Sept. 29, 1964 A. DUGGAR, JR 3,150,734

AIRPLANE POWER DOLLEY

Filed March 21, 1962 2 Sheets-Sheet 1

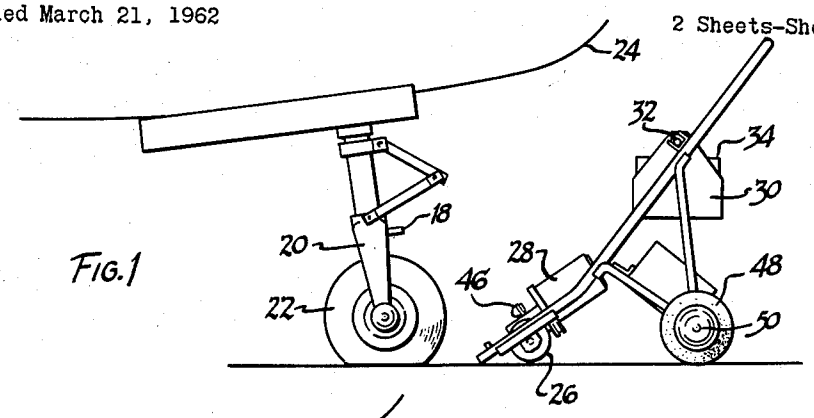


FIG. 1

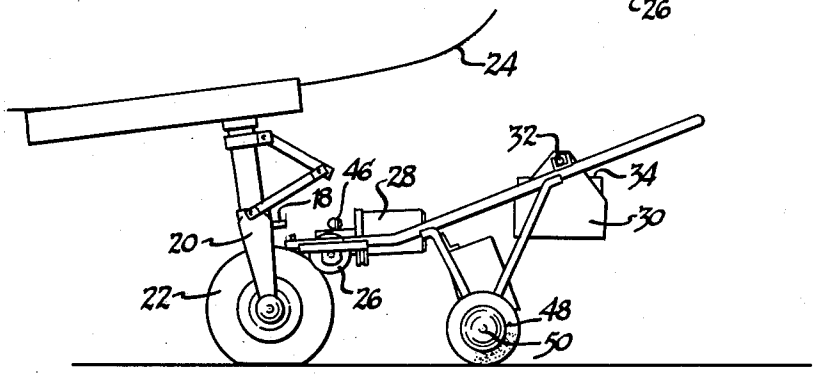


FIG. 2

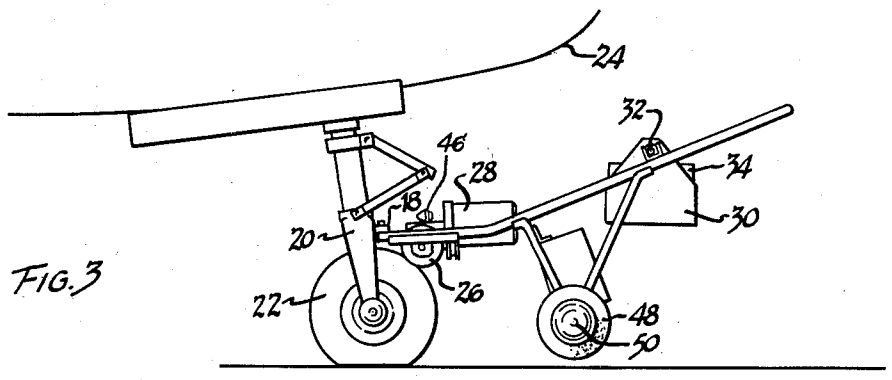


FIG. 3

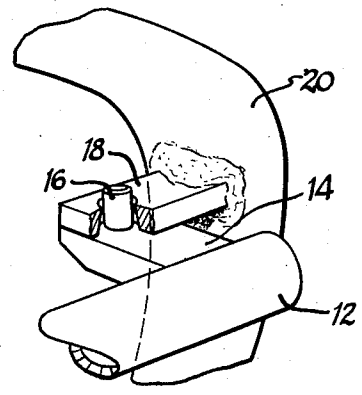


FIG. 4

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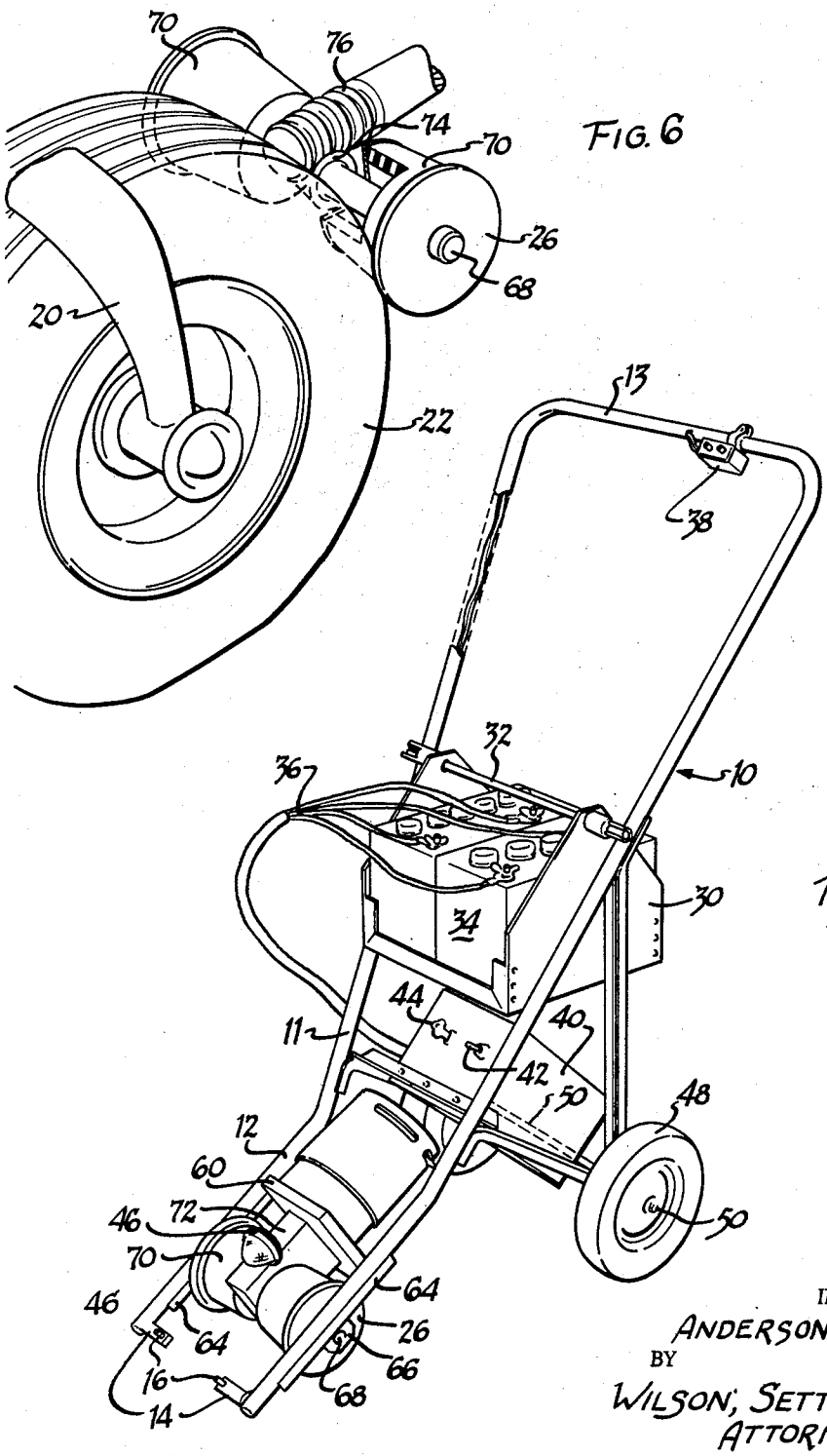


FIG. 6

FIG. 5

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AIRPLANE POWER DOLLEY

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3 Claims. (Cl. 180—11)

This invention relates to tow sticks for moving airplanes on the ground. It is intended to be easily attached to a ground wheel of the plane and to move the plane by power derived from a source carried by the tow stick. Examples of tow sticks of the general character to which the invention relates are shown in the patents to Palmiter, 2,920,845, and Wirkkala, 2,949,972.

In the devices of this character which have come to my attention, the tow sticks have been difficult to transport to and from the plane, or have been difficult to attach to the plane in operating relation, or both. The invention seeks to overcome these and other disadvantages of known tow sticks and has among its objects the provision of an improved and convenient tow stick which:

(1) Can be easily transported to and from a plane;

(2) Can be easily and effectively attached to the plane;

(3) Can be raised easily into working position by power devices carried by the tow stick;

(4) Is supported out of contact with the ground when towing the plane;

(5) The weight of the tow stick and its power devices is used to urge power driving means into effective contact with the wheel of the plane, and especially one in which the distribution of the weight of the power devices on the tow stick with respect to the point of attachment of the stick to the plane automatically urges the power driving device into effective friction contact with the wheel of the plane, and so provides enough friction effectively to move the plane; and

(6) Having a battery-driven electric motor with an arrangement for keeping the batteries substantially level during all movement and operation of the tow stick.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein the same reference character always designates the same part throughout the various views.

In the drawings:

FIGURE 1 includes a schematic side elevation of a tow stick embodying one form of the invention, shown in inoperative position;

FIGURE 2 shows the tow stick in the position in which it starts to be lifted by power to operative position;

FIGURE 3 shows the tow stick attached to the plane inoperative position for towing;

FIGURE 4 is an enlarged detail in perspective, partly broken away, showing one form of fastener for securing the tow stick to the plane;

FIGURE 5 is a perspective view of the tow stick; and

FIGURE 6 is a schematic perspective, partly broken away, of one form of driving drum in contact with a ground wheel of the plane.

Before explaining the present invention in detail, it is to be understood that the invention is not limited in construction nor application to the details nor arrangement of parts shown and described herein for illustration, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the terminology employed herein is for the purpose of description only and does not limit the invention.

Referring to FIGURE 5, the tow stick may include

a generally U-shaped frame **10**, the arms of which are bent to form portions **11** and **12** and having a bight **13** forming a handle. At the tips of the U are fasteners for securing the tow stick to the plane. The fasteners may conveniently include an arm **14** welded to each arm of the frame and projecting inwardly and carrying a pin **16** which is to be attached to the plane in any suitable manner, for example by being inserted upwardly into an eye **18** (FIGURE 1) welded to, or formed in, the fork or other support **20** which carries the steerable nose wheel **22** of the plane **24**. The pins and eyes form fastening means securing the stick to the plane along a horizontal pivot line above the wheel and adjacent the tread of its tire, to permit vertical movement of the handle **13**. The frame portion **12** is intended to be substantially horizontal when the tow stick is in position to move a plane and the angle between the portions **11** and **12** is such that the handle is then disposed at a convenient height for an operator.

As shown in FIGURE 2, a driving drum **26** is journalled on the frame **10**. Its axis of rotation is in front of the vertical plane of the eyes **18** when the tow stick is in operating position and the surface of the drum is in contact with the surface or tread of the nose wheel at a point substantially removed circumferentially from the eyes **18** and substantially below the horizontal plane of the eyes. By circumferentially removed I mean that there is a distance from the point of contact of the driving drum with the nose wheel, along the tread or circumference of the nose wheel, to that point on the tread of the nose wheel which is nearest to the eyes **18**. This spacing or distance enables the entire stick to pivot about the eyes **18** to bring the drum into firm and yielding contact with the wheel. It also enables the entire stick to pivot about the point of contact with the wheel to insert the pins **16** into the eyes **18** when attaching the tow stick to the plane, as will be explained. An electric motor **28** is attached to the frame forward of the driving drum and is connected to rotate the driving drum in either direction through a reduction gear which will be described.

A battery support **30** hangs from a pivot bar **32** which is located between the handle of the tow stick and the motor. This maintains upright, regardless of the position of the tow stick, any suitable electric storage battery **34** placed in this support. The battery is connected to the motor by any suitable leads **36** in circuit with a forward and reverse switch **38** placed on the handle. A control box **40**, attached to the frame in any suitable way, may contain a two-speed switch **42** for selecting the speed at which the forward and reverse switch rotates the drum. The control box may also include a lock switch **44** which may also control a light **46**. Any suitable battery charger may be carried in the control box for connection with a power line to charge the battery.

The entire assembly or tow stick is supported by a pair of ground wheels **48** journalled on an axle **50**, supported in a pair of U-shaped brackets depending from the frame. Preferably the axle **50** is disposed so that when the portion **12** of the frame is substantially horizontal the axle is in a vertical plane which includes the center of gravity of the assembly, or is close to it.

Preferably the motor and driving drum are mounted as a unit on a sub-frame which is attached to the frame **10** and can easily be removed. As shown in FIGURE 5, the sub-frame includes plate **60** attached to one end bell of the motor and in turn attached to a U-shaped bracket, the ends of which terminate in side arms **64**, each of which carries a bearing **66** which supports the shaft **68** on which the drum **26** rotates. The side arms **64** may be

bolted to the arms of the frame **10**. The drum may consist of two frusto-conical friction elements **70** disposed on either side of a worm housing **72** secured to the plate **60** and containing a reversible worm wheel **74** keyed to the drum and meshing with a reversible worm **76** forming part of the shaft of the motor, or secured to it. This arrangement provides a driving torque at the longitudinal center of the drum and simplifies the construction and arrangement of the necessary drum bearings and connection of the drum to the motor through a speed-reducing gear.

In operation, the tow stick is wheeled to the plane and the drum is placed against the nose wheel as shown in FIGURE 2. The drum is then rotated slowly forward, or counter-clockwise as FIGURE 2 is seen, while the handle end of the frame is supported by the operator. This causes the drum to roll up the periphery of the nose wheel and both raises the ground wheels **48** off the ground and places the pins **16** just below the eyes **18**. The frusto conical driving elements engage the nose wheel at spaced points on opposite sides of the center of the tread. This provides a stable contact between wheel and drum which enables the drum to roll up the tread of the wheel securely and without falling off. The handle is then lowered slightly to project the pins into the eyes from below. The tow stick is now supported entirely by the plane. The arms **14**, together with the drum resting on the nose wheel, support the entire weight of the tow stick. The pins and the eyes can transmit thrust either forward or backward to the fork **20** when the driving drum is rotated.

Because the driving drum is located between the pins **16** and the motor and battery, the weight of the battery and motor urges the drum forcibly against the nose wheel to provide sufficient friction to drive the nose wheel from the drum and so move the plane. Because the wheels are off the ground the plane may be steered by simple movement of the handle to the right or left as the plane is being towed.

To remove the tow stick from the plane, the handle is raised slightly to lower the pins out of the eyes, and then the drum is driven backward to lower the wheels to the ground.

I claim:

1. In a power tow stick for moving over the ground an airplane having a steering wheel mounted on a rotatable support, the combination of a frame, attaching means on the frame for fastening the frame to the support at a horizontal pivot line above the wheel, a driving drum journaled on the frame and horizontally spaced from the support, a rolling ground support for moving the frame to place the drum in friction contact with the wheel at a point circumferentially spaced from the support, and means for lifting the tow stick to place the attaching means at said pivot line, said last-mentioned means including a motor for rotating the driving drum in contact with the wheel.

2. In a power tow stick for moving over the ground an airplane having a steering wheel mounted on a rotatable support, the combination of a frame, attaching means on the frame for fastening the frame to the support at a horizontal pivot line above the wheel, a driving drum journaled on the frame and horizontally spaced from the support, a rolling ground support for moving the frame to place the drum in friction contact with the wheel at a point circumferentially removed from the attaching means, and means for raising the ground support from the ground, said last-mentioned means including a motor for rotating the driving drum in contact with the wheel.

3. In a power tow stick for moving over the ground an airplane having a steering wheel mounted on a rotatable support, the combination of a frame including a handle, attaching means on the frame for fastening the frame to the support at a horizontal pivot line above the wheel, a driving drum journaled on the frame and located between the handle and the attaching means, a rolling ground support for moving the frame to place the drum in friction contact with the wheel at a point circumferentially spaced from the support, and means for raising the ground support from the ground including means for rotating the drum in contact with the wheel, said driving drum being placed between the raising means and the attaching means so that the weight of the raising means urges the drum into frictional engagement with the wheel both when the tow stick is supported by the ground support and the drum on the wheel, and when the tow stick is supported by the attaching means and the drum on the wheel.

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