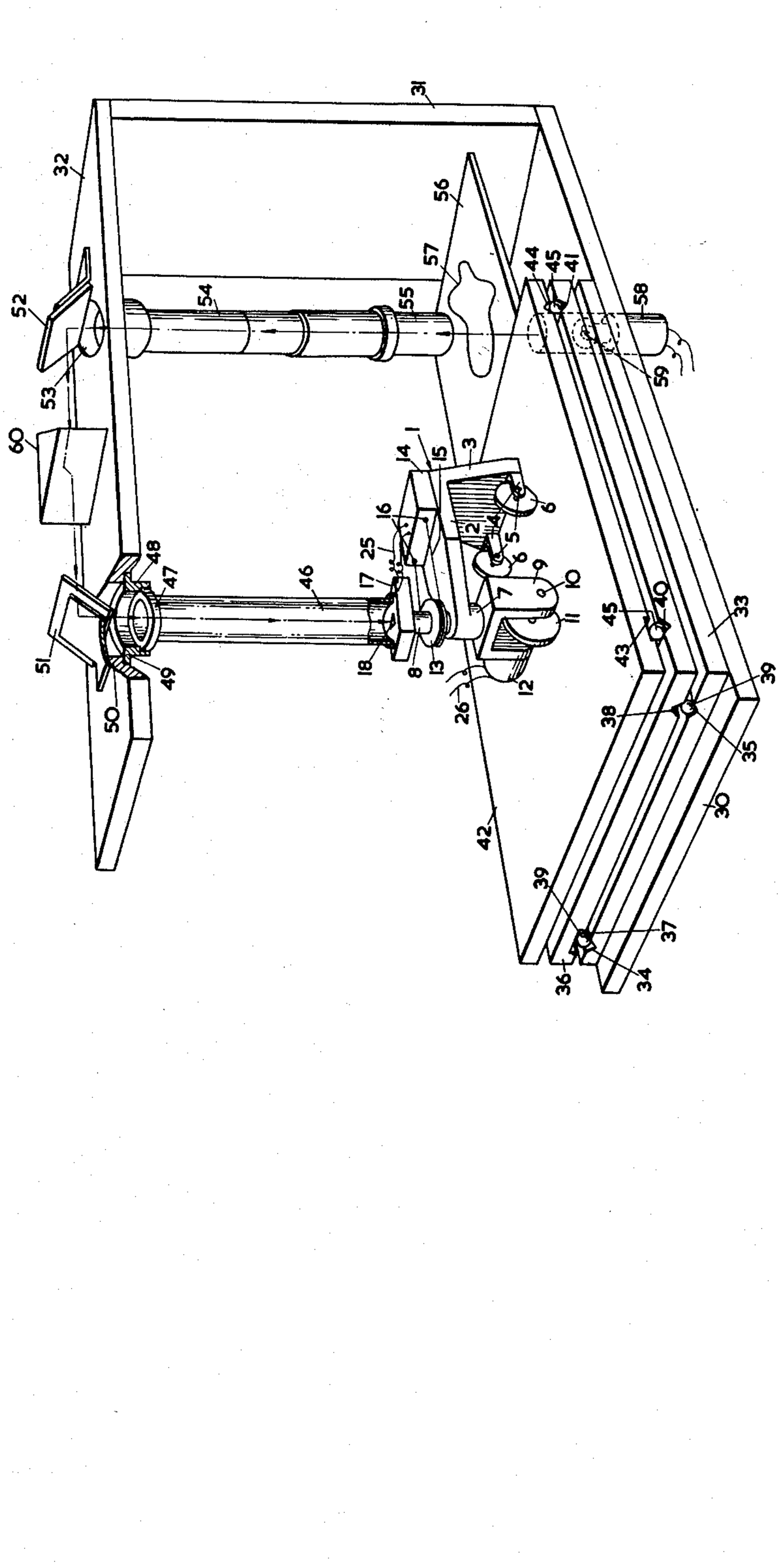
April 27, 1965 C. C. BARBER 3,180,993

PHOTO-ELECTRIC TRACKING DEVICES

Filed Sept. 5, 1961



United States Patent Office

3,180,993

Patented Apr. 27, 1965

3,180,993

PHOTO-ELECTRIC TRACKING DEVICES

Clifford Charles Barber, Chingford, London, England, assignor to National Research Development Corporation, London, England

Filed Sept. 5, 1961, Ser. No. 135,845
Claims priority, application Great Britain, Sept. 13, 1960, 31,522/60
2 Claims. (Cl. 250—202)

This invention relates to improvements in or connected with photo-electric tracking devices.

An object of this invention is to provide an improved photo-electric tracking device for executing movement as instructed by a light-contrasted marking and driven by a single photo-electrically controlled steerable means disposed at a fixed location.

The expression "light-contrasted" marking is intended to include a line contrasted upon a dark or light background or a dark area around which is a light area, or any other marking which will afford a sufficient light contrast to influence the photo-electric cell, and the expression known "photo-electric cell" is intended to mean any photo-electric device capable of adequately sensing this contrast for the purpose of carrying into effect the invention.

The invention will now be described with reference to the accompanying drawing which is a perspective view of one form of line tracking device according to the invention.

In the construction shown in the drawing, the device comprises a tricycle 1 having a main frame consisting of a horizontal member 2 and a depending member 3 at the rear of the member 2, the lower end portion of which member 3 is provided with forwardly extending substantially U-shaped brackets 4, 4. Each of the brackets 4 carries a spindle 5 on which is mounted a wheel 6.

Formed at the underside of the forward end of the horizontal member 2 of the frame of the tricycle is a thickened portion 7 which is drilled to form a bearing for the lower part of a steering shaft 8, which shaft, at its lower end, carries a fork 9 which in turn carries between its two parallel limbs a rotatable shaft 10 upon which is fixed a combined steering and driving wheel 11 for which the said shaft 10 constitutes the driving shaft by being connected through reduction gearing (not shown) to an electric motor (also not shown), which gearing and motor are housed within a casing 12 fixed upon the outside of one of the limbs of the fork 9.

Fixed upon the steering shaft 8 is a pulley 13, and fixed upon the rear end portion of the member 2 is a casing 14 containing an amplifier (not shown) and a motor (not shown) this motor being similar in construction to the electro magnetic movement of a ammeter and having a pulley (not shown) around which pulley and the pulley 13 passes a driving cord 15, the casing 14 being provided with holes 16, 16, to permit of this.

Fixed upon the upper end of the steering shaft 8 is a casing 17 containing a photo-electric cell (not shown), above which cell is formed in the upper wall of this casing a triangular shaped slit or iris 18.

The tricycle forms part of an apparatus comprising a frame consisting of a base 30, an upright part 31, and an upper part 32 parallel to the said base. Fixed upon the base 30 is a plate 33 having in its upper face a pair of V-shaped grooves 34, 35, and formed in the underface of a similar plate 36 are grooves 37, 38, which engage with steel balls 39 carried in the grooves 34, 35, so that the plate 36 will be constrained to move, upon these balls, freely back and forth over the plate 33. Formed in the upper face of the plate 36, and extending at right angles with respect to the grooves 34, 35, are V-shaped grooves 40, 41. Parallel to the plate 36 is a plate 42 having

grooves 43, 44, formed in its underside, which grooves engage with steel balls 45 carried in the grooves 43, 44, so that this plate will be constrained to move upon these balls freely across the apparatus. It will be readily appreciated that the arrangement just described permits the plate 42 virtually to move in any direction in a horizontal plane.

There is fixed upon the casing 17 the lower end of a tube 46, the upper end of which tube has attached to it a ring 47 which is rotatably fitted within the lower end of a tubular bearing 48 the upper end of which bearing is provided around its exterior with a flange 49 and this flange is secured to the part 32 of the frame, around the outside of a perforation 50 in this part. Over the said perforation in the part 32 is carried a mirror 51, which is inclined at an angle of 45° to the horizontal so as to cooperate, in a manner to be hereinafter described, with a mirror 52 which is inclined at 90° to the mirror 51 and is disposed over a perforation 53 in the rear portion of the part 32. Fixed to the underside of the part 32 and depending therefrom coaxially with the perforation 53 is a tube 54 the lower end of which carries a projection lens 55.

Fixed to the rear edge of the aforesaid plate 42 is a rearwardly extending plate 56 of translucent material, adapted to carry a line marking or trace such as 57. Carried by the base 30 is a lamp housing 58, carrying a lamp 59, as shown in broken lines, for illuminating at least a part of the trace 57 below the projection lens 55. The arrangement is such that a magnified image of a part of the trace will be projected up the tube 54, onto the mirror 52 then onto the mirror 51, by way of an erecting prism 60 secured upon the part 32 by means of a suitable adhesive, the mirror 51 reflecting the said image down the tube 46 and across the iris 18, the said photo-electric means being arranged, in accordance with the known art, so that the steering wheel will be operated by the said motor, within the casing 17, to cause the iris to maintain a predetermined attitude and position with respect to the image. The tricycle will drive the plate 42 so that the locus of any point upon it will execute a figure of movement substantially similar to the trace.

It will be understood that various modifications are within the scope of the invention, for example, any suitable electrically operated motor means may be employed for effecting the steeing and the means which, through the photo-electric cell controls this, may consist of any suitably biased thermionic valve or this amplifier, or the control circuit may comprise any suitable form of well known "error feed back" type of device.

I claim:

1. A photo-electrically controlled tracking device for executing movement as instructed by a light-contrasted marking, comprising: a table mounted for coordinate movement in its own plane; means adapted to receive the said marking; a tricycle on said table and having a steering wheel and two co-axial rear wheels, said steering wheel being mounted to revolve in a steering movement about a fixed axis at right angles to the table and passing diametrically through the axis of rotation of the steering wheel, said steering wheel lying in the plane of said fixed axis so as to be in frictional driving contact with the table; a motor for driving the steering wheel about its axis of rotation to move the table; photo-electric means mounted to partake of the steering movement of the steering wheel; a steering motor operatively connected to the steering wheel to rotate said steering wheel about said fixed axis in response to signals received from said photo-electric means; an apertured masking plate mounted in fixed relationship to the photo-electric means so as to partake of the movement thereof with the steering wheel and which masking plate is so arranged that, during opera-

tion of the device, the steering motor will operate the steering wheel in response to signals received from said photo-electric means so that the aperture in the masking plate will move to successive positions relative to said marking so as to track the said marking.

2. A photo-electrically controlled tracking device for executing movement as instructed by a light-contrasted marking, comprising: a table mounted for coordinate movement in its own plane; means adapted to receive the said marking; a frame; a pair of wheels upon the rear of the frame, said wheels being arranged coaxially so as to roll upon the table; a shaft disposed upon a fixed axis at right angles to the table, which shaft extends downwardly through the forward part of the frame and is journaled in the forward part of the frame; a body carried at the lower end of this shaft; a steering wheel carried by said body so that the said fixed axis extends diametrically through the axis of rotation of said steering wheel, said steering wheel being in frictional driving contact with said table; said frame, said rear wheels and said steering wheel forming a tricycle; a driving motor for driving said steering wheel about its axis of rotation to move said table; photo-electric means mounted to partake of the steering movement of said steering wheel; a steering motor operatively connected to said steering wheel to rotate said steering wheel, said body, and said shaft about said fixed axis; a compartment carried by said shaft, said photo-electric means being mounted in said compartment; an apertured masking plate mounted in said compartment above said photo-electric means and in fixed relationship

to said photo-electric means so as to partake of the movement thereof with said steering wheel; a tubular member in axial alignment with and having its lower end fixedly connected to the upper end of said shaft; a fixed bracket having a perforated portion overhanging said table to constitute a bearing in which is journaled the upper end of said tubular member; magnifying optical means for scanning said marking and for projecting a magnified image of a part of said marking down said tubular member and across the aperture in the masking plate; said masking plate being so arranged that during operation of the device said steering motor will operate said steering wheel in response to signals received from said photo-electric means to cause the aperture in said masking plate to assume successive positions so as to track the marking projected across the aperture, in order that the path of movement of said table will be determined by said light-contrasted marking.

References Cited by the Examiner

UNITED STATES PATENTS

2,397,933	4/46	Fowle et al.	250—202 X
2,419,641	4/47	Hart	250—202 X
2,461,585	2/49	Anderson	250—202
2,499,178	2/50	Berry et al.	250—202 X

RALPH G. NILSON, *Primary Examiner.*

WALTER STOLWEIN, *Examiner.*