Oct. 27, 1925. 1,559,259

K. KNAPP

CENTRIFUGAL FRICTION COUPLING FOR STARTERS FOR INTERNAL COMBUSTION ENGINES

Filed Jan. 27, 1923

Fig.1

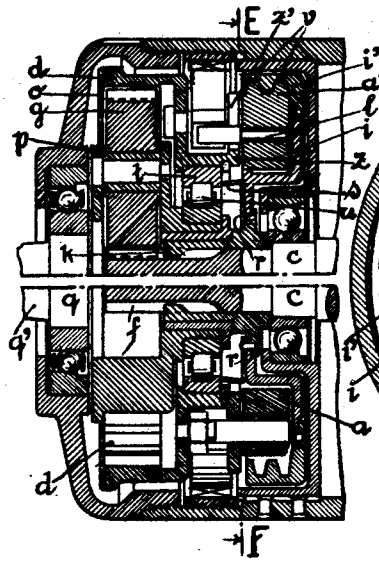


Fig.2

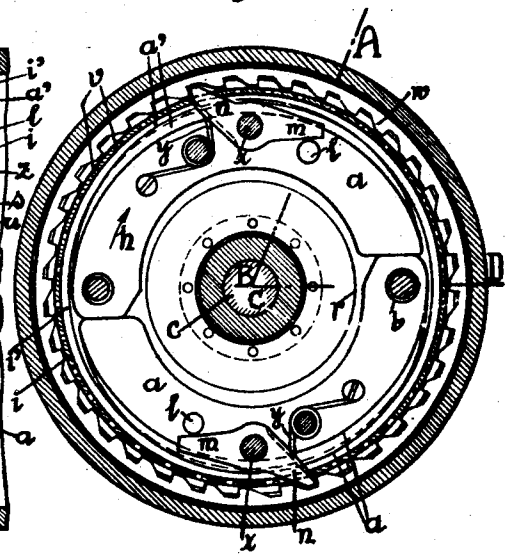
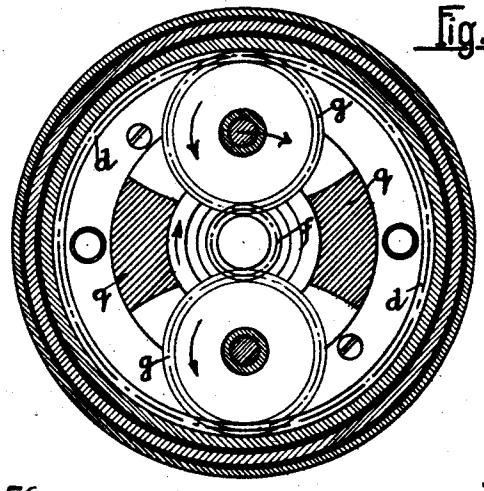


Fig.3



WITNESSES

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Patented Oct. 27, 1925. 1,559,259

UNITED STATES PATENT OFFICE.

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CENTRIFUGAL FRICTION COUPLING FOR STARTERS FOR INTERNAL-COMBUSTION ENGINES.

Application filed January 27, 1923. Serial No. 615,393.

To all whom it may concern:

Be it known that I, KARL KNAPP, a citizen of the German Republic, residing at Halle-on-the-Saale, Germany, have invented certain new and useful Improvements in Centrifugal Friction Couplings for Starters for Internal-Combustion Engines (for which I have filed an application in Germany on the 28th of January, 1922), of which the following is a specification.

This invention relates to a starter for internal combustion engines in which for starting the engine an epicyclic gear is driven with slow speed transmission from a dynamo which can be run as a motor supplied with current from the battery the further running of the dynamo for the charging up of the battery being effected by the started internal combustion engine through the intermediary of the epicyclic gear which is connected with a centrifugal friction gear the centrifugal masses of which are hinged on pivots, parallel to the axis of the gear, to the internally toothed hollow pinion. With starters of this type for motor cars it frequently happens in town traffic that the battery is not sufficiently charged up in consequence of the slow speed at which the car is being run so that the battery does not suffice for the next starting and for complete illumination. In order to avoid this inconvenience dynamos of special construction have already been used which begin to charge the battery up already at comparatively slow speed. This very important and valuable capability of the dynamo could however not be thoroughly utilized hitherto as no centrifugal friction couplings are known which, at the small dimensions which are only admissible, make the dynamo revolve with the low number of revolutions at which the internal combustion engine revolves. On the contrary exact measurings have shown that a driving of the dynamo absolutely free from slipping is attained with the aid of the very best centrifugal friction couplings of known type only at a speed from 1200–1300 revolutions per minute whilst shortly before and especially at about 450 revolutions of the internal combustion engine, at which the most suitable dynamos would already charge up, the dynamo lags much behind the engine and consequently does not yet charge up. This difficulty is overcome according to the invention by an improved centrifugal friction coupling. The novelty of the coupling consists essentially in that all the centrifugal masses are arranged in the sense of the revolution, in front of their hinge bolts and in that they all have in the well known manner wedge-shaped friction ribs on their circumferences. These friction ribs engage already at slow speed with wedge-shaped grooves of the friction crown meshing with the pinion on the shaft of the motor dynamo and push the same instead of pulling it as is otherwise the case. Experiments have proved that a centrifugal friction coupling of this type produces a driving of the dynamo which is absolutely free of slipping at 300 revolutions per minute especially if care is taken, as will be seen from the statements below, that the centrifugal masses when moving out of their inner position have not to overcome any appreciable resistance and that their wedge shaped friction ribs, notwithstanding abundant lubrication of the other parts of the starting gear, work free of oil or dry.

A form of construction of the improved centrifugal friction coupling is illustrated by way of example on the accompanying drawing, wherein:

Fig. 1 shows the coupling at the upper half in a section on line A—B and at the lower half in a section on line C—D of Fig. 2.

Fig. 2 is a front elevation in section on line E—F of Fig. 1.

Fig. 3 shows in front elevation the well known epicyclic gear.

The friction elements a are hinged in the well known manner by means of bolts b parallel to the shaft c of the dynamo on the internally toothed hollow wheel d of the epicyclic gear d, f, g. According to the invention the friction elements are arranged in front of their hinge bolts b in the direction of revolution h and they are constructed so that wedge-shaped ribs a' are formed on the circumference which cooperate with wedge-shaped grooves i' of the friction crown i which meshes by teeth k with the pinion f of the shaft of the dynamo.

The centrifugal masses a are held in the position of rest, at starting and in the event

of back rotation of the internal combustion engine, only by the studs l for the throw-out pawls being in contact with the tails m of the throw-out pawls n which engage with the stationary crown w. The pivot pins x of the pawls n and the feeble springs y for throwing-in the pawls are mounted in the end wall of the hollow wheel d and in a flange z joining the same. The throwing-out studs l project through recesses z' of this flange under the pawls m.

The running gear f, g, d is enclosed by a casing. A sheet iron ring o which grips over the edge of the internally toothed hollow wheel and the inner edge of which joins tightly the outer flange p of the support q for the intermediary pinion of the epicyclic gear prevents the projection of lubricating oil to the outer side. The support q carries upon its outer end q' a driving wheel (which is not shown on the drawing), and which by means of chain or intermediary wheel drives a corresponding wheel on the shaft of the internal combustion engine and consequently this engine. The projecting of oil in inward direction towards the friction coupling is prevented by a sheet iron ring r, which joins the friction disk i and has an inwardly bent edge s tightly enclosing the bearing ring t of the roller bearing u and designed to intercept the oil flowing out from said bearing.

The friction crown i has at the bottom of the wedge-shaped grooves i' bores v through which the oil escapes which at excessive lubrication should get between the coupling friction surfaces, so that these friction surfaces remain always dry or essentially dry and act consequently with great force.

In this arrangement the improved coupling operates as follows:—

(1) *Starting.*—If the dynamo supplied with current from the battery rotates the pinion f in the right hand direction (seen from the end q' of the shaft) the intermediary wheels g which rotate in the left hand side direction tend to rotate the internally toothed crown also in the left hand direction. This crown is however prevented from rotating in this direction as the pawls are in engagement with the stationary toothed crown w. The intermediary wheels g roll consequently on the locked internally toothed crown d whereby the shaft q is rotated in the right hand direction. At this driving of shaft q which is converted by the pinion f into slow speed transmission the centrifugal masses a which are in the position of rest are held in this position only by the studs l being in contact with the tails m of the pawls. At starting the friction crown i rotates in right hand direction at the high speed of the shaft c of the dynamo. The centrifugal masses must not come in contact with this friction crown as they would otherwise brake the same, merely by their weight. Hitherto powerful springs were required for preventing this contact and for holding the centrifugal masses together. These springs are no longer necessary as the centrifugal masses are already held together and away from the friction crown by the tails m of the pawls. These tails m of the pawls cannot yield or give way as the pawls n cannot pivot inwardly around their pivot pins x as long as they are locked.

(2) *Working dynamo as a generator.*—When the internal combustion engine starts, the rotation in right hand direction of the shaft q which carries the intermediary wheels is accelerated and the whole epicyclic gear is held together to form one rotating centrifugal mass. The current is shut off. The internally toothed crown d rotates in right hand direction and draws along the pawls, the centrifugal masses a swinging at the same time in outward direction and pressing the tails in outward direction by means of studs l, so that the pawls are held back from the locking crown w. The centrifugal masses have thus to overcome only the resistance of the feeble pawl-springs y which they will be able to do already at a quite low number of revolutions. The swinging outwards of the centrifugal masses does therefore no longer depend on the previous overcoming of the resistance of a powerful spring, which was hitherto necessary to pull the masses together so that at the starting they remained in the position of rest. The centrifugal masses oscillate therefore already at a very low number of revolutions into contact with the friction crown and the friction pressure exerted upon this crown is no longer decreased by the gradually increasing pulling force of a separate holding spring but only by the antagonistic effect of the feeble pawl spring which is insignificant in comparison to the centrifugal force. By this means alone the driving of the friction crown free of slipping would be ensured however only at higher revolving speeds than those which are necessary for the charging up of the dynamo. The pushing wedge-shaped ribs however press themselves into the wedge-shaped grooves and owing to the resistance of the dynamo become wedged so that the drive is free from slipping even, at a comparatively low friction pressure, and even below the number of revolutions at which the dynamo begins to charge up. The above mentioned inconvenience that the battery, even with the best dynamo, is not sufficiently charged up at the slow travelling in towns is therefore obviated by the simplest and most effective means. The advantage, essential for the manufacturing on a large scale and for the perfect putting together,

is further obtained that all centrifugal masses, pawls and pawl springs are identical which would not be the case if a common pivot bolt were used for two centrifugal masses.

(3) *Stopping of the internal combustion engine.*—If at the stopping the number of revolutions of the internal combustion engine sinks below that at which the studs *l* began to throw out the pawls, these pawls are thrown in again automatically by their springs *y*. If the internal combustion engine has the tendency to equilibrate itself before the final stopping there is nothing to prevent this as at the return stroke, when the internally toothed crown *i* is locked and the pawls are thrown in, the tails *m* of said pawls will securely retain by means of the studs *l* the centrifugal masses *a* from coming in contact with the friction crown. The secure prevention of this contact without the aid of a locking spring is very important as the friction crown would be moved by the return stroke of the engine with transmission into increasing speed in left hand direction towards the free ends of the centrifugal masses. This centrifugal mass, if it remained in outward position owing to the slackening of the hitherto used locking spring or to the hardening of the old lubricating oil in the bearings of the hinge pins, were it not for the pawls *n*, would lock almost instantaneously the friction crown after the manner of an eccentric locking cone and prevent thus a further equilibrating of the engine. This sudden stop would produce actions of the masses which would submit the elements for the transmission of power and the gear elements to extraordinarily high strain and it could lead to fracture.

I claim:—

1. A centrifugal friction coupling for the starters for internal combustion engines comprising in combination with the shaft of the internal combustion engine and with an epicyclic gear comprising an inner hollow wheel, a pinion on said shaft of the dynamo, a friction crown having wedge shaped grooves and meshing with said pinion, hinge bolts fixed in the inner hollow wheel of said epicyclic gear, centrifugal masses pivoted on said hinge bolts so that they extend forward the same in the direction of rotation, and wedge-shaped friction ribs on the circumference of said centrifugal masses designed to engage at low number of revolutions with said wedge shaped grooves of the friction crown and drive the same by pushing.

2. A centrifugal friction coupling for the starters for internal combustion engines comprising in combination with the shaft of the internal combustion engine and with an epicyclic gear comprising an inner hollow wheel, a pinion on said shaft of the dynamo, a friction crown having wedge-shaped grooves and meshing with said pinion, hinge bolts fixed in the inner hollow wheel of said epicyclic gear, centrifugal masses pivoted on said hinge bolts so that they extend forward the same in the direction of rotation, wedge shaped friction ribs on the circumference of said centrifugal masses designed to engage at low number of revolutions with said wedge-shaped grooves of the friction crown and drive the same by pushing, a stationary crown in the casing toothed on its inner circumference, spring controlled locking pawls pivotally mounted on the end wall of said hollow wheel and adapted to engage with the stationary toothed crown, tails of said pawls, and studs on said centrifugal masses designed to come in contact with the tails of the pawls which are thrown in and so to hold said centrifugal masses in the inoperative position at starting and in the event of back strokes.

3. A centrifugal friction coupling for the starters for internal combustion engines comprising in combination with the shaft of the internal combustion engine and with an epicyclic gear comprising an inner hollow wheel, a pinion on said shaft of the dynamo, a friction crown having wedge-shaped grooves and meshing with said pinion, hinge bolts fixed in the inner hollow wheel of said epicyclic gear, centrifugal masses pivoted on said hinge bolts so that they extend forward the same in the direction of rotation, wedge-shaped friction ribs on the circumference of said centrifugal masses designed to engage at low number of revolutions with said wedge-shaped grooves of the friction crown and drive the same by pushing, a casing of said epicyclic gear protecting the friction surfaces of the centrifugal friction coupling against admission of the oil which lubricates said epicyclic gear, and holes in the bottom of the wedge-shaped grooves of said friction crown through which any oil is expelled which may have got between said friction surfaces.

In testimony whereof I affix my signature.

KARL KNAPP.