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MEANS FOR STARTING THE ENGINES OF AEROPLANES.

APPLICATION FILED SEPT. 26, 1918.

1,313,693.

Patented Aug. 19, 1919.

4 SHEETS—SHEET 1.

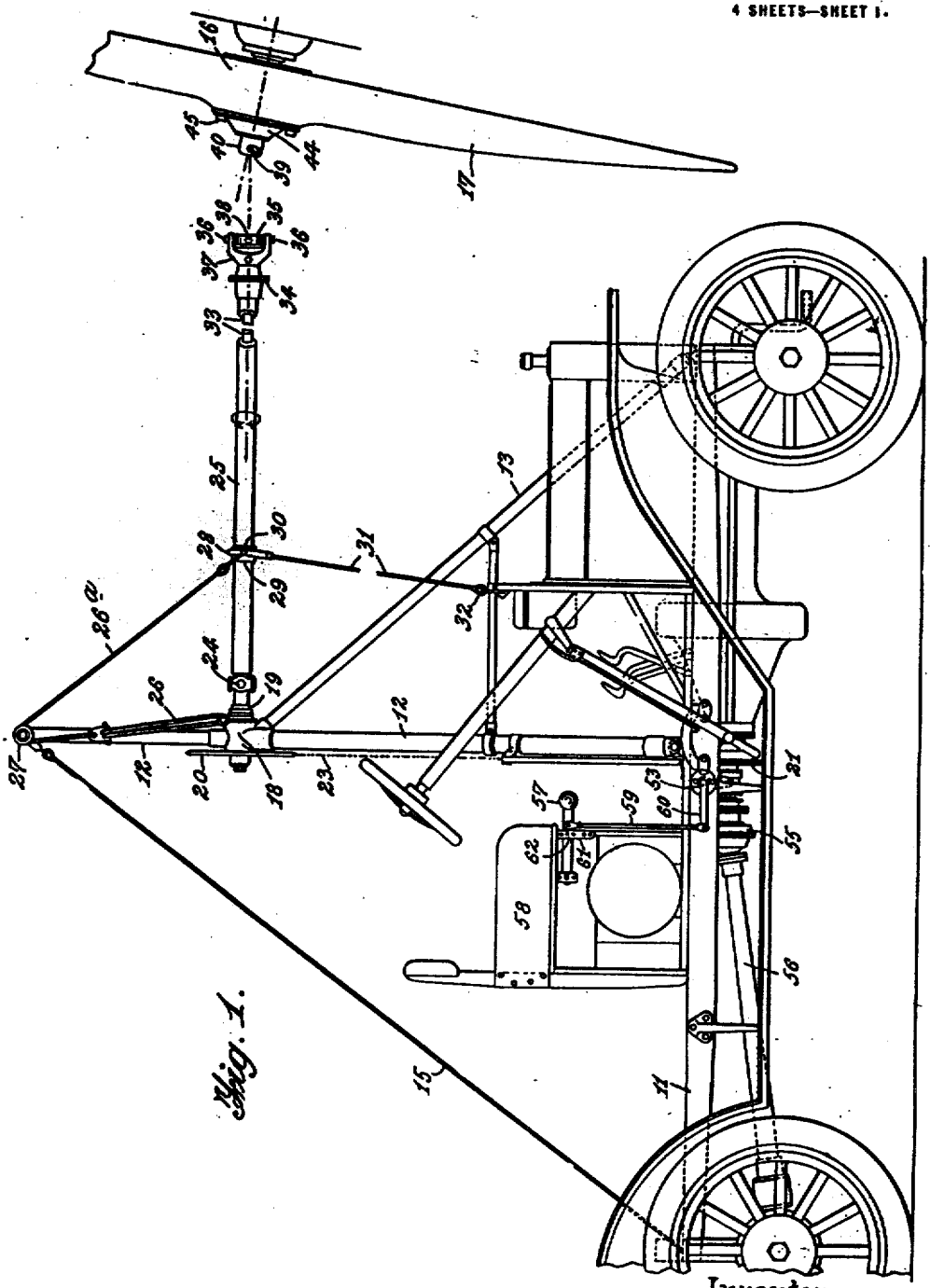


Fig. 1.

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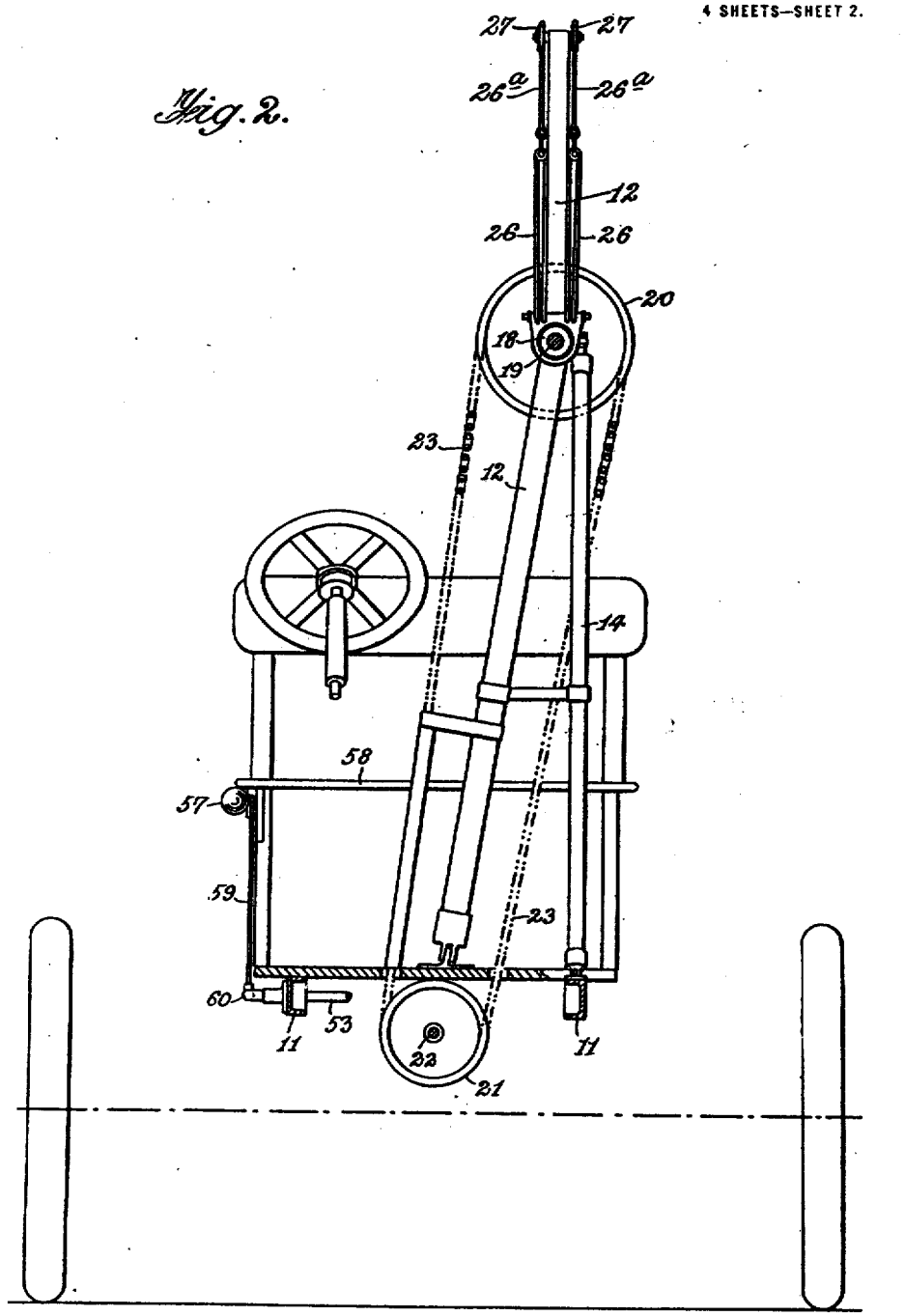
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4 SHEETS—SHEET 2.

Fig. 2.



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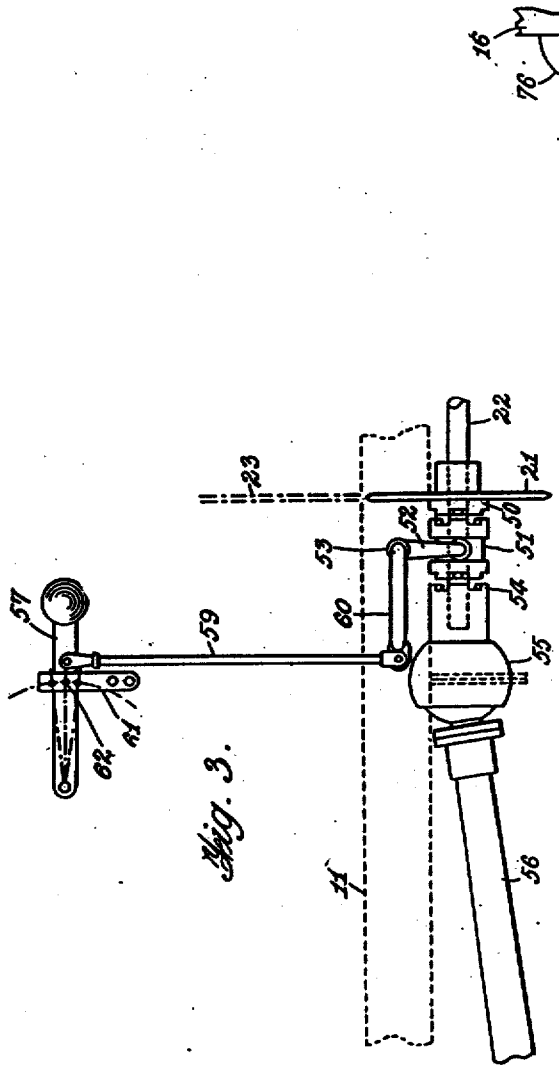


Fig. 3.

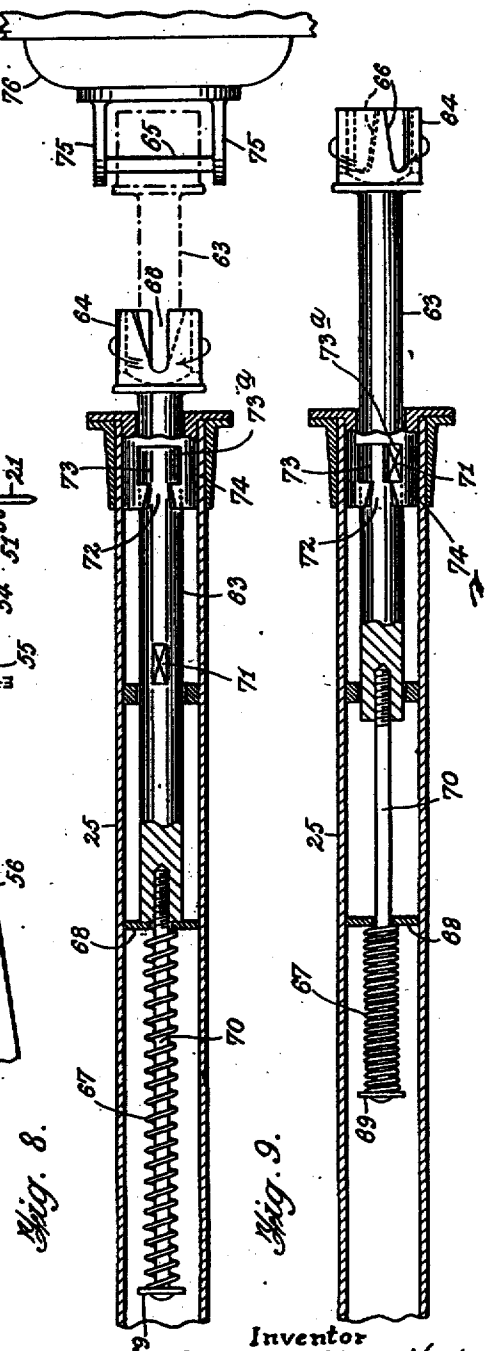


Fig. 8.

Fig. 9.

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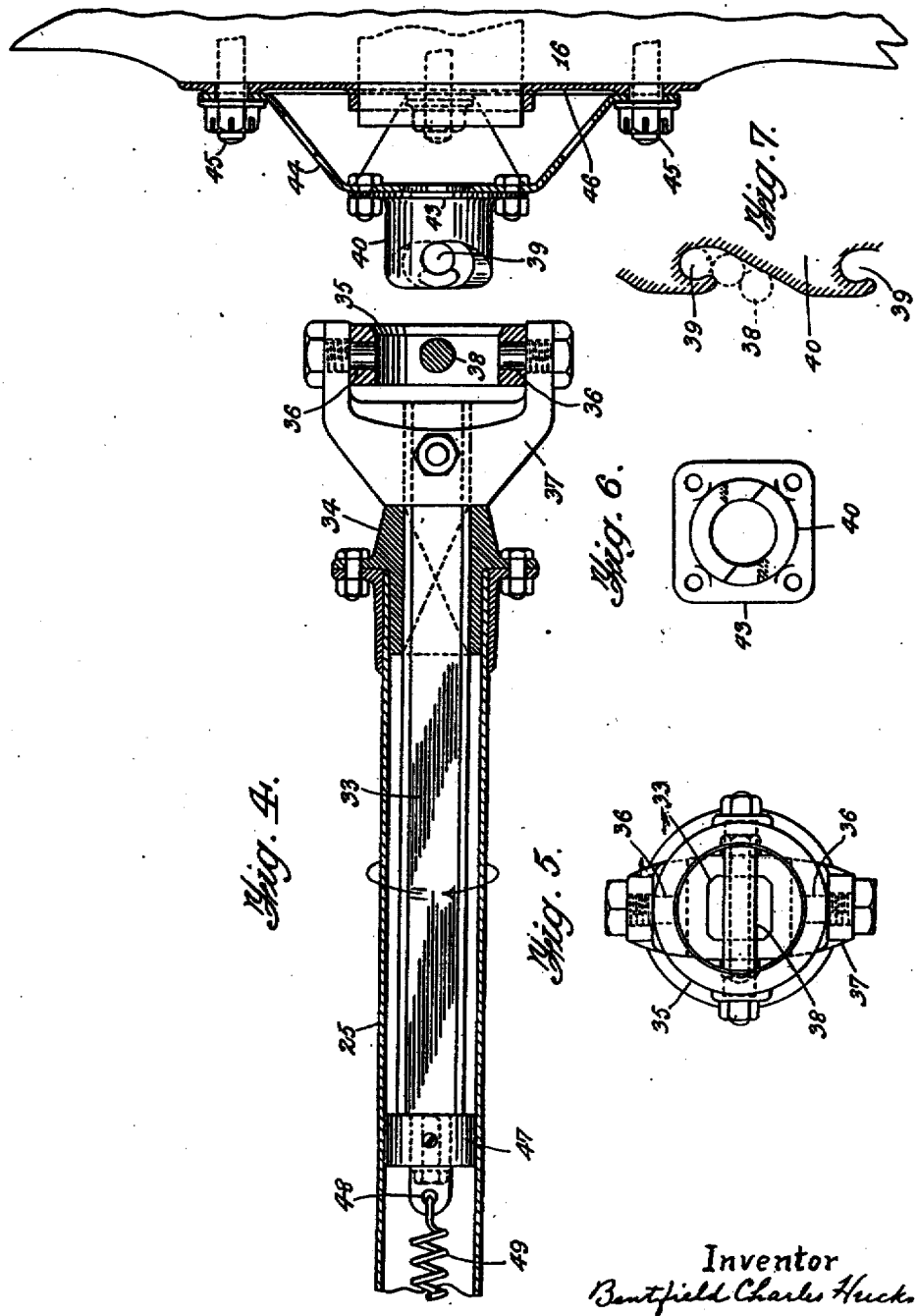


Fig. 4.

Fig. 7.

Fig. 6.

Fig. 5.

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UNITED STATES PATENT OFFICE.

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MEANS FOR STARTING THE ENGINES OF AEROPLANES.

1,313,693. Specification of Letters Patent. Patented Aug. 19, 1919.

Application filed September 26, 1918. Serial No. 255,873.

To all whom it may concern:

Be it known that I, BENTFIELD CHARLES HUCKS, a subject of the King of Great Britain, and resident of 5, Queen's Gate Terrace, London, England, have invented a certain new and useful Improvement in Means for Starting the Engines of Aeroplanes, of which the following is a specification.

This invention relates to a power-driven device for starting the engines of aeroplanes, and has for object to enable the propeller of an aeroplane to be swung, at starting, by power derived from the engine of a motor car.

According to the invention, the motor car employed for the purpose referred to carries, at about the average level of the hub of the propeller of an aeroplane standing on the ground, a substantially horizontal shaft (hereinafter termed the starter-shaft) which at one end is adapted for being geared to the engine-shaft of the car and at the other end is adapted for being clutched to the hub of the propeller; the starter-shaft, which is capable of angular displacement about its point of support on the car and is driven at a speed sufficient for swinging the propeller but less than that of the propeller when the latter is driven by the aeroplane engine, being provided with means whereby, on the aeroplane engine starting under its own power so as to cause the speed of revolution of the propeller to exceed that of the starter-shaft and thus put an end to the effective driving engagement between them, the starter-shaft will be automatically withdrawn from its clutched connection with the propeller hub, with the result that the car will be free to move out of the way of the aeroplane before the latter begins to advance.

In the accompanying drawings, which illustrate a convenient embodiment of the invention, Figure 1 is a part side elevation of a motor car provided with starting mechanism for enabling the propeller of an aeroplane to be swung, a portion of such a propeller being shown adjacent to the motor car. Fig. 2 is a part front elevation of the same motor car, showing the starting mechanism but omitting those portions of the car which are not required for the purpose of explaining the invention. Fig. 3 is a part side elevation (as in Fig. 1) showing the clutch-mechanism for throwing the engine shaft of the motor car into gear, alternatively, with the propeller shaft of the car and with the starter-shaft appertaining to the invention. Fig. 4 is a side elevation, partly in section, showing the outer end of the telescopic starter-shaft and the hub-portion of an aeroplane propeller as illustrated in Fig. 1, the respective clutch-members being disengaged from one another and the telescopic shaft-extension being retracted. Figs. 5 and 6 are face views of the clutch-members on the outer end of the starter-shaft and on the propeller-hub respectively. Fig. 7 shows the periphery of the clutch-member on the propeller hub, developed in the flat. Fig. 8 is a side elevation, partly in section, similar to Fig. 4, showing a modified construction of the parts illustrated in said figure. Fig. 9 is a side elevation, partly in section, showing the telescopic shaft-extension of Fig. 8 in the extended position. Figs. 4 to 9 inclusive are drawn to a larger scale than Figs. 1 and 2.

So far as the general arrangement of the apparatus is concerned, it will be seen on referring to Figs. 1 and 2 that upon the chassis 11 of the motor car is mounted a substantially upright pillar 12 which, in the example illustrated, is held steady by means of struts 13, 14 and a stay 15. At about the average level of the hub 16 of the propeller 17 (Fig. 1) of an aeroplane (the remainder of which is omitted) when standing on the ground, the pillar 12 carries a horizontal bearing 18 wherein is journaled a short shaft 19 extending longitudinally of the car, this shaft 19 having fast upon it a sprocket wheel 20 around which, and around a similar wheel 21 on a continuation 22 of the engine shaft, is passed an endless sprocket-chain 23 for transmitting motion to the shaft 19 as hereinafter explained. The shaft 19 is coupled by a universal joint 24 to the substantially horizontal starter-shaft 25, which constantly tends to rise about the joint 24 owing to the stress of a pair of rubber tension-springs 26 which are attached at one end to the bearing 18 and at the other end to cords 26ª which, passing over guide-pulleys 27 at the top of the pillar 12, are fastened to a ring 28 loosely mounted on the shaft 25 between a pair of collars 29, 30 thereon. Normally (as indicated in Fig. 1) the shaft 25 is held substantially level by

means of a cord 31 fastened to the ring 28 and detachably hooked as at 32 to a fixed part of the car.

The starter-shaft 25 is telescopic, being made tubular and fitted internally with an internal member 33 which is telescopically-extensible for the purpose of enabling a clutch-member on the outer end of the extension to be engaged with a clutch-member on the hub of the aeroplane-propeller; the telescopic shaft-extension 33 constantly tending under spring-action to assume the retracted position.

In the construction illustrated in Figs. 1, and 4 to 7, the shaft-extension 33 is of rectangular shape in cross-section and fitted to slide through a correspondingly shaped aperture in a gland 34 at the outer end of the tubular main portion 25 of the shaft, so that the two portions of the shaft are constrained to revolve together as one, whatever the amount to which the extension 33 may for the time being be drawn out. The shaft-extension 33 carries a gimbal-ring 35 which is rotatable, on a pair of trunnions 36, between the limbs of a fork 37 fixed on the outer end of the extension; the gimbal-ring being spanned diametrically by a cross-pin 38 which is adapted to engage, in one direction of rotation of the shaft 25, 33, with a pair of undercut notches 39 opening out in the front edge of the wall of a clutch-member constituted by a cylindrical fitting 40 fixed concentrically on and projecting forward from the hub-portion 16 of the aeroplane propeller 17 (Fig. 1) with which the starting apparatus is to cooperate. The undercut notches 39 are so formed as to insure not only their easy engagement with the cross-pin 38 before the starting operation is commenced, and the maintenance of a firm driving connection between said cross-pin and the fitting 40 during the starting operation, but also the automatic disengagement of the fitting 40 from the cross-pin 38 as soon as the speed of revolution of the propeller 42 exceeds that of the starter-shaft 25, 33. A suitable form for the notches 39 is indicated in Fig. 7.

It will be obvious that the direction of revolution of the starter-shaft 25, 33, and the direction in which the notches 39 open, must accord with the direction of rotation of the propeller 17.

In the example illustrated in Figs. 1 to 7 inclusive, the notched cylindrical fitting 40 is shown as having a base-flange 43 attached by bolts to the raised central portion of an open spider-frame 44 which is bolted at 45 to the propeller-hub 16 so as to project forward from a plate 46 superposed concentrically on the face of the hub.

The rear end of the shaft-extension 33 carries a collar 47 which is fitted to slide within the tubular main portion 25 of the starter-shaft, this collar having an eye 48 to which is attached one end of a coiled tension-spring 49 the opposite end of which is fixed to a convenient abutment (not shown) situated so far toward the inner end of the shaft 25 as to insure the spring remaining under stress for all positions of the shaft-extension 33.

In operation, assuming the motor car to be drawn up in proper position relatively to the aeroplane whereof the propeller is to be started, the shaft-extension 33 is drawn out from the main portion 25 of the starter-shaft so far as may be necessary in order to permit of the gimbal-mounted cross-pin 38 being engaged with the notches 39 of the fitting 40. The cord 31 having been thereupon cast off from its attachment to the car at 32, the starter-shaft 25, 33 is maneuvered by hand so as to cause the cross-pin 38 to enter the notches 39, and the shaft 25, 33, being then set in motion in the appropriate direction (as hereinafter explained), the propeller 17 is caused to participate in the rotation of the starter-shaft. As soon, however, as the aeroplane engine, starting under its own power, drives the propeller at a speed greater than that of the shaft 25, 33, the notches 39 slip away from the cross-pin 38 with the result that, when the propeller 17 and fitting 40 have advanced through the small angle necessary for bringing the mouths of the notches opposite to the pin, the spring 49 immediately causes the retraction of the shaft-extension 33 within the main portion 25 of the starter-shaft, while at the same time the springs 26 and cords 26^a cause the entire starter-shaft to swing upward clear of the propeller, so that the car is enabled to move out of the path of the aeroplane before the latter begins to travel over the ground on the removal of the usual chocks (not shown) preparatory to the commencement of flight.

In order that the sprocket wheel 21 may receive motion from the shaft 22 when the car is at rest, the wheel 21 is rotatable about the shaft 22 and has formed upon its hub a clutch-member 50 with which one end of a double-ended dog clutch 51 splined upon the shaft can be made to engage by means of a clutch-fork 52 on a transverse shaft 53; the other end of the clutch 51 being adapted for engagement with a clutch-member 54 on one member of the universal joint 55 of the Cardan shaft 56 of the motor car. The clutch 51 is shown in Fig. 3 as in the mid or neutral position wherein it transmits motion from the shaft 22 neither to the Cardan shaft 56 nor to the sprocket wheel 21 so that, while the car remains stationary, the starter-shaft 25 is not actuated. On the clutch 51 being engaged with the clutch-member 50, the sprocket wheel 21 will be caused to revolve (assuming the engine to

be at work) and to drive the shaft 25, leaving the car at rest; but on the clutch 51 being engaged with the clutch-member 54, the Cardan shaft 56 will be caused to revolve so as to propel the car.

The clutch-fork shaft 53 is rocked at will by means of a hand-lever 57, which is mounted in convenient proximity to the driver's seat 58 and coupled by a rod 59 to an arm 60 on the shaft 53. The hand-lever 57 works over a quadrant or equivalent plate 61 to which it can be pinned as at 62 to retain it in either of its positions when necessary.

It is to be observed that the shaft 22, from which motion is transmitted, alternatively, to the Cardan shaft 56 of the motor car or to the starter-shaft 25, is itself driven through usual change-speed and reversing gear (not shown) in the gear-box of the car. Hence the shaft 22, and consequently also the starter-shaft 25 for turning the propeller 17, may be made to revolve at any speed and in either direction, as would be the case if the road wheels of the car were being driven.

This permits the starting device to be used for different aeroplanes, some having propellers revolving in one direction and others in the opposite direction, it being understood that the respective propellers are provided with clutch hubs 40 having notches 39 opening in the proper direction.

Dealing now with the modified construction of starter-shaft and associated clutch-members upon said shaft and upon the propeller-hub respectively, as illustrated in Figs. 8 and 9, it will be observed that, as before, the main portion 25 of the starter-shaft (or shaft proper) is tubular, and has slidable within it an extension 63 on the outer end of which is fixed a clutch-member 64 adapted to engage a corresponding clutch-member on the hub of the propeller; this latter clutch-member consisting of a cross-pin 65 capable of entering into driving-engagement with a pair of diametrically-opposite notches 66 in the cylindrical wall of the clutch-member 64 so as to form in effect a universal joint therewith. The shaft-extension 63 is normally held retracted within the shaft proper 25 (see Fig. 8) by means of a spring 67 coiled in compression between a diaphragm 68 forming a stop to limit the rearward movement of the shaft-extension, and a washer 69 on the rear end of an axial tail-rod 70 fixed to the inner end of the shaft-extension and projecting rearward through a hole in the diaphragm. Within the hollow shaft 25, the shaft-extension 63 carries a key 71 which, when the extension is drawn outward (against the stress of the spring 67) in order that the clutch-member 64 may be engaged with the cross-pin 65, passes through a gate 72 into a recess 73 provided in a sleeve 74 fixed within the shaft 25; the recess 73 being wider than the gate so that, when the key is in the recess, the shaft-extension 63 can be turned about its axis relatively to the shaft proper 25 so far as to enable the key 71 to engage, under the stress of the spring 67, behind the gate 72 and prevent the retraction of the shaft-extension by the spring (see Fig. 9).

In operation, assuming the motor car to be in proper position relatively to the aeroplane which is to be started, the shaft-extension 63 is drawn out until the key 71 has passed through the gate 72 into the recess 73, the key being made to engage, as indicated in Fig. 9, with what may be termed the driving side 73^a of the recess, that is to say, that side which, when the shaft 25, 63 is revolving, presses against the key and thus transmits rotation to the shaft-extension 63. The cord 31 having been cast off from its attachment at 32, the shaft 25 is manœuvered so as to cause the notches 66 in the clutch-member 64 to engage the cross-pin 65. The shaft 25 being set in motion, rotation is transmitted in the direction of the arrows in Figs. 8 and 9 from this shaft to the shaft-extension 63 and thence to the aeroplane propeller, the engagement of the key 71 in the recess 73, and of the notches 66 with the cross-pin 65, continuing as long as the speed of rotation of the shaft 25, 63 exceeds that of the propeller. As soon, however, as the aeroplane engine, starting under its own power, drives the propeller at a speed greater than that of the shaft 25, 63, the engagement of the cross-pin 65 with the notches 66 causes the shaft-extension 63 to rotate faster than the shaft 25, 63 through the small angle necessary for bringing the key 71 opposite to the gate 72, through which the key is immediately retracted by the spring 67 so as to withdraw the notches 66 of the clutch-member 64 out of engagement with the cross-pin 65 and bring the shaft-extension 63 from the position shown in Fig. 9 to that shown in Fig. 8, while at the same time the shaft 25, 63, being freed to the action of the springs 26, swings upward clear of the propeller, so that the car is enabled to move out of the path of the aeroplane before the latter begins to travel over the ground on the removal of the usual chocks.

In the example illustrated, the cross-pin 65 extends between the jaws 75 of a bifurcated bracket 76 fixed concentrically on the front of the hub 16 of the aeroplane propeller.

By the use of the invention, the engines of any number of aeroplanes drawn up on an aerodrome can be readily started in quick succession by means of a single motor car, which can be run from one aeroplane to another as required.

What is claimed is:—

1. The combination with a motor car, of a power-driven device for starting the engines of aeroplanes, comprising a substantially horizontal shaft capable of angular displacement about its point of support on the car and adapted at one end for being geared to the engine-shaft of the car and at the other end for being detachably clutched to the hub of the aeroplane propeller, substantially as set forth.

2. The combination with a motor car of a power-driven device for starting the engines of aeroplanes, comprising an upright pillar fixed to the chassis of the motor car, a substantially horizontal bearing carried by said pillar, a short shaft journaled in said bearing, sprocket wheels respectively on said shaft and on a shaft driven by the motor car engine and connected by an endless sprocket chain, a substantially horizontal shaft coupled to said short shaft by a universal joint, a clutch-member fast on the outer end of said substantially horizontal shaft and adapted for being detachably engaged with a clutch-member on the hub of the aeroplane propeller, and a spring tending to move said substantially horizontal shaft out of its normal horizontal position, substantially as set forth.

3. The combination with a motor car, of a power-driven device for starting the engines of aeroplanes, comprising an angularly movable shaft normally substantially horizontal, adapted at one end for being geared to the engine shaft of the car and at the other end for being detachably clutched to the hub of the aeroplane propeller, means mounted on the chassis of the car for supporting said shaft and spring connections between said supporting means and the shaft tending to move said shaft out of its normal horizontal position, substantially as set forth.

4. The combination with a motor car, of a power-driven device for starting the engines of aeroplanes, comprising an angularly movable shaft normally substantially horizontal, adapted at one end for being geared to the engine shaft of the car and at the other end for being detachably clutched to the hub of the aeroplane propeller, means mounted on the chassis of the car for supporting said shaft, spring connections between said supporting means and the shaft tending to move said shaft out of its normal horizontal position, and a releasable member for holding said shaft substantially horizontal against the action of said spring, substantially as set forth.

5. The combination with a motor car, of a power-driven device for starting the engines of aeroplanes, comprising an angularly movable shaft adapted at one end for being geared to the engine shaft of the car, the other end of said shaft being provided with a telescopic extension thereof carrying a clutch member adapted to be detachably clutched to the hub of the aeroplane propeller, substantially as set forth.

6. The combination with a motor car, of a power-driven device for starting the engines of aeroplanes, comprising an angularly movable shaft adapted at one end for being geared to the engine shaft of the car, the other end of said shaft being provided with a telescopic extension thereof carrying a clutch member adapted to be detachably clutched to the hub of the aeroplane propeller, and a spring connecting the shaft and said telescopic extension tending at all times to retract the latter, substantially as set forth.

7. The combination with a motor car, of a power-driven device for starting the engines of aeroplanes, comprising an angularly movable shaft adapted at one end for being geared to the engine shaft of the car, the other end of said shaft being provided with a telescopic extension thereof carrying a clutch member adapted to be detachably clutched to the hub of the aeroplane propeller, and means for connecting the shaft and telescopic extension for rotation in unison, substantially as set forth.

8. The combination with a motor car, of a power-driven device for starting the engines of aeroplanes, comprising an angularly movable shaft adapted at one end for being geared to the engine shaft of the car, the other end of said shaft being provided with a telescopic extension thereof carrying a clutch member adapted to be detachably clutched to the hub of the aeroplane propeller, a spring connecting the shaft and said telescopic extension tending at all times to retract the latter, and means adapted to automatically detach the clutch from said hub and permit the retraction of said extension by said spring when the speed of revolution of the propeller exceeds that of said shaft and telescopic extension, substantially as set forth.

9. The combination with a motor car provided with a Cardan shaft adapted to be connected with the engine for driving the car, of a power-driven device for starting the engines of aeroplanes, comprising an angularly movable shaft mounted above the chassis of the car, adapted at one end to be detachably connected with the hub of the aeroplane propeller and a manually controlled clutch for connecting the engine to drive, alternatively at will, said Cardan shaft and said angularly movable shaft, substantially as described.

10. The combination with a motor car, of a power-driven device for starting the engines of aeroplanes, comprising an angularly movable shaft supported on the car and adapted at one end to be geared to the

engine shaft of the car and provided, at the other end with a telescopic shaft extension, and a clutch member consisting of a cross-pin extending diametrically of a ring mounted in gimbal-bearings on the outer end of said shaft extension, adapted to coöperate with a clutch member carried by the propeller hub, consisting of a cylindrical fitting having undercut notches for engaging said pin, whereby said clutch members may become automatically disengaged when the speed of the propeller exceeds that of said shaft, substantially as described.

11. The combination with a motor car, of a power-driven device for starting the engines of aeroplanes, comprising an angularly movable shaft supported on the car and adapted at one end to be geared to the engine shaft of the car and provided, at the other end with a telescopic shaft extension, a clutch member consisting of a cross-pin extending diametrically of a ring mounted in gimbal-bearings on the outer end of said shaft extension, adapted to coöperate with a clutch member carried by the propeller hub, consisting of a cylindrical fitting having undercut notches for engaging said pin, whereby said clutch members may become automatically disengaged when the speed of the propeller exceeds that of said shaft, and spring means tending to and adapted for swinging said shaft angularly about its support when said clutch members are thus disengaged, substantially as described.

12. The combination with a motor car, of a power-driven device for starting the engines of aeroplanes, comprising an angularly movable shaft supported on the car and adapted at one end to be geared to the engine shaft of the car and provided, at the other end with a telescopic shaft extension, a spring for retracting said telescopic extension, a key and latch connection between said shaft and the telescopic extension adapted for holding said telescopic extension fully extended and to prevent rotation thereof relative to said shaft and a clutch member on the end of said telescopic extension adapted to be detachably connected with the hub of the propeller for starting the aeroplane engine, said key and latch being adapted to be automatically disengaged and the telescopic extension withdrawn by said spring when the speed of the propeller exceeds that of said shaft, substantially as described.

13. In a power-driven device for starting the engines of aeroplanes, the combination with a motor mounted exteriorly of the aeroplane, of an angularly movable shaft adapted at one end to be geared to said motor and at the other end provided with a clutch member adapted for coöperation with a clutch member secured to the hub of the aeroplane propeller said clutch members being adapted to maintain engagement when said shaft is rotated by the motor for turning the propeller and starting the aeroplane engine and to become disengaged automatically when the speed of the propeller exceeds that of said shaft, substantially as described.

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