatively turned by an axial displacement of one of the two parts of the threaded connection with respect to the other, then repeating the meshing-in operation. This, however, is only possible with small starters for light motors, in view of the forces required for turning the driving shaft.

It is an important object of the present invention to provide a device which does not show the above mentioned drawbacks, can be used for large starter devices and is simple, inexpensive and safe in operation.

With this and further objects in view, as may become apparent from the within disclosures, the invention consists not only in the structures herein pointed out and illustrated by the drawings, but includes further structures coming within the scope of what hereinafter may be claimed.

The character of the invention, however, may be best understood by reference to certain of its structural forms, as illustrated by the accompanying drawings in which—

Fig. 1 is a schematic side elevation, partly in section, of a starter device having the invention applied thereto.

Fig. 2 is a similar view, showing a modification, and

Fig. 3 is a similar view of a second modification.

As here shown, an important feature of our novel starter device consists in that a pressure member during the throwing-in action is positively connected with a part of the friction disks only, the rest of the friction disks being positively engaged only at the end of the longitudinal motion of the driving member, and a resilient pressure member being interpolated between the driving member and the part which is arbitrarily moved by the driver or operator.

Referring now to the drawing in greater detail, and first to Fig. 1, it will be noted that a shell-shaped clutch member c constituting the driving part of a frictional disk clutch *b* of the free-motion type is seated on a driving shaft *a* of the starter device which, for instance, may be driven by an electric motor.

The driven part of the clutch, constituted by a pressure disk *d*, is fixedly keyed on a shaft *f* by means of its hub *e*, frictional disks *g* being interposed between the shell member *c* and the hub *e* of the pressure disk. The last frictional disk *g'* adjacent to the pressure disk *d* is engaged between the pressure disk *d* and a shell or sleeve *h* which surrounds the coupling shell *c* and is slidable thereon, a pressure plate *i* bearing against the coupling member c by means of springs *k* and serving as an abutment face for the frictional disks.

The shaft *f* is formed with a thread *m* engaged by a pinion *n*. A pressure spring o is inserted between the pinion and the pressure disk *d*. Another spring *q* is arranged between the pressure disk and the casing *p* of the starter.

Slidably mounted on the hub of the coupling member *c* is a sleeve *r* which is engaged by a bifurcated lever *s* and serves for throwing in the pinion. A pressure spring *t* is disposed between the sleeve *r* and the shell *h*.

The device operates as follows: In order to engage the pinion *n* of the starter with the toothed wheel *u* of the internal combustion engine, the driver or operator advances the sleeve *r*, by operation of the lever *s*, thereby moving forward the shaft *f* with its pinion, through spring *t*, shell *h*, friction disk *g'* and pressure disk *d*. Now, in case the teeth of the pinion should strike against the end faces of the teeth of the toothed wheel *u*, thus locking the pinion, the following procedure is taking place: The driver through the

friction disk g' and the pressure disk d causes the threaded shaft f to move by a certain length through the locked pinion. Hereby, the pinion is either turned with respect to the toothed wheel, owing to the turning action of the thread or, if the pinion is very tightly locked, the shaft is turned in the thread of the pinion, this being possible owing to the fact that the pressure disk in this state is coupled with the friction disk g' only, permitting transmission of a small torque only. As the driver withdraws the sleeve r, for another engaging attempt, the shaft f with the pinion is moved back by the spring q acting upon the pressure disk d. As soon as the pinion in this movement is released from the teeth of the toothed wheel u, it is moved along the thread m, by the spring o, turned, and simultaneously forced into the space between two teeth. Now the driver may advance the sleeve r once more and engage the pinion completely. On rotation of the driving shaft a the shaft f is at first rotated only under action of the torque transmitted between the pressure disk d and the friction disk g', screwing itself back in the pinion, which is locked by its engagement with the toothed wheel u of the engine, until the pressure disk d forces all of the friction disks g against the pressure plate i, whereby the entire friction clutch comes to a positive or torque-transmitting engagement. In this operation, the spring t is compressed if the sleeve r is still held in its advanced position by the lever s.

Referring now to the embodiment illustrated in Fig. 2, it will be noted that the pinion shaft **10** is provided with two threads **11** and **12** of similar direction of their pitch. The pinion **13** is seated on the thread **11** while the thread **12** is provided for a pressure nut **14** of the frictional disk clutch. A stop face **15** for the pinion is provided on the front end of the pinion shaft, while a collar **16** for the pressure plate **17** of the clutch is provided on its rear end. Moreover, a stop **18** in the form of a spring or retaining ring for a spring plate **19** is provided on said shaft, between the pinion and the pressure unit, a pressure spring **20** being interpolated between said spring plate **19** and the pinion.

The spring **21** corresponds to the spring q and the shell **22** corresponds to the shell h of Fig. 1. In the embodiment of Fig. 2, the shell **22** is advanced by a push rod **23** extending through the hollow driving shaft **24** of the starter and being operated by hand or, for instance, by an electromagnet (not shown).

The device of Fig. 2 operates as follows: In order to throw the pinion into mesh, the shell **22** is moved, and through the pressure nut **14** and the spring ring **18** moves the pinion shaft with its pinion towards the toothed rim **25** of the engine fly wheel. In case the pinion should get locked at the front face of the toothed rim, the driver advances the shell **22** further, thereby turning the pressure nut **14** as in Fig. 1. As the sleeve **22** is withdrawn for the purpose of a second attempt, the pressure nut with the pinion shaft is moved back by the spring **21** and the pinion is released from its locked position. The released pinion, on the other hand, is advanced on the pinion shaft, by the spring **20** and thereby turned through a certain angle, whereby it is enabled to catch with its respective tooth into the space between two teeth and to mesh on another advance of shell **22**. If the driving shaft is now turned, the pinion at first is screwed on the rotating shaft **10** towards the stop face **15**, stopping the shaft as it reaches the stop face. Now the pressure nut is screwed on the stopped shaft, pressing the friction disk against the pressure plate **17** and the collar **16**, whereby the clutch is fully engaged.

Fig. 3 shows an embodiment of our invention which is particularly simple and useful. A driving shaft **30** is formed with a smooth portion **31** and a portion **31***a* having longitudinal grooves or flutes. A pinion **33** having a threaded hub member **32** is supported on the smooth portion to be freely rotatable and slidable, while the pressure nut **34** of a frictional disk clutch is seated on the threaded hub portion **32**. Arranged at both sides of the flange **35** of the pressure nut **34** are frictional disks **36** and **37** which engage into grooves **38** of the shell member **39** of the clutch. The frictional disk **36** is held in position by a spring ring **40** engaged in an inner groove of the shell **39**, which is stepped at its end for formation of a shoulder **41** abutting the frictional disk **37**. The rest of the frictional disks **42** are arranged in customary manner between the shell **39** and the pressure nut **34**. A pressure plate **43** bearing against a stop face **45** on the hub of the pinion, through spring disks **44**, serves as an abutment for the frictional disks. The shell member **39** is slidable on the fluted portion of the driving shaft, but secured against rotation, by engagement with the flutes. A pressure spring **46** in a recessed portion of the shell **39** acts upon a spring washer **47** which engages the hub of the pinion. The stroke of the spring washer **47** in the recess is defined by a spring ring **49**.

The operation of said device is substantially the same as in the case of Figs. 1 and 2. In order to throw the pinion into gear the shell member **39** is advanced and through its shoulder **41** transmits its motion to the frictional disk **37**, the pressure nut **34** and the pinion. In case the pinion in this operation is locked by face to face engagement with the teeth of the toothed rim **49** of the engine fly wheel, the pressure nut is turned on further advance of the shell **39**. On withdrawal of the shell the pinion is released from its locked position and screwed into the pressure nut by the spring **46**, until it meshes into a space between two teeth of the toothed rim of the fly wheel . Now the pinion may be engaged completely by another advance of the shell member **39**. As the driving shaft is rotated, the pressure nut **34** is screwed tight and compresses all of the frictional disks **42**, thus transmitting the full torque to the pinion.

The method and apparatus of the present invention have been described in detail with reference to specific embodiments. It is to be understood, however, that the invention is not limited by such specific reference but is broader in scope and capable of other embodiments than those specifically described and illustrated in the drawing.

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