June 10, 1958 J. BORTFELDT 2,837,864

TOY AEROPLANE

Filed July 19, 1956 2 Sheets-Sheet 1

Fig 1

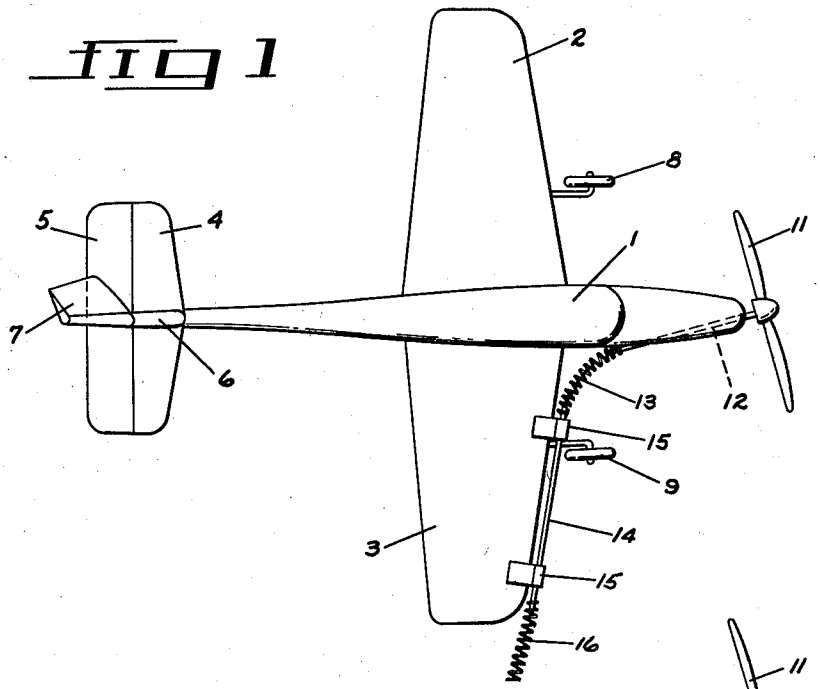


Fig 2

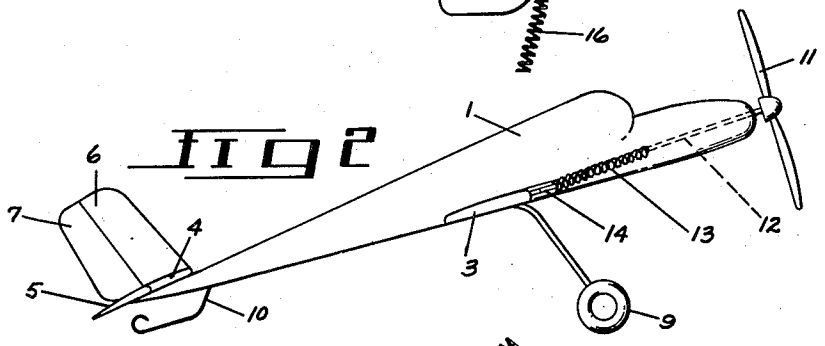
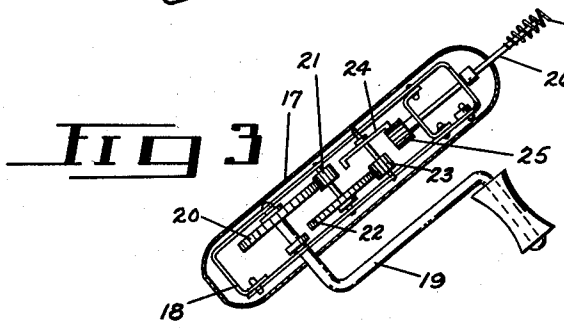


Fig 3



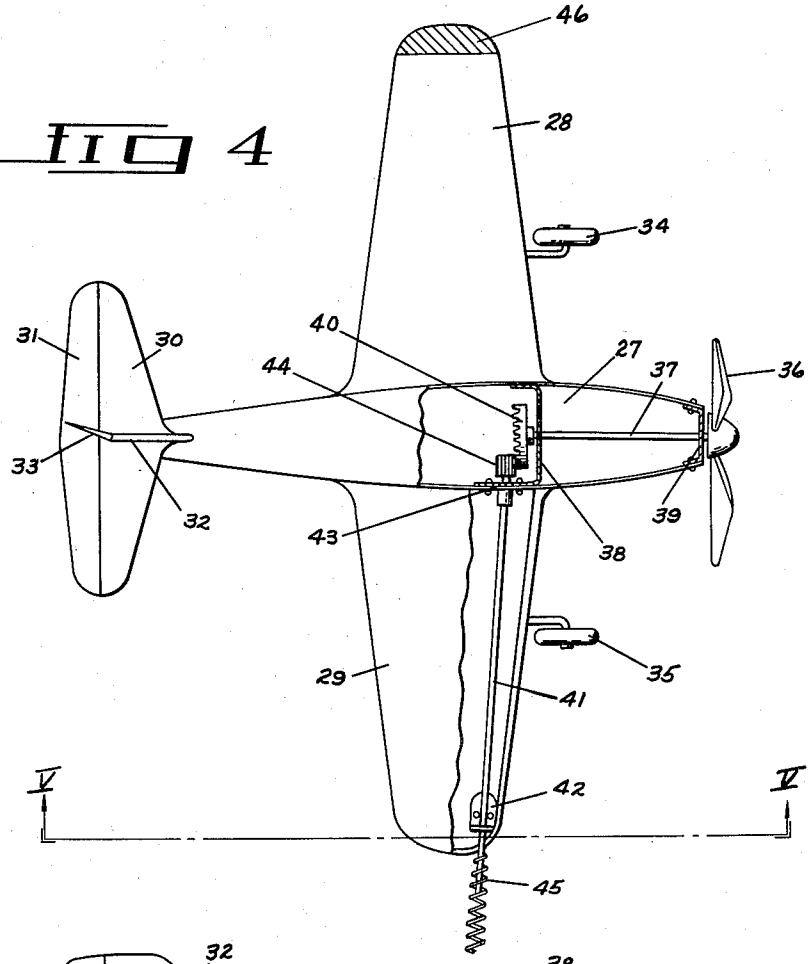
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Fig 4



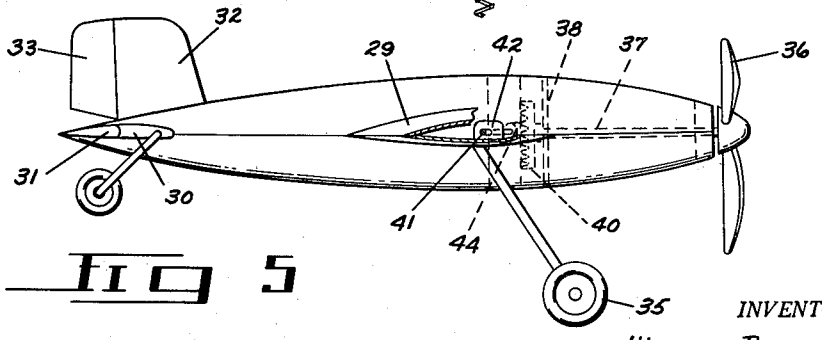


Fig 5

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United States Patent Office 2,837,864 Patented June 10, 1958

2,837,864

TOY AEROPLANE

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Application July 19, 1956, Serial No. 598,777

Claims priority, application Germany December 23, 1952

2 Claims. (Cl. 46—77)

The present invention relates to toys and, more specifically, concerns a captive toy aeroplane which has associated therewith a device to be held by the hand of the playing child and a flexible shaft interconnecting said device and the toy aeroplane, while said device is operable to convey driving forces through said flexible shaft to said propeller.

This application is a continuation-in-part application of my co-pending application Serial Number 398,170 filed December 14, 1953, now abandoned.

A toy airplane of this type is known in which the flexible shaft is introduced into the fuselage from below and in a tiltable manner. This arrangement, however, results in an insufficient flying stability. Furthermore, in order to avoid twisting of the drive shaft, a drive shaft has to be employed which is stiffened by means of a cover. However, by such an arrangement, the drive shaft becomes too heavy for the purpose involved.

It is, therefore, an object of the present invention to provide a captive toy aeroplane which will overcome the above mentioned drawbacks.

It is another object of this invention to provide a captive toy aeroplane which is characterized by a great flying stability.

Still another object of this invention consists in the provision of a toy aeroplane which will avoid accidental twisting of the drive shaft leading to said aeroplane.

A still further object of this invention consists in the provision of a toy aeroplane which will be adapted to start from the ground.

These and other objects and advantages of the invention will appear more clearly from the following specification in connection with the accompanying drawings in which:

Fig. 1 illustrates a top view of a toy aeroplane according to the invention with direct drive of the propeller by a flexible drive shaft.

Fig. 2 is a side view of the toy shown in Fig. 1.

Fig. 3 is a partial section through a manually operable driving device for a toy aeroplane according to the invention.

Fig. 4 illustrates a top view of a further embodiment of a toy aeroplane according to the invention which is provided with a step down transmission between the drive shaft and the propeller.

Fig. 5 is a side view of Fig. 4.

General arrangement

According to one of the primary features of the present invention, the flexible shaft for conveying the driving forces to a captive toy aeroplane of the above mentioned type is introduced into the aeroplane from the side thereof in the neighborhood of the center of gravity of the plane; according to a particularly favorable embodiment of the invention, this can be effected in such a manner that the flexible drive shaft enters the aeroplane or is passed to the aeroplane approximately at the end of a wing. According to a further important feature of

the invention, the flexible drive shaft consists of a twist resistant wire or the like. A drive shaft of a pulled-out helical spring has proved particularly advantageous in this connection. The drive wire making up said drive shaft preferably consists of hard steel wire.

Tests have proved that with the design of the drive shaft according to the present invention, the drive shaft may have a length up to and more than 21 yards. In view of its low weight, the wire is carried by the aeroplane without any difficulties.

In order to convey the necessary driving power through the transmission shaft to the propeller and thereby the toy aeroplane, a strong torque is required which, however, has the undesired effect that the driving wire or flexible driving shaft will tend to form loops. This is particularly the case when the toy aeroplane is to be started because in such an instance there are no centrifugal or air forces present which can act upon the toy aeroplane in the direction of the flexible drive shaft.

Applicant has realized that in order to design a remotely driven toy aeroplane which may be airborne it is necessary from the very start to produce a considerable air force which will hold the flexible shaft in stretched out condition. To this end, the intermediate transmission shaft between the propeller shaft and the flexible power conveying shaft is arranged in such a manner that said intermediate shaft forms an acute angle with the transverse axis of the aeroplane, or expressed in a different manner, the said intermediate shaft forms with the longitudinal axis of said plane an obtuse angle toward the front portion of the plane. In this way the propeller exerts not only a forward drive but also exerts a strong pull upon the drive shaft so that the toy aeroplane can start without forming loops.

While it is also possible by adjustment of the side rudder or by setting the propeller shaft at an angle to obtain an additional outwardly directed air force, these last mentioned two steps are not as favorable as the inclination of the intermediate shaft between the propeller shaft and the flexible drive shaft.

Due to the fact that the drive shaft is arranged on one side of the fuselage, especially at the end of a wing, a torque is exerted upon the plane which has the tendency to turn the plane by a certain angle about its longitudinal axis. In order to avoid that due to the said torque the plane will assume a right or left wing low attitude, the plane may be provided with means which will either partly or entirely counteract or compensate said torque.

The danger of twisting of the drive shaft can be further decreased by maintaining the torque to be conveyed through the drive shaft as small as possible. Therefore, it is advisable with a given driving power to employ a propeller with a high speed of rotation and a relatively small diameter while a relatively small pitch is to be selected. The torque to be absorbed by the drive shaft is particularly small if the speed of rotation of said drive shaft is likewise rather high. According to the present invention, it is suggested to select the speed of rotation of the drive shaft at least equal or higher than the speed of the propeller. If the propeller and the drive shaft are driven at the same speed of rotation, the most simple arrangement consists in connecting the propeller directly with the drive shaft without intermediate transmission. If, however, the speed of rotation of the drive shaft is to be higher than that of the propeller, a corresponding transmission is provided which may be arranged in the hollow fuselage. For driving the flexible shaft, there may, according to an extremely simple solution, be provided a transmission arranged in a casing and provided with a crank. In this instance it has proved particularly advantageous to select the transmission approximately

within the limits of 1:50 to 1:80. Instead of the manually operable crank, there may, of course, also be provided a spring operated device or electric motor for driving the flexible shaft.

Structural arrangement

Referring now to the drawings in detail, and more particularly, to Figs. 1 and 2, the toy aeroplane illustrated therein may consist of a light but nevertheless resistant material such as wood or any other appropriate material. The model plane consists primarily of a fuselage **1** having connected thereto the wings **2** and **3** as well as the tail plane **4**, the elevator **5**, the tail fin **6** and the side rudder **7**. The elevator **5**, side rudder **7** and also the fins **4** and **6** may consist of a flexible material as for instance sheet metal, so that their position can be adjusted. Below the wings **2** and **3**, there are the two wheels **8** and **9** with respective struts, making up the landing gear. Below the tail unit there is a resilient tail skid **10**. The propeller **11** is arranged at the nose of the fuselage **1**. The propeller shaft **12** is easily rotatably journalled in the fuselage **1** and is directed outwardly by an angle of approximately 10 degrees. The propeller shaft **12** is connected with a shaft **14** through the intervention of a flexible shaft portion **13** which consists of a spiral spring. The shaft **14** is easily rotatably journalled at the leading edge of the right hand wing **3** by means of the bearing **15**. The shaft **14** has an angle of inclination of approximately 5 degrees with regard to the transverse axis of the toy aeroplane. However, this angle of inclination is not limited to approximately 5 degrees but may effectively vary from 3 to 10 degrees. One end of the drive shaft **16** is drivingly connected with the shaft **14**, while the other end of said drive shaft **16** is drivingly connected with a driving mechanism which will be explained later. It should be noted that the side rudder is greatly turned outwardly.

Referring now to the driving mechanism illustrated in Fig. 3, this mechanism consists primarily of a casing **17**, housing a transmission. In the transmission frame **18** there is journalled a strong crank **19**, the rotational movements of which are conveyed through gears **20**, **21**, **22** and **23** to a crown wheel **24** and from the latter to a driving pinion **25**. The shaft **26** of the drive pinion **25** is connected with the flexible drive shaft **16**.

Operation

The operation of the toy aeroplane according to the invention is extremely simple as will presently appear. The toy plane is placed on a fairly even surface while care is taken that the flexible shaft **16** is held straight between the toy plane and the driving device held by the hand of the playing child. If now the crank **19** is rotated, a strong rotational movement is conveyed to the propeller through the intervention of the flexible shaft **16** so that the toy plane starts moving and after a short take-off roll, becomes airborne. Due to the inclined position of the shaft **14**, the propeller and the side rudder, an aerodynamic force is produced which holds the flexible drive shaft in stretched-out position. The maximum altitude of the model plane depends on the length of the flexible drive shaft, which may amount to 21 yards and more. The respective altitude can be adjusted by the speed of rotation of the propeller. With increasing speed of the crank, the toy plane flies and with decreasing speed of the crank the toy plane descends.

If the playing child remains at one and the same spot, the model plane describes a circular path as a result of which the occurring centrifugal force will aid the outwardly directed aerodynamic force in its tendency to maintain the drive shaft **16** in stretched-out position. It is, of course, also possible to drive the toy plane from a moving point, as, for instance, from a vehicle, in which

instance the plane will perform a straight line of flight or will fly any desired pattern, depending upon the movement of the moving point. By causing the driving mechanism gradually to reduce its speed to zero, the plane can be landed in a natural manner. When reversing the direction of rotation of the drive shaft, also a braking effect can be produced during the landing operation.

The embodiment illustrated in Fig. 4 shows a toy aeroplane composed of hollow bodies, for instance of half shells of thin material. The plane model shown in Fig. 4 consists of the hollow fuselage **27** having connected thereto the likewise hollow wings **28**, **29**, the elevator assembly **30**, **31** and the rudder assembly **32**, **33**. The side rudder **33** is also in this instance strongly turned toward the outside. Below the wings **28**, **29** there are the wheels **34**, **35** with the respective struts which together make up the landing gear.

The propeller **36** is arranged at the nose of the fuselage **27**. According to the arrangement shown in Fig. 4, the propeller shaft **37** extends in the direction of the longitudinal axis of the toy aeroplane and is journalled in two transverse walls **38** and **39** within the fuselage **27**. The rear end of the propeller shaft **37** is provided with a crown wheel **40**. Furthermore, in the wing **29**, there is provided a shaft **41** which is journalled near the leading edge of the wing **29** by means of bearing blocks **42** and is journalled in the fuselage **27** in the wall portion **43**. As has been clearly shown in Fig. 4, also in this instance the shaft **41** is inclined to the transverse axis of the aeroplane by about 8 degrees although this angle of inclination may vary similar to the angle of inclination referred to in connection with the intermediate shaft **14** of Fig. 1. That end of the shaft **41** which extends into the fuselage is provided with the pinion **44** which meshes with the crown wheel **40**. The other end of shaft **41** protrudes somewhat from the tip of the wing **29** and is connected with the flexible drive shaft **45**. The flexible drive shaft **45** is in the form of a coiled steel wire with the windings pulled apart somewhat. In some exceptional instances the wing **28** may at its tip be provided with a counter weight **46**. However, it has been found in actual practice that generally the counter weight **46** is not necessary. The driving mechanism for the toy aeroplane of Fig. 4 may for instance be designed similar to the driving mechanism shown in Fig. 3.

It is to be understood that the present invention is, by no means, limited to the specific constructions shown in the drawings but also comprises any modifications within the scope of the appended claims.

What I claim is:

1. A captive toy airplane, which comprises in combination: a fuselage, two wings supported by said fuselage, a propeller shaft journalled in the front portion of said fuselage, a propeller connected to one end of said propeller shaft, an intermediate shaft rotatably supported by one of said wings and located substantially in the plane passing through the longitudinal axis and the transverse axis of said airplane, said intermediate shaft having its one end drivingly connected to the other end of said propeller shaft and defining with said propeller shaft an obtuse angle, a remote driving device, and a flexible power conveying shaft having one end drivingly connected with said driving device and having its other end drivingly connected with the other end of said intermediate shaft.

2. A captive toy airplane according to claim 1, in which the intermediate shaft defines with said propeller shaft an angle of at least nearly 5°.

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