Jan. 4, 1927. 1,613,052

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STARTING DEVICE FOR MAGNETO ELECTRIC IGNITION MACHINES

Filed August 22, 1922 2 Sheets-Sheet 1

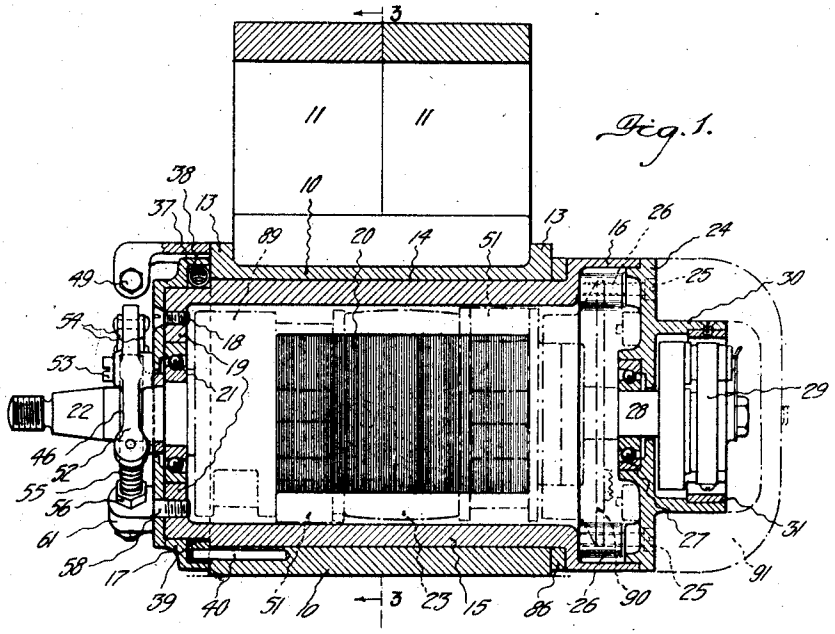


Fig. 1.

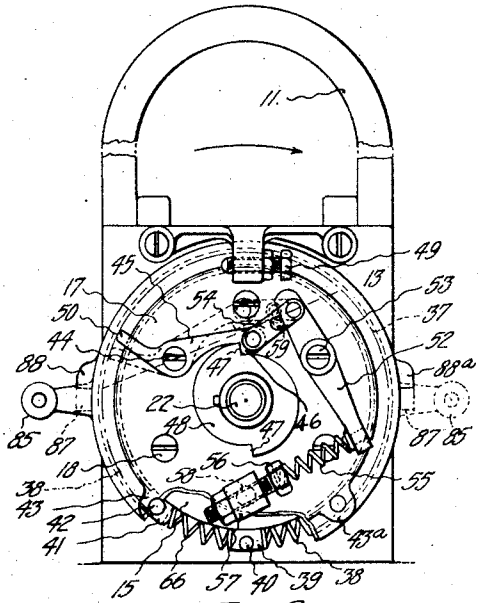


Fig. 2.

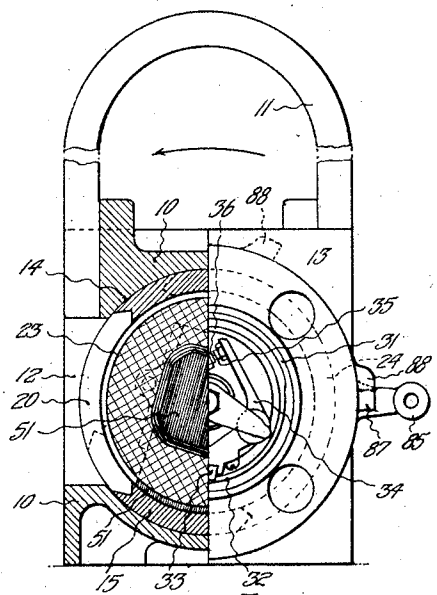


Fig. 3.

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STARTING DEVICE FOR MAGNETO ELECTRIC IGNITION MACHINES

Filed August 22, 1922 2 Sheets-Sheet 2

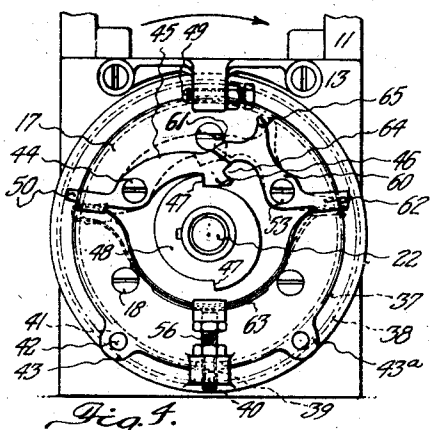


Fig. 4.

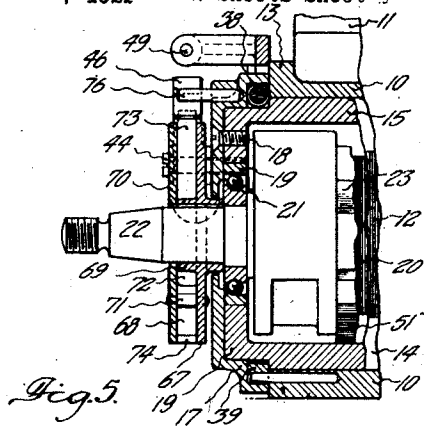


Fig. 5.

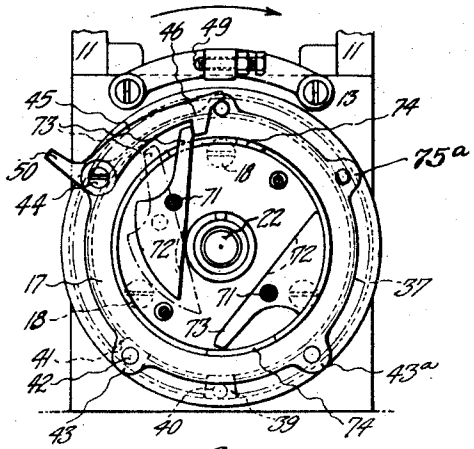


Fig. 6.

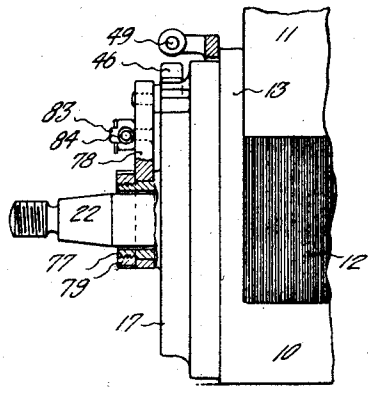


Fig. 7.

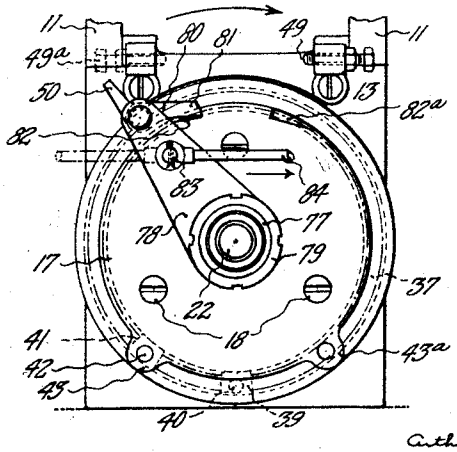


Fig. 8.

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UNITED STATES PATENT OFFICE.

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STARTING DEVICE FOR MAGNETO-ELECTRIC IGNITION MACHINES.

Application filed August 22, 1922, Serial No. 583,524, and in Australia September 3, 1921.

This invention relates to magneto electric machines, shortly termed magnetos, ordinarily employed for ignition purposes in internal combustion engines and more particularly to means whereby intensified currents are generated to ensure satisfactory ignition at starting and when running at low speeds.

Internal combustion engines have inherently bad starting characteristics, and oftentimes in cranking up several attempts have to be made before an initial explosion is obtained.

In the case of motor cars it is now customary, when starting up, to apply a driving torque to the engine crankshaft by means of an electric motor which is supplied with current from a battery carried on the car.

Even when such means is provided, a considerable interval of time frequently elapses before the engines fire. During this interval a heavy load is thrown on the motor and battery, and the latter especially requires more frequent repair and renewal than it would do if the engine started more promptly.

In this invention a transversely disposed magnetic field is employed, which is capable of rotation relatively to the armature; means being provided whereby at starting the transversely disposed magnetic field is displaced angularly in opposition to a retractive force, which after movement of the field through a predetermined angle has taken place, is rendered capable of action and rapidly rotates said field about the armature into its original position. The rapid motion of the transversely disposed field in relationship to the armature brings about a rapid flux change in the armature core and correspondingly effects the generation of powerful currents in the armature windings.

A transversely disposed angularly displaceable magnetic field is provided by mounting auxiliary pole pieces or polar segments in a sleeve of non-magnetic metal, hereinafter termed the "timing sleeve" or for brevity the "sleeve", which is rotatively fitted in the frame or body-casting of the machine.

The auxiliary pole pieces or polar segments contact closely with fixed pole pieces or magnetic elements of opposite polarity secured in the frame or body-casting either when the timing sleeve is stationary or when it is being partially rotated for purposes hereinafter described.

The timing sleeve is detachably fitted in the frame or body-casting and it extends through said frame or casting and projects beyond its front and rear ends.

On the portion of the timing sleeve which projects beyond the rear end of the body-casting is mounted a releasable element which is adapted, at starting, to partially rotate said sleeve by engagement with a contacting element on the driving shaft of the magneto, or by connection with a coacting element on the timing sleeve itself.

On the opposite end of the timing sleeve, which projects beyond the front end of the body-casting, is mounted the cam cage of the interrupter or contact breaker and the timing lever if the latter is provided on the magneto.

In a convenient position on the rear end of the timing sleeve, is located a spring, which at one end bears upon a fixed abutment secured to the body-casting, and at its opposite end contacts with an abutment fixed to and movable with the timing sleeve. The application of a torque to the sleeve angularly displaces the same and distorts the spring and the latter rapidly restores the sleeve to its original position when released from the torque, thereby effecting the generation of high voltage currents as previously indicated.

No spark, however, would occur at an ignition plug unless the primary circuit was interrupted at or about the time the armature occupies a peak voltage position, relatively to the auxiliary pole pieces. Accordingly the sleeve and auxiliary pole pieces are timed to be restored to their original positions synchronously with the arrival of the armature in a peak voltage position and with the separation of the contacts of the contact breaker.

A torque may be applied to the sleeve either by mechanical operation or manually, and in the former case the sleeve is conveniently furnished with a pawl on its rear end which becomes interconnected with ratchet members mounted on the armature driving shaft.

The sleeve and auxiliary pole pieces are in this manner angularly displaced in opposition to said spring and they move forwardly with the armature. After the sleeve and

auxiliary pole pieces have been displaced through a predetermined angle and as the armature approaches a point at which an ignition is required and at a sufficient interval therebefore the pawl contacts with a stop adjustably fixed to the body casting and is thrown out of engagement with the ratchet members. Thereupon, the spring being free to act immediately rotates said sleeve and pole pieces backwardly at a high speed in relationship to the armature thereby generating a powerful current in the armature windings. As pole pieces regain their normal positions the contact breaker points are opened and an intense spark at once occurs at the gap of the ignition plug.

If the engine does not immediately start the pawl becomes re-engaged with and again disconnected from the ratchet members, and a second spark is produced at the plug. These actions continue until the engine starts, and a predetermined speed is reached, whereupon, the pawl is thrown out of action and the magneto operates in the ordinary way.

The pawl may be thrown out of action and locked in an inoperative position in various ways.

In one arrangement as the engine accelerates the pawl strikes with increasing force against the adjustable stop, and finally, it is thrown out of action by the overcentring of a spring controlled link which is attached to it. When the pawl is again required for starting purposes it is manually replaced in an operative position.

The speed at which said pawl is thrown out of action may be varied by adjusting the strength of the spring controlling the link or said catch, or by changing the position of said stop. Peripheral adjustment of said stop is likewise employed to adjust the range of angular movement of the sleeve and auxiliary pole pieces fixed thereto.

In another arrangement the functions of the pawl are automatically controlled at starting, and it is normally disposed for engagement with centrifugally governed pivoted members mounted on the driving shaft. The pivoted members are provided with ratchet teeth which automatically engage with the pawl at starting and recede from the range of action thereof when the speed exceeds a predetermined rate and reappear when the speed falls below that rate.

An object of the invention is to enable a magneto to generate currents for starting purposes even though the engine is stationary and the armature accordingly at rest. In order that this may be effected said sleeve and pole pieces are arranged to be rotated by manual operation relatively to the armature in opposition to the retractive action of said spring. After said sleeve and pole pieces have been moved through an arc of required magnitude they are automatically released and are rotated backwardly with great rapidity by the spring into their normal positions, thereby setting up an intense current in the armature windings.

As previously stated no spark will be produced at an ignition plug unless this current is interrupted by separation of the contacts of the contact breaker. The contacts cannot be separated in the ordinary way since both the armature and the contact breaker are stationary.

To enable the contact breaker to function under these conditions the timing sleeve is mechanically connected to the actuating members or cams of the former in such manner that at or about the termination of the movement of said sleeve a separation of the contacts is effected.

A satisfactory mechanical connection can be effected, for this purpose, by extending the timing sleeve to form a mounting for said actuating members or cams.

In this manner the sleeve may be arranged to be connected with the actuating members or cams at all times, and it will accordingly partake of the advance and retard movements of said members or cams effected by the timing lever of the magneto.

The operation of the invention is not dependent on the timing adjustment of the sleeve, and it can be applied to magnetos arranged for "fixed ignition" in which means for effecting adjustments is not provided.

The engagement of said pawl with a co-acting element is effected without preliminary movement of the timing sleeve and independently of its timing adjustments. At starting, manual operation of the timing lever is not required, and said lever can be left in either a retarded or advanced position, and it may be placed with advantage in the latter position as starting is thereby facilitated after the initial explosion has occurred.

Means hereinafter described are provided whereby the movements of the sleeve at starting are effected independently of the timing lever, and whereby the latter in effecting advance and retard movements angularly displaces the said sleeve in opposition to the spring.

Reference is had to the drawings illustrating the invention:—

Figure 1 is a view partly in longitudinal section and partly in side elevation of a magneto provided with means for the production of intensified sparks at starting.

Figure 2 is a view in end elevation at the rear or driving end of the magneto shewn in Figure 1.

Figure 3 is a view partly in end elevation at the front or contact breaker end of the magneto shewn in Figure 1, and partly in vertical section on the line 3—3 in Figure 1.

Figure 4 is a view in rear elevation of portion of a magneto shewing a modified detail of the construction shewn in Figures 1 and 2.

Figures 5 and 6 are views respectively in vertical section and rear elevation of portion of a magneto shewing an automatically controlled detail of the invention.

Figures 7 and 8 are views respectively in side elevation and rear elevation of a portion of a magneto shewing a manually operated detail of the invention.

In these drawings the numeral 10 designates a body casting or frame of a magneto having secured thereto field magnets 11 which contact with fixed pole pieces 12, preferably of laminated structure mounted in the body casting 10. The body casting 10 is made of non-magnetic metal and is provided with flanged ends 13, and the interior thereof is accurately bored to form a cylindrical chamber 14, open at both ends.

In the chamber 14 is rotatably fitted a hollow cylindrical sleeve 15, likewise made of non-magnetic metal, which projects from the front and rear ends of the body casting 10. Endwise movement of the sleeve 15 in the chamber 14 is prevented by an enlarged extension 16 at the front end of said sleeve, and by a cap 17 mounted on the rear end thereof and secured thereto as by screws 18, which are inserted into an inwardly projecting flange 19, formed integrally with said sleeve.

In the sides of the sleeve 15 are mounted auxiliary pole pieces 20, likewise preferably laminated, the outer peripheral surfaces of which are closely contiguous to the fixed pole pieces 12.

Mounted in the flange 19 is a bearing 21 in which is supported a driving shaft 22 of an armature 23, indicated by broken lines in Figure 1 and partly shewn in Figures 3 and 5.

The enlarged extension 16 of the sleeve 15 is furnished with a detachable end plate or cover 24, conveniently fixed to said sleeve by screws 25 which are inserted into lugs 26. In the end plate 24 is mounted a bearing 27 which supports a shaft 28 at the front end of the armature. The shaft 28 projects outwardly from the bearing 27 and has mounted upon it a contact breaker 29.

The end plate 24 is provided with an extension which forms a cam cage or housing 30 for the contact breaker 29. Within the cam cage 30 is mounted a cam ring 31 having formed thereon cams 32 which co-act with a fibre heel 33 fixed in a lever 34, to effect separations of movable and insulated contacts, indicated respectively by numbers 35 and 36, in the ordinary way.

The portion of the cap 17 contiguous to the flange 13 of the body casting 10 is enlarged to form an annular chamber 37 in which is located a helical spring 38. The spring 38 at one end bears upon an abutment 39 fixed to or carried upon a pin 40 or the like, mounted in said body casting, and the opposite end of said spring bears against an abutment 41 fixed on a pin 42 secured in a boss 43 on the cap 17.

It will be obvious that a torque bringing about rotary movement of the sleeve 15 and cap 17 in the direction of the arrow shewn in Figure 2 will compress the spring between the abutments 39 and 41, and that said spring when the torque ceases to operate will immediately return said sleeve and cap to their initial position.

Pivotally mounted on a screw 44 or the like, securely fixed in the cap 17, is a lever 45 having one arm constructed as a pawl 46, which is adapted for engagement with ratchet teeth 47 formed on a disc 48 keyed to the shaft 22.

If the shaft 22 and disc 48 be rotated, the pawl 46 will become engaged with one of the ratchet teeth 47, and it will accordingly be moved forwardly in the direction of motion of the shaft 22 carrying with it the cap 17 and sleeve 15 and compressing the spring 38 as described above.

If, when the sleeve 15 has been displaced through an arc of required magnitude and the spring 38 has been sufficiently compressed, the pawl 46 is released from the ratchet tooth 47, said spring being rendered free to act will immediately rotate the pawl 46, sleeve 15, auxiliary pole pieces 20, and cap 17 backwardly at high speed into their original positions.

In order that the pawl 46 may be tripped or released when required, an adjustable stop 49 is provided which contacts with an arm 50 of the lever 45 and thereby disengages said pawl.

The stop 49 is positioned and adjusted so that the pawl 46 will be disengaged from the ratchet tooth 47 when the armature and interrupter have moved into a well retarded position wherein the engine piston is at or slightly beyond the end of its compression stroke.

The position, wherein the pawl 46 is disengaged from the ratchet tooth 47, being governed by contact with a fixed member, as the stop 49, the release of the timing sleeve is invariable and it will always occur when the armature and interrupter have arrived at the same predetermined retarded position, thereby making it impossible for back-firing to occur.

The time of release of the timing sleeve 15 is constant and it will be unaffected whether said sleeve be in an advanced or retarded position.

If the timing sleeve be placed in an ad-

vanced position the ratchet tooth 47 will engage the pawl 46 earlier than when said sleeve is in a retarded position. If the sleeve 15 be placed in a retarded position engagement of the tooth 47 with the pawl 46 will be delayed, for part of the movement of said sleeve which would have been effected by said tooth and pawl has already been performed by the timing lever, hereinafter described.

In the operation of starting an engine the pawl 46 as the magneto rotates becomes engaged with a ratchet tooth 47. This engagement is effected when the core 51 shewn in Figure 3, of the armature 23 occupies an approximately maximum flux position relatively to the auxiliary pole pieces 20, that is normally when the armature core 51 is parallelly disposed to the magnetic axis and extends horizontally from one pole piece to the opposite one.

Immediately the pawl 46 engages with a ratchet tooth 47 the pole pieces 20 are moved forwardly with the armature 23 as previously described, the magnetic field becomes angularly displaced and the core 51 and said pole pieces are maintained in a relatively maximum flux position.

Shortly before the armature 23 arrives at a point at which an ignition is required and when the pole pieces 20 have been moved into the position indicated by broken lines in Figure 3, the pawl 46 is tripped and the pole pieces 20 are rotated at high speed relatively to the armature 23 into their normal position.

A rapid flux change is accordingly produced in the armature core 51 and an intense current is generated in the windings, which attains its peak voltage synchronously with the return of the pole pieces 20 to their normal position and the separation of the contacts 35 and 36 brought about by impact of the fibre heel 33 with a cam 32. In this manner a powerful induced current is set up in the secondary winding of the armature 23, and an intensified spark is produced at the electrodes of an ignition plug, even when the engine is cranked at a low speed.

A short interval after the return of the pole pieces 20 to their normal location and when the armature core 51 has arrived at or about the next maximum flux position the pawl 46 becomes engaged with the succeeding ratchet tooth 47 on the disc 48, and said pole pieces are again moved forwardly and then impelled backwardly, and another efficient spark is generated. This cycle of operations is repeated until an explosion occurs and the engine accelerates. It is then desirable that the engagement of the pawl 46 with the ratchet teeth 47 should discontinue, as the magneto having attained a sufficient speed is capable of furnishing sparks in the ordinary way.

The pawl 46 may be thrown into an inoperative position and secured therein in various ways, two of which are illustrated respectively in Figures 1 and 2, and in Figure 4, of the drawings.

In the construction illustrated in Figure 2 a lever 52 pivoted on a screw 53 secured in the cap 17, is connected at one end to the pawl 46 by a pair of links 54.

A spring 55, which can be tensioned as required by an adjusting screw 56, bears upon the opposite end of the lever 52. The screw 56 is mounted in a lug 57 secured to a stem 58 which is screwed into or otherwise fixed to the cap 17 and flange 19.

The spring 55 by means of the lever 52 and links 54, applies pressure to the pawl 46 urging it downwardly, when the links 54 are positioned beneath the plane, indicated by broken lines in Figure 2, passing through the axis of the screw 44 and the point at which the links 54 are pivoted on the lever 52, and upwardly when the links 54 are located above said plane.

At starting pressure is applied, manually, either directly or indirectly by suitable actuating means as for example, Bowden wire mechanism, to the arm 50 of the lever 45. In this way the links 54 are thrown beneath the plane above mentioned and the pawl 46 is brought to bear upon the periphery of the disc 48 in which position it becomes engaged with the ratchet teeth 47 when said disc is rotated.

When the engine is slowly turning as in cranking up, the arm 50 contacts with the adjustable stop 49 and the pawl 46 is raised from the teeth 47 as previously described. Said pawl 46, however, is not elevated sufficiently when cranking up to move the links 54 above said plane.

Upon the engine starting the lever 45 is carried rapidly forwards and the arm 50 impacts with sufficient force (due to increased speed) against the stop 49 to cause the overcentering of the links 54, which now being positioned above said plane move the pawl 46 into an inoperative position, shewn by broken lines, and retain it therein.

To limit the movement of the pawl 46 and lever 52 when the links 54 are over centred, a stop is provided. Conveniently this stop may be arranged as a pin 59 which is fixed to the links 54 and extends therebetween. This pin 59 contacts with the upper end of said lever 52 and in this manner limits the arcuate movement of the latter. The speed at which said links are overcentred is readily adjusted by varying the strength of the spring 55, as will be readily understood.

In the alternative arrangement illustrated in Figure 4, a locking lever 60 is pivoted on the screw 53. One arm of the locking lever 60 is constructed to form a catch 61, whereas

the opposite arm thereof forms a seating 62 for one end of a leaf spring 63, the opposite end of which bears upon the arm 50 of the lever 45

In the operative position the spring 63 throws the pawl 46 downwardly upon the periphery of the disc 48, and brings the catch 61 to bear upon the upper side of said pawl, which is thereby firmly pressed upon said disc and maintained in engagement with the ratchet teeth 47, until released by the stop 49.

A notch 64 is formed in the end of the pawl 46, and upon a predetermined speed being reached said pawl is sufficiently elevated to permit the catch 61 to become engaged with the notch 64 as indicated by broken lines. In this manner the pawl 46 and catch 61 become securely interlocked by the spring 63 which is further tensioned when said parts are thrown into an inoperative position.

The speed at which the pawl 46 and catch 61 become interlocked is readily adjusted in a similar manner to the arrangement previously described, namely by means of a tensioning screw 56 mounted in a lug 57, which in this case is formed integrally with said cap 17.

To enable the pawl 46 and catch 61 to be placed in an operative position a lug 65 is provided on the latter by means of which it may be moved upwardly by direct or indirect manual operation, thereby permitting the pawl 46 to descend into contact with the disc 48.

In Figures 2 and 4 the parts are shewn as arranged for clockwise or right handed rotation, but they may be readily adjusted for the opposite or anticlockwise direction.

To enable this to be effected the pivot screws 44 and 53 are made alike and they are symmetrically positioned on opposite sides of the vertical plane of the magneto. The levers 45 and 52 in Figures 2, and 45 and 60 in Figure 4, may accordingly be interchanged into positions for anticlockwise rotation. The adjustable stop 49 may be reversed end for end, and the lug 57 in Figures 1 and 2 may be turned to accommodate the tensioning screw 56 to the opposite position of the lever 52.

To enable the spring 38 to be adapted for angular displacement of the sleeve 15 in the opposite sense, the pin 42 supporting the abutment 41 is transferred to a corresponding boss 43a formed on the cap 17 on the opposite side of the vertical plate on the magneto, and said abutment is mounted on the pin 42 when the latter is refixed.

The spring 38 is re-positioned so as to bear upon the opposite side of the fixed abutment 39, wherein it will be adapted for anticlockwise displacement of the sleeve 15 and pole pieces 20.

In order to absorb the shock of recoil of the sleeve 15 when returned to its normal position by the spring 38, a recoil spring 66 is positioned between the abutments 39 and 41. This spring is likewise moved so as to be positioned between opposite sides of said abutment when the parts are adjusted for anticlockwise rotation.

In Figures 5 and 6 are shewn means whereby the pawl 46 is automatically caused to function at starting and to become inoperative when the speed reaches a predetermined rate, and to re-commence functioning when the speed falls below that value.

In order that the pawl 46 may have its actions controlled a disc 67 having an annular peripheral extension 68 and an axial boss 69, is keyed to the shaft 22. A second disc 70 is likewise mounted on the shaft 22 and is spaced apart from the disc 67 by the annular extension 68 and the boss 69, and said discs 67 and 70 are secured together by a plurality of transverse rivets, screws, or shouldered pins 71.

A pair of said pins 71 are arranged at equal radial distances from the axis of the shaft 22 and are disposed in diametrically opposite positions. Upon this pair of pins 71 and in the space between the discs 67 and 70 are mounted a pair of freely suspended flyweights 72.

These flyweights 72 are provided with oppositely disposed arms 73, and owing to their configuration, their centres of gravity are positioned in such manner that when freely suspended on the pins 71 under the action of gravity, they assume a position indicated by broken lines in Figure 6. In this figure the disc 70 is removed in order that the actions of the flyweights 72 may be more easily followed.

Peripheral openings 74 are made in the annular extension 68 adjacently to the ends of the arms 73.

When said discs are being slowly rotated as when starting an engine, the arms 73 under the action of gravity take up a position as indicated by broken lines in Figure 6 as they approach pawl 46, and the ends of said arms project through the opening 74 in readiness for engagement with said pawl.

As soon as engagement is effected with the pawl 46 the inner sides of the flyweights 72 facing the boss 69 contact with the latter, and the arms 73 accordingly become locked and ends function as ratchet teeth and the pawl 46 and sleeve 15 and pole pieces 20 are drawn forwardly and released when the arm 50 contacts with the stop 49 as previously described.

As soon as an explosion occurs and the engine accelerates the flyweights 72 are thrown outwardly at quite a low speed by centrifugal action into contact with the annular extension 68, and the arms 73 are

simultaneously moved inwardly through the openings 74, thereby receding from the range of action of said pawl. The flyweight 72 and arms 73 then occupy positions as shewn by the lower flyweight 72 in Figure 6 wherein they remain until the speed is reduced to a very low value.

Preferably the flyweights 72 are shaped as shewn by broken lines in order to prevent bearing upon the boss 69. When so made the ends of the arms 73 contact with the trailing ends of the peripheral openings 74 and said arms are more firmly supported and the pins 71 relieved to a great extent from straining actions.

In this construction the pivot screw 44 is inserted into a boss 75 on the cap 17, and the pawl 46 is supported at its outer end upon a pin 76 in order that it may be held clear of said discs and said peripheral extension.

For anticlockwise rotation the flyweights are inverted end for end on the pin 71, and the screw 44 and pawl 46 are transferred to a boss 75a formed on the cap 17. The adjustable stop 49 and said springs 38 and 66 are arranged for anticlockwise in the manner previously described.

In Figures 7 and 8 are shewn means whereby the sleeve 15 and auxiliary pole pieces 20 can be angularly displaced relatively to the armature 23 in opposition to the spring 38 and independently of the driving shaft 22, thereby enabling currents to be generated in said armature when at rest, and when an engine with which it is connected is stationary.

In carrying out this feature of the invention the cap 17 is provided with a boss 77, preferably integrally formed with it, upon which is mounted an arm 78 which is kept in position on said boss by a retaining nut.

Upon the outer end of the arm 78 is pivotally mounted a lever 80 which has one of its arms constructed as a pawl 81 adapted to engage with a notch 82 formed in the cap 17.

To a pin 83 fixed in the arm 78 is connected a rod 84 or the like, by means of which said arm may be partly rotated.

In operation the arm 78 is moved by the rod 84 in the direction shewn by the arrow in Figure 8. The pawl 81 enters into engagement with the notch 82, and the cap 17 and the sleeve 15 are moved forwardly until the arm 50 of the lever 80 contacts with the stop 49. The pawl 81 is thereon thrown out of engagement with the notch 82 and the spring 38 impels the sleeve 15 backwardly as before described.

As hereinbefore mentioned it is necessary, in order that a spark may be reduced at an ignition plug, that the contacts 35 and 36 should be separated when the generated currents approximately attain their peak voltage.

In the forms of the invention previously described the separation of said contacts is brought about by the rotation of the contact breaker 29 in the usual manner. This cannot be effected in the construction now being considered since the engine and magneto are stationary.

It is therefore essential in this construction that the actuating cams 32 of the contact breaker 29 should be mechanically linked with the sleeve 15. This is effected as hereinbefore described by mounting said cams on an end plate 24 fixed to the sleeve 15.

When said sleeve 15 and pole pieces 20 are rotated by the pawl 81, the cams 32 are simultaneously moved forwards and when said pawl is released the cams 32 impact with the fibre heel 33 synchronously with the return of said pole pieces to their normal positions.

In order to start an engine from rest, it is necessary that an explosive gaseous mixture be present in the engine cylinder which happens to have its ignition plug connected with the distributer of the magneto. It is also necessary that the armature core 51 should occupy a peak voltage position in relationship to said pole pieces 20 before the latter are drawn forwardly by the pawl 81, this occurs when a piston of the engine is at or about the end of its compression stroke.

Assuming these conditions to be fulfilled, the pole pieces 20 are drawn forwardly into a maximum flux position relatively to the armature 23, and upon release of said pawl 81 they are rapidly returned to the peak voltage position, thereby causing a rapid flux change in the armature core 51 and effecting the generation of a powerful current in the armature windings, which is simultaneously interrupted by impact of one of the cams 32 as it returns to its original position, with a fibre heel 33 of the contact breaker lever 34.

An intense spark is produced at the ignition plug in this way which explodes the gaseous mixture in the cylinder and the engine starts. If this spark fails to explode the mixture said sleeve 15 and pole pieces 20 are again drawn forward and another spark is produced and so on until ignition occurs.

An explosive mixture may be induced into the cylinder by turning the engine with the ignition switched off, or in other known manner, or a residual explosive mixture remaining in the cylinder when the engine previously ceased running may be used for the purpose.

To enable the pole pieces 20, to be displaced by manual operation in an anticlock-

wise direction the lever 80 is turned end for end on its pivot and the arm 78 is moved to allow said pawl 81 to engage with a corresponding notch 82ª on said cap 17. The stop 49 is changed as indicated by broken lines in Figure 8, and the springs 38 and 66 are transferred as hereinbefore described.

Advance and retard timing movement of the operative cams 32 are performed in the usual manner by a timing lever 85 connected by suitable linkage (not shewn) to a manually operated control.

The sleeve 15 and pole pieces 20 being mechanically linked to the cams 32 will move synchronously with the latter during the advance and retard movements thereof.

It therefore becomes necessary to provide means whereby said sleeve 15 and pole pieces 20, can be moved by the pawl 46 independently of the timing lever 85 and linkage (not shewn) by which the latter is operated.

To enable this to be effected the lever 85 is attached to or formed integrally with an annular member or ring 86 which is mounted upon the sleeve 15 and shewn in Figure 1.

The lever 85 is furnished with a lateral lug 87 which contacts with a projecting boss 88 formed on or fixed to the extension 16 of the sleeve 15.

The spring 38 normally maintains the boss 88 in contact with the lug 87 and accordingly during timing movements the lever 85 and linkage connected therewith move the sleeve 15 in one direction in opposition to the spring 38. When the lever 85 is moved in an opposite direction said spring compels the sleeve 15 to follow said lever as will be readily understood.

On account of the loose or non-rigid connection above described between the timing lever 85 and the sleeve 15, the pawl 46 or 81 is enabled to move said sleeve independently of the timing lever 85, and to displace the boss 88 into the position indicated by broken lines in Figure 3.

The means described in the foregoing for intensifying the sparks generated by a magneto when an engine is being started, being largely disposed within the machine the latter may be easily constructed to comply with ordinary standard dimensions, and it may be readily installed on an engine arranged to accommodate a standard magneto.

The operative members take no part in driving the magneto and are only connected with the driving elements thereof at starting. The armature shaft on the magneto is connected directly with the driving shaft on an engine in the ordinary way, and no relatively displaceable members are interposed between said shaft as in the case of an "impulse starter" coupling. The spring 38 may be more lightly constructed than that employed in an "impulse starter" coupling, as it is not subject to torsional vibrations and does not transmit a driving torque. The recoil on the sleeve 15 is accordingly less violent than the impulse given to the armature when an "impulse starter" coupling is used, and as the sleeve and the parts thereon can be lightly constructed its inertia is less so that risk of breakage is minimized. Even if fracture of the operative parts should occur the magneto may still function in the ordinary way and without disturbing its timing relatively to the engine.

The invention has been described with reference to an armature 23 of special construction, having primary windings 89 and secondary windings 90, and having at one end a condenser housing 91 and at the opposite end a distributer rotor 92 which co-operates with a distributer stator 93 mounted on the cam cage 30; but it may be applied to a magneto having an armature of ordinary shuttle or H construction, or other type of armature as will be readily understood.

I claim:

1. A magneto having a timing sleeve extending through it and projecting beyond its opposite ends, a releasable element on the timing sleeve, a coacting element adapted for engagement with the releasable element to partially rotate the timing sleeve, a spring opposing the partial rotation of the timing sleeve, and a fixed member adapted to disengage said elements when the timing sleeve has been moved into a predetermined retarded position.

2. A magneto having a timing sleeve extending through it and projecting beyond its opposite ends, a releasable element on the timing sleeve, a coacting element adapted for engagement with the releasable element to partially rotate the timing sleeve, a fixed member adapted to disengage said elements, a spring opposing the partial rotation of the timing sleeve and adapted to restore said sleeve to its initial position upon disengagement of said elements, and means for absorbing the recoil of the timing sleeve.

3. A magneto having a timing sleeve extending through it and projecting beyond its opposite ends, pole pieces in the timing sleeve adapted to move in contact with magnetic elements of opposite polarity, an armature rotatively mounted in the timing sleeve, primary and secondary windings on the armature, an interrupter, interrupter cams on one end of the timing sleeve, a releasable element and a spring on the opposite end of said sleeve, a coacting element adapted to engage the releasable element to partially rotate the timing sleeve in opposition to the spring, and a stationary member adapted to disengage said elements.

4. A magneto having a body-casting, an angularly displaceable timing sleeve extending through the body-casting and beyond its opposite ends, a releasable element on the timing sleeve, a coacting element adapted for engagement with the releasable element to partially rotate the timing sleeve, a spring opposing the partial rotation of said sleeve, and a member fixed to the body-casting for disengaging the releasable element from the coacting element.

5. A magneto having a body-casting, an interrupter, an angularly displaceable timing sleeve extending through the body-casting and beyond the opposite ends thereof, a releasable element and a spring on one end of the timing sleeve, interrupter cams on the opposite end of the timing sleeve, a coacting element adapted for engagement with the releasable element to partially rotate the timing sleeve in opposition to said spring, and a fixed member on the body-casting for disengaging said elements.

6. A magneto having a body-casting, an interrupter, an angularly displaceable timing sleeve extending through the body-casting and beyond the opposite ends thereof, pole pieces in the timing sleeve adapted to move in contact with magnetic elements of opposite polarity, an armature in the timing sleeve, primary and secondary windings on the armature, a releasable element and a spring on one end of the timing sleeve, interrupter cams on the opposite end of the timing sleeve, a coacting element adapted for engagement with the releasable element to partially rotate the timing sleeve in opposition to said spring, a fixed member on the body-casting for disengaging said elements, and a buffer spring to absorb the recoil of said sleeve.

7. A magneto having a body-casting, an interrupter, a timing sleeve extending through the body-casting and beyond the opposite ends thereof, a releasable element and a spring on the end of the timing sleeve which projects beyond the rear of the body-casting, interrupter cams on the end of said sleeve which extends outwardly from the front of the body-casting, a coacting element adapted for engagement with the releasable element to partially rotate the timing sleeve in opposition to said spring and a fixed member on the body-casting for disengaging the releasable element from the coacting element.

8. A magneto having a body-casting, an interrupter, a timing sleeve extending through the body-casting and beyond the opposite ends thereof, a pawl and an annular chamber on one end of the timing sleeve, interrupter cams on the opposite end of the timing sleeve, a spring in the annular chamber, a coacting ratchet member adapted for engagement with the pawl to partially rotate the timing sleeve in opposition to said spring, and a fixed member on the body-casting for disengaging the pawl from the ratchet member.

9. A magneto having a body-casting, a timing sleeve extending through the body-casting and beyond the ends thereof, means for retaining the timing sleeve in the body-casting consisting of an enlarged extension on one end of the former and a cap on the opposite end thereof, a pawl mounted on the cap, an enlargement on the cap forming with the timing sleeve an annular chamber, a spring in the annular chamber, a coacting ratchet member adapted for engagement with the pawl to partially rotate the timing sleeve in opposition to said spring, and a fixed member on the body-casting for disengaging the pawl from the ratchet member.

10. A magneto having a body-casting, a timing sleeve extending through the body-casting and beyond the ends thereof, a cap on one end of the timing sleeve, a pawl on the cap, an annular chamber between the cap and the sleeve, a movable abutment mounted on the cap and positioned in the annular chamber, a stationary abutment fixed to the body-casting and projecting into the annular chamber, a spring in the annular chamber disposed between said abutments, ratchet members adapted for engagement with said pawl to partially rotate the timing sleeve and compress the spring between said abutments, an adjustable stop for disengaging the pawl from the ratchet members, and a recoil spring between the movable and fixed abutments.

11. A magneto having a body-casting, a timing sleeve extending through the body-casting and beyond the ends thereof, pole pieces in the timing sleeve adapted to move in contact with fixed magnetic elements of opposite polarity, an armature in the timing sleeve, primary and secondary windings on the armature, a shaft at the front of the armature, a driving shaft at the rear of the armature, an interrupter on the former shaft, interrupter cams on the front end of the timing sleeve, a pawl on the rear end of the timing sleeve, ratchet teeth on the driving shaft adapted for engagement with the pawl to partially rotate the timing sleeve in the direction of armature rotation, a spring opposing the partial rotation of said sleeve, and an adjustable stop on the body-casting for disengaging the pawl from the ratchet teeth.

12. A magneto having a body-casting, a timing sleeve extending through the body-casting and beyond the ends thereof, a driving shaft, a pawl on said sleeve, toothed ratchet members on the driving shaft, adapt-

ed to engage the pawl to partially rotate the timing sleeve, and a stop on the body-casting for disengaging the pawl and toothed ratchet members.

13. A magneto having a body-casting, a timing sleeve extending through the body-casting and beyond the ends thereof, a driving shaft extending outwardly from the timing sleeve, a pawl on said sleeve, discs rotating with the driving shaft, ratchet members pivoted between the discs on opposite sides of the driving shaft, means for positioning the pawl to be engaged by the pivoted ratchet members to angularly displace the timing sleeve, an adjustable stop on the body-casting for disengaging the pawl from the ratchet members at the limit of the angular displacement of said sleeve, and means for moving the ratchet members into operative and inoperative positions.

14. A magneto having a body-casting, a timing sleeve extending through the body-casting and beyond the ends thereof, a pawl on the timing sleeve, a driving shaft extending outwardly from said sleeve, discs rotating with the driving shaft, freely suspended flyweights oppositely pivoted on and rotatable with the discs, ratchet arms on the flyweights adapted under gravity to be positioned to engage the pawl and under centrifugal action to recede into inoperative positions, and an adjustable stop on the body-casting for disengaging the pawl and ratchet arms.

15. A magneto having a body-casting, a timing sleeve extending through the body-casting and beyond the ends thereof, a pawl on the timing sleeve, a driving shaft extending outwardly from said sleeve, a pair of discs mounted on the driving shaft and spaced apart by an annular extension and an axial boss on one of the discs, freely suspended flyweights mounted on and between the discs, oppositely disposed peripheral openings in the annular extension, ratchet arms on the flyweights adapted under gravity to project outwardly through the peripheral openings to engage the pawl and under centrifugal action to recede inwardly through said openings into inoperative positions, and an adjustable stop on the body-casting for disengaging the pawl and ratchet arms.

16. A magneto having a body-casting, a timing sleeve extending through the body-casting and beyond its opposite ends, a pawl on the timing sleeve, a driving shaft extending outwardly from said sleeve, a pair of discs mounted on the driving shaft and fixed thereto and to each other, an annular chamber between the discs, freely suspended flyweights pivotally mounted in the annular chamber, weighted portions on the flyweights having their outer edges arcuately shaped and of corresponding radius to the inner periphery of the annular chamber, peripheral openings in the annular chamber, ratchet arms on the flyweights adapted for engagement with the pawl and to be moved through the peripheral openings into operative and inoperative positions by said weighted portions, and an adjustable stop fixed to the body-casting for disengaging the pawl and ratchet arms.

17. A magneto having a body-casting, a timing sleeve extending through and beyond the ends of the body-casting, a pawl on the timing sleeve, a driving shaft extending outwardly from said sleeve, a pair of discs fixed to each other and to the driving shaft, an annular chamber between the discs, freely suspended flyweights pivotally mounted in the annular chamber, ratchet arms on the flyweights adapted for engagement with the pawl, oppositely disposed peripheral openings in the annular chamber having their trailing ends formed as supports for the ratchet arms when the same are engaged with the pawl, and an adjustable stop fixed to the body-casting for disengaging the pawl and ratchet arms.

18. A magneto having a timing sleeve extending through it and beyond its opposite ends, a releasable element on the timing sleeve, a coacting element adapted for engagement with the releasable element to partially rotate the timing sleeve in one direction, a timing member adapted independently to partially rotate the timing sleeve in the same direction, and a spring opposing the partial rotation of the timing sleeve by said elements and by the timing member and adapted to rotate said sleeve in the opposite direction.

19. A magneto having a body-casting, a timing sleeve extending through the body-casting and beyond the opposite ends thereof, an interrupter, interrupter cams on one end of the timing sleeve, a pawl on the opposite end of said sleeve, a driving shaft, ratchet members on the driving shaft adapted for engagement with the pawl to partially rotate the timing sleeve in the direction of rotation of said shaft, a timing lever pivoted on the timing sleeve and adapted independently to partially rotate said sleeve in the same direction, a spring on the timing sleeve positioned between movable and fixed abutments and opposing the partial rotation of the timing sleeve by the pawl and ratchet members and by the timing lever and adapted to rotate said sleeve in the reverse direction, and an adjustable stop fixed to the body-casting for disengaging the pawl and ratchet members.

20. A magneto having a body-casting, a timing sleeve extending through the body-casting and beyond the ends thereof, a pawl on the timing sleeve, ratchet members adapted to engage the pawl to rotate the timing

sleeve in one direction, a timing lever on the timing sleeve adapted independently to rotate said sleeve in the same direction, an abutment on the timing lever, a coacting abutment on the timing sleeve, a spring opposing the rotation of the timing sleeve by the pawl and ratchet members and by the timing lever and adapted to rotate the timing sleeve in the reverse direction, and an adjustable stop on the body-casting for disengaging the pawl and ratchet members.

In testimony whereof I affix my signature.

ARTHUR GEORGE LLOYD NEIGHBOUR.