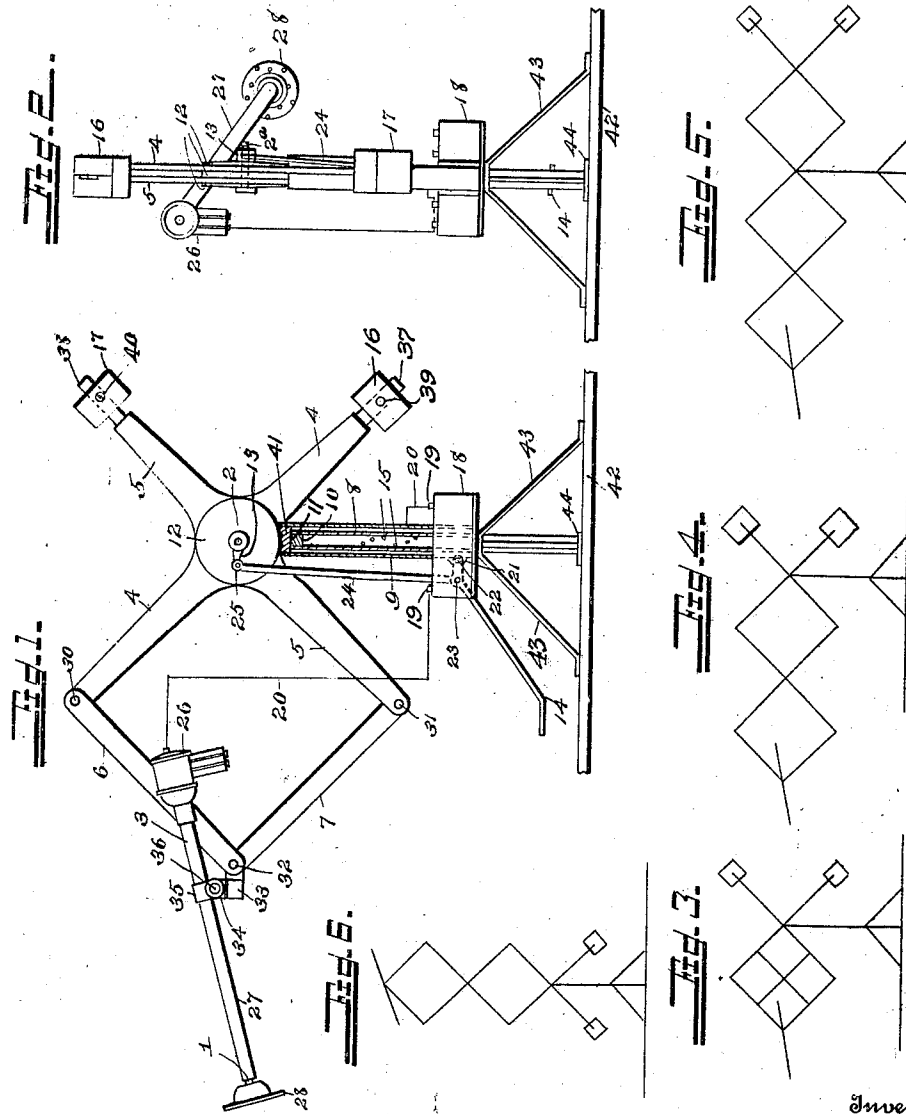


A. C. FOULK,
FLEXIBLE BALANCED SUPPORT.
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FLEXIBLE BALANCED SUPPORT.

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To all whom it may concern:

Be it known that I, ALBERT C. FOULK, a citizen of the United States, residing at Holton, in the county of Jackson and State of Kansas, have invented certain new and useful Improvements in Flexible Balanced Supports, of which the following is a specification.

This invention relates in general to flexible supports and more particularly to such a device as will be suitable for use in connection with field engine starters, heavy implements, tools, guns or any other objects requiring frequent adjustment of location and attitude.

It is proposed to provide a flexible support which will be capable of the greatest range of adjustment in all planes. This feature is of great advantage over the conventional telescopic supports as their range of adjustment is necessarily limited by their construction.

It is further proposed to provide the balancing arms of the support with counterbalancing weights and also to provide conveniently operated locking mechanism for retaining the support in any desired position.

While this invention may be of use in conjunction with numerous devices as enumerated above, it is especially adapted for use in connection with portable field engine starters by reason of its range of adjustment, simple and conveniently operated locking and releasing mechanism, and also the stability of the support when in operation.

It will be readily realized that these features are most essential in the proper functioning of a portable starter for airplane engines, when it is taken into consideration that the driving shaft of the engine starter must be substantially in alignment with the hub of the propeller, as any material differentiating therebetween will practically prevent the proper connection of the starter driving plate with the propeller hub plate. With the proposed construction, it will be possible to engage propellers of different heights with a minimum amount of adjustment of the starter support between such operations.

With the foregoing and other objects in view, which will appear as the description proceeds, the present invention resides in the

combination of parts and in the details of construction herein described, it being understood that changes therein may be made without departing from the spirit of the invention hereinafter described and claimed, the precise embodiment thereof being illustrated in the accompanying drawings in which:

Figure 1 is a side view partly in section of the flexible support as applied to the field engine starter, showing the electrical motor driving shaft and plate, and the locking means for the support.

Figure 2 is a view in rear elevation of same.

Figure 3 is a diagrammatic illustration of a modification of the lever system shown in Figure 1.

Figure 4 is another modification of same.

Figure 5 is a still further modification of same.

Figure 6 is a diagrammatical illustration of the support so adjusted as to assume a vertical attitude.

Referring more particularly to the construction shown in Figures 1 and 2, the two levers 4 and 5 arranged about shaft 2 are connected by links 6 and 7, converging and connected at 32, such connection forming the supporting means for bracket 33, receiving a rotatable member 34, pivotally connected at 36 to a bracket 35 adapted to engage and support the torque tube 27 and the engine starter shaft 1 mounted therein. On one end of the shaft 1 is mounted by suitable connecting means a driving plate 28 adapted to, in case of use for cranking propellers, fit securely the nuts on the propeller hub plate as will be clearly understood by those skilled in the art.

The free ends of the levers 4 and 5 are provided with weights 16 and 17 arranged around the reduced ends 37 and 38 of the levers 4 and 5 and adjustable by means of set screws 39 and 40 respectively, for the purpose of counterbalancing the flexible support system and also to provide means of adjustment of same.

A hollow supporting tube 8 is connected by suitable means 44 at the platform 42 and braced by the members 43. Arranged around said tube 8 is a hollow rotatable tube 9 provided with an internal bearing block 41 adapted to bear against, during rotation, the block 10 in the upper extremity of the

supporting tube 8. Fixedly attached to the rotatable tube 9 is a suitable battery 18 provided with terminals 19 and a system of electrical conductors or wires 20 extending therefrom to the electric starting or cranking motor 26.

Arranged on either side of and intermediate of levers 4 and 5 are circular plates 12, three in number. The middle plate is integral with the outer tube, the root forming a part of the filler block or bearing block. This middle disc supports the shaft 2, which in turn supports the levers. The shaft 2 is threaded at 2^a on which threaded portion fits a correspondingly threaded portion of lever 13 and is loosely keyed to the middle disc to prevent the shaft turning with the lever but still allowing longitudinal movement of the small shaft 2. As shown in Figure 2, a locking lever 13 is mounted on the shaft 2 in screw-threaded relation with the threads 2^a of shaft 2. The locking lever 13 is connected at 25 to a vertically extending rod 24 connected at 23 to an extension of the locking pedal 14, which extension is pivotally connected at 22 to the bracket 21 integral with the rotatable tube or sleeve 9.

In order to secure travel of the operating unit 1 to the left or right, the unit is pushed accordingly in that direction and the levers and links fold together approaching a single horizontal or vertical line as the case may be as with the usual pantagraph or lazy-tongs. To secure rotative travel perpendicular to the plane of Figure 1 movement of the unit 1 rotates the system about the pivot 11. To secure vertical adjustment, an upward or downward movement of the unit 1 revolves the flexible support system about the shaft 2. Vertical or horizontal alignment of the unit 1 is secured by means of the two-way joints between the brackets 33 and 35, it being understood that such joints may be supplanted by a suitable universal joint if deemed advisable in actual operation.

The flexible support system may be locked in position and thus prevent the possibility of a vertical rotation and folding of the levers or links by applying downward pressure on the locking pedal 14. This action, by means of the rod 24, causes the locking lever 13 to rotate on the screw threads 2^a and shaft 2 in such a direction that the member 13 will draw therefor the clamping discs 12 toward each other and cause the latter to clamp against levers 4 and 5, thus preventing their rotation and consequent folding. In order to prevent horizontal rotation of the system, apertures 15 may be arranged in the tubes 8 and 9 in alignment to receive suitable locking pins or the like and thus prevent movement of the one with relation to the other.

The flexible support system, as a whole, is in static balance under all conditions, the

original balance being secured by varying or adjusting the weights 16 and 17 on the levers 4 and 5.

The battery 18 and the foot lever 14 rotate with the system by means of their fixed attachment to the rotatable outer sleeve 9. This obviates in a great degree the possibility of entanglement of the wires 20 extending to the electric starting or cranking motor 26, which is mounted on the end of the torque tube 27 at 3 and is directly in connection with the starting motor drive shaft 1.

It will be clearly seen that there is thus provided a flexible support system capable of the widest range of adjustment in all planes, one which will be stable and in static balance, and one which will be easily locked in any position or released therefrom for further adjustment, said system being adaptable for various uses. It will also be seen that the present support system is especially advantageous for the particular use for which it is shown in the accompanying illustrations, viz., that of supporting a portable starter for aeronautical engines mounted in aircraft.

It is also recognized that it is possible to use many different systems of levers other than those shown in Figures 1 and 2 and it is therefore desired that the scope of this invention be interpreted in sufficiently broad terms to allow me to employ such systems as shown in the remaining figures of the attached illustrations, as well as other similar systems as may occur to me in the actual operation of my invention.

Having thus described my invention, I claim:

1. In a flexible supporting system comprising a system of interconnected counter-balanced levers and links, means for attaching the object to be supported, means for adjusting said levers and links of said supporting system in all planes, means for locking said system in any position and releasing same therefrom, and means for permitting movement of the object to be supported, in any plane with relation to the supporting system.

2. A flexible supporting system comprising a plurality of levers mounted at their centers on a common shaft, a rotatable sleeve surrounding a hollow cylindrical stationary member for supporting said shaft, clamping discs mounted on said shaft on either side of and intermediate of said levers, a clamping lever screw-threaded on said shaft adapted to compress said clamping discs for the purpose of preventing rotation of the levers about said shaft.

3. A flexible supporting system comprising a plurality of levers mounted at their centers on a common shaft, a rotatable sleeve surrounding a hollow cylindrical stationary member for supporting said shaft, clamping discs mounted on said shaft on either side of

and intermediate of said levers, a clamping lever screw-threaded on said shaft, and adapted to compress said clamping discs for the purpose of preventing rotation of the levers about said shaft, means for operating said clamping lever comprising a foot lever pivotally mounted on and rotatable with said outer sleeve, apertures extending through said outer sleeve and said stationary cylindrical member for receiving a locking pin or the like for the purpose of preventing rotation of said outer sleeve.

4. A flexible supporting system comprising a plurality of levers mounted at their centers on a common shaft, a rotatable sleeve surrounding a hollow cylindrical stationary member for supporting said shaft, clamping discs mounted on said shaft on either side of and intermediate of said levers, a clamping lever screw-threaded on said shaft adapted to compress said clamping discs for the purpose of preventing rotation of the levers about said shaft, counterbalancing weights adjustably mounted on one end of each of said levers, and a plurality of links arranged on the outer ends of said levers, means for carrying the object to be supported, said means being arranged at the outer point of convergence of said links and capable of rotation in any plane.

5. A flexible supporting system comprising a plurality of levers mounted at their centers on a common shaft, a rotatable sleeve surrounding a hollow cylindrical stationary member for supporting said shaft, clamping discs mounted on said shaft on either side of and intermediate of said levers, a clamping lever screw-threaded on said shaft and adapted to compress said clamping discs for the purpose of preventing rotation of the levers about said shaft, means for operating said clamping lever comprising a foot lever pivotally mounted on and rotatable with said outer sleeve, apertures extending through said outer sleeve and said stationary cylindrical member for receiving a locking pin or the like for the purpose of preventing rotation of the said outer sleeve, counterbalancing weights adjustably mounted on one end of each of said levers, and a plurality of links arranged on the outer ends of said levers, means for carrying the object to be supported, said means being arranged at the outer point of convergence of said links and capable of rotation in any plane.

6. In a device for supporting an electric motor, a flexible supporting system comprising a plurality of levers mounted at their centers on a common shaft, a rotatable sleeve surrounding a hollow cylindrical stationary member for supporting said shaft, clamping discs mounted on said shaft on either side of and intermediate of said levers, a clamping lever screw-threaded on said shaft adapted to compress said clamping discs for the pur-

pose of preventing rotation of the levers about said shaft, means for operating said clamping lever comprising a foot lever pivotally mounted on and rotatable with said outer sleeve, an electric battery also securely mounted on said outer sleeve, and rotatable therewith, means for supporting the conducting wires between said battery and said motor.

7. In an apparatus for starting the engine of an airplane, an engine starting motor, a driving plate, a driving shaft between said plate and said starting motor, a flexible supporting system for said starting motor comprising a system of interconnected counterbalanced levers and links, means for attaching the starting motor, means for adjusting the levers and links of said supporting system in all planes, means for locking said system in any position, and means for permitting movement of the starting motor in any plane with relation to the supporting system.

8. In an apparatus for starting the engine of an airplane, an engine starting motor, a driving plate, a driving shaft between said plate and said starting motor, a flexible supporting system for said starting motor comprising a plurality of levers mounted at their centers on a common shaft, a rotatable sleeve surrounding a hollow cylindrical stationary member for supporting said shaft, clamping discs mounted on said shaft on either side of and intermediate of said levers, a clamping lever screw-threaded on said shaft and adapted to compress said clamping discs for the purpose of preventing rotation of the levers about said shaft.

9. In an apparatus for starting the engine of an airplane, an engine starting motor, a driving plate, a driving shaft between said plate and said starting motor, a flexible supporting system for said starting motor comprising a plurality of levers mounted at their centers on a common shaft, a rotatable sleeve surrounding a hollow cylindrical stationary member for supporting said shaft, clamping discs mounted on said shaft on either side of and intermediate of said levers, a clamping lever screw-threaded on said shaft and adapted to compress said clamping discs for the purpose of preventing rotation of the levers about said shaft, means for operating said clamping lever, said means comprising a foot lever pivotally mounted on and rotatable with said outer sleeve, apertures extending through said outer sleeve, and said stationary cylindrical member for receiving a locking pin or the like, for the purpose of preventing rotation of said outer sleeve.

10. In an apparatus for starting the engine of an airplane, an engine starting motor, a driving plate, a driving shaft between said plate and said starting motor, a flexible supporting system for said starting motor com-

prising a plurality of levers mounted at their centers on a common shaft, a rotatable sleeve surrounding a hollow cylindrical stationary member for supporting said shaft, 5 clamping discs mounted on said shaft on either side of and intermediate of said levers, a clamping lever screw-threaded on said shaft and adapted to compress said clamping discs for the purpose of preventing rotation 10 of the levers about said shaft, counterbalancing weights adjustably mounted on one end of each of said levers, and a plurality of links arranged on the other ends of said levers, means for carrying the object to be 15 supported, said means being arranged at the outer point of convergence of said links, and capable of rotation in any plane.

11. In a portable apparatus for starting the engine of an airplane, an engine starting 20 motor and a driving plate, a driving shaft connected to said engine starting motor, and adapted to rotate said driving plate, a torque tube surrounding said driving shaft, a flexible supporting system for said starting 25 motor comprising a plurality of levers mounted at their centers on a common shaft, a rotatable sleeve surrounding a hollow cylindrical stationary member for supporting said shaft, clamping discs mounted on said 30 shaft on either side of and intermediate of

said levers, a clamping lever screw-threaded on said shaft and adapted to compress said clamping discs for the purpose of preventing rotation of the levers about said shaft, counterbalancing weights adjustably mounted on one end of each of said levers, and 35 plurality of links arranged on the other ends of said levers, means for carrying the engine starter, said means being arranged at the outer point of convergence of said links, and 40 capable of rotation in any plane, and comprising a bracket fixed to said torque tube, a second bracket at the point of convergence of said links, a rotatable member in said second bracket pivotally connected to the 45 first named bracket.

12. A supporting structure comprising a system of interconnected levers capable of being contracted or expanded with relation to a state of parallelism therebetween, and 50 also capable of rotation or movement in any plane for the purpose of horizontal or vertical adjustment, said levers being counterbalanced to produce a static balance at all times, and means for locking said levers in 55 any position and releasing same therefrom.

In testimony whereof I have affixed my signature.

ALBERT C. FOULK.