United States Patent [19]

Gutler

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[45] **May 15, 1973**

[54] **TORSION BAR FOR RAISING AND LOWERING A TARGET**

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[73] Assignee: **The United States of America as represented by the Secretary of the Navy,** Washington, D.C.

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[21] Appl. No.: **236,390**

[52] **U.S. Cl.**...**273/102.1 E,** 273/105.6, 273/102.2 S, 267/154

[51] **Int. Cl.** **F41j 7/00**

[58] **Field of Search** .....273/102 S, 102.1 R, 273/102.1 C, 102.1 E, 102.2 R, 102.2 S, 105.6, 105.2; 124/7

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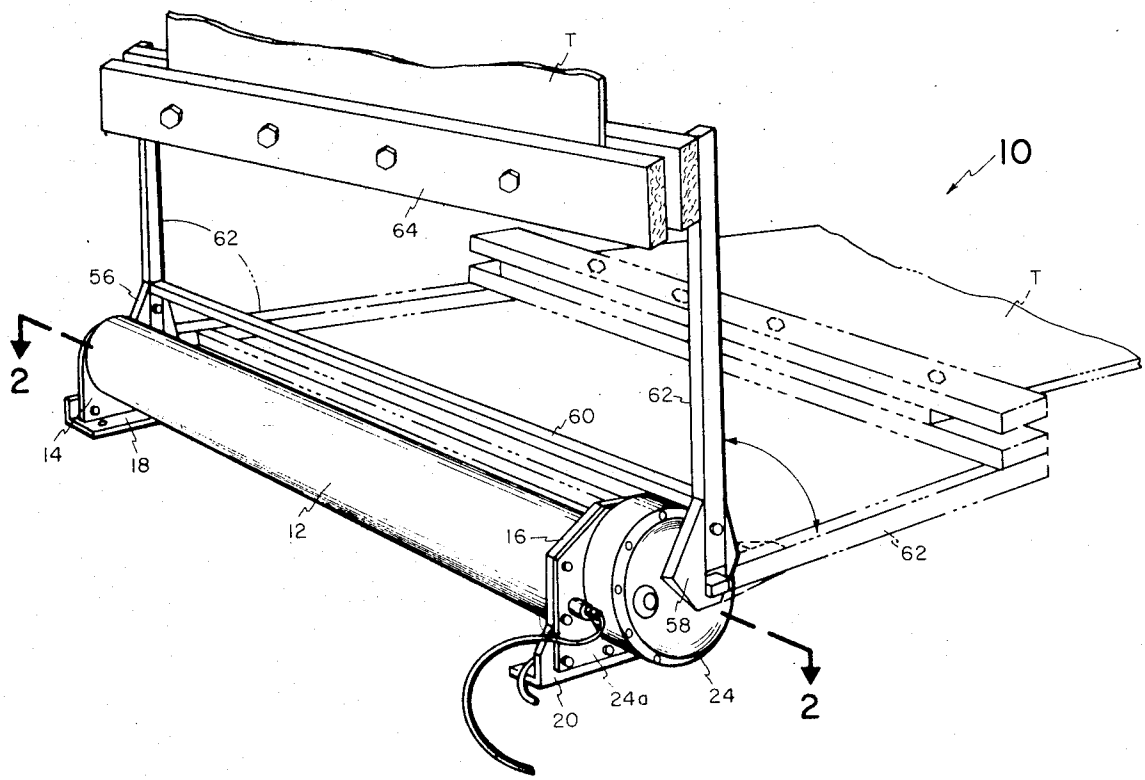
Assistant Examiner—Marvin Siskind

Attorney—Richard S. Sciascia et al.

[57] **ABSTRACT**

A target raising and lowering mechanism employs a torque tube and torsion bar combination to provide weatherproof housing for its electric motor and reduction gear means while also storing energy in the torsion bar during lowering of a target for later use during raising of the target.

5 Claims, 3 Drawing Figures



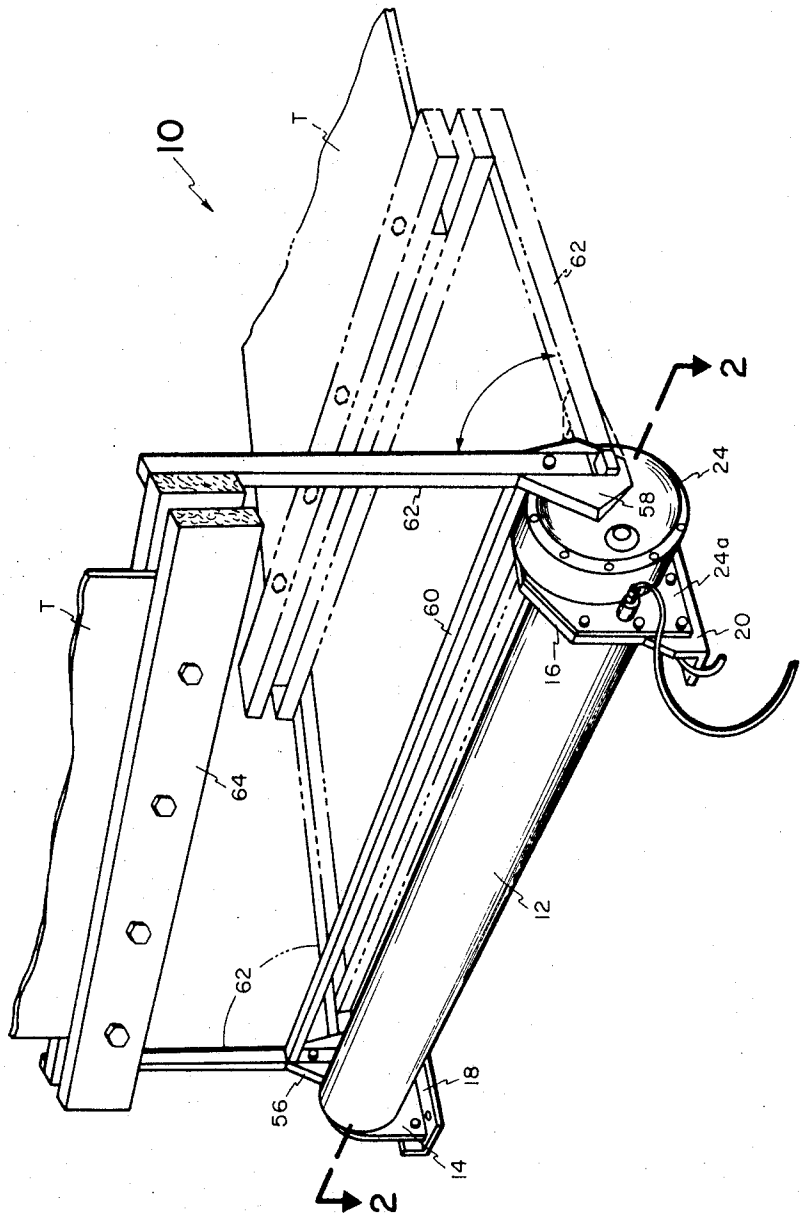


FIG. 1

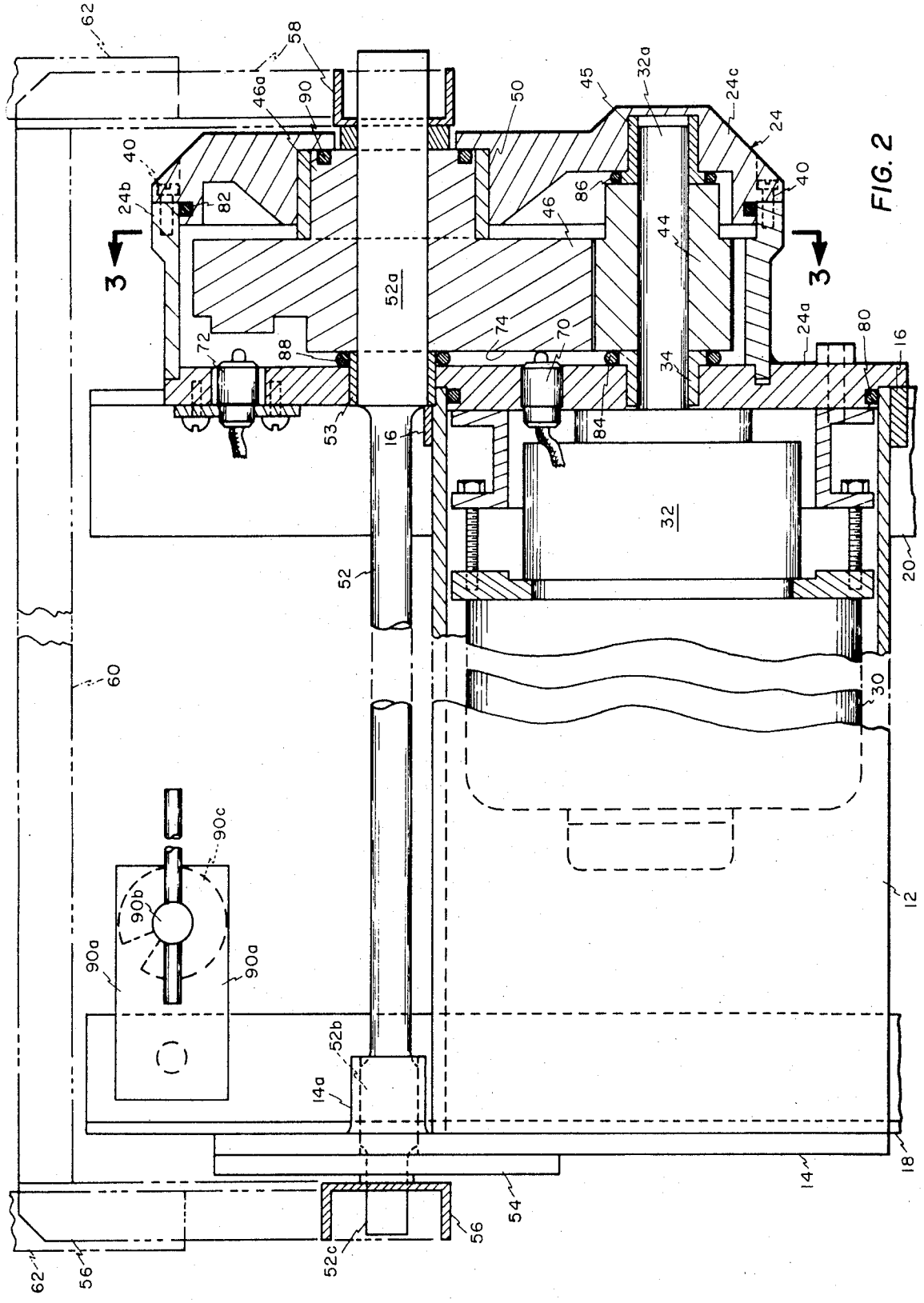

62
58
46a
90
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FIG. 2

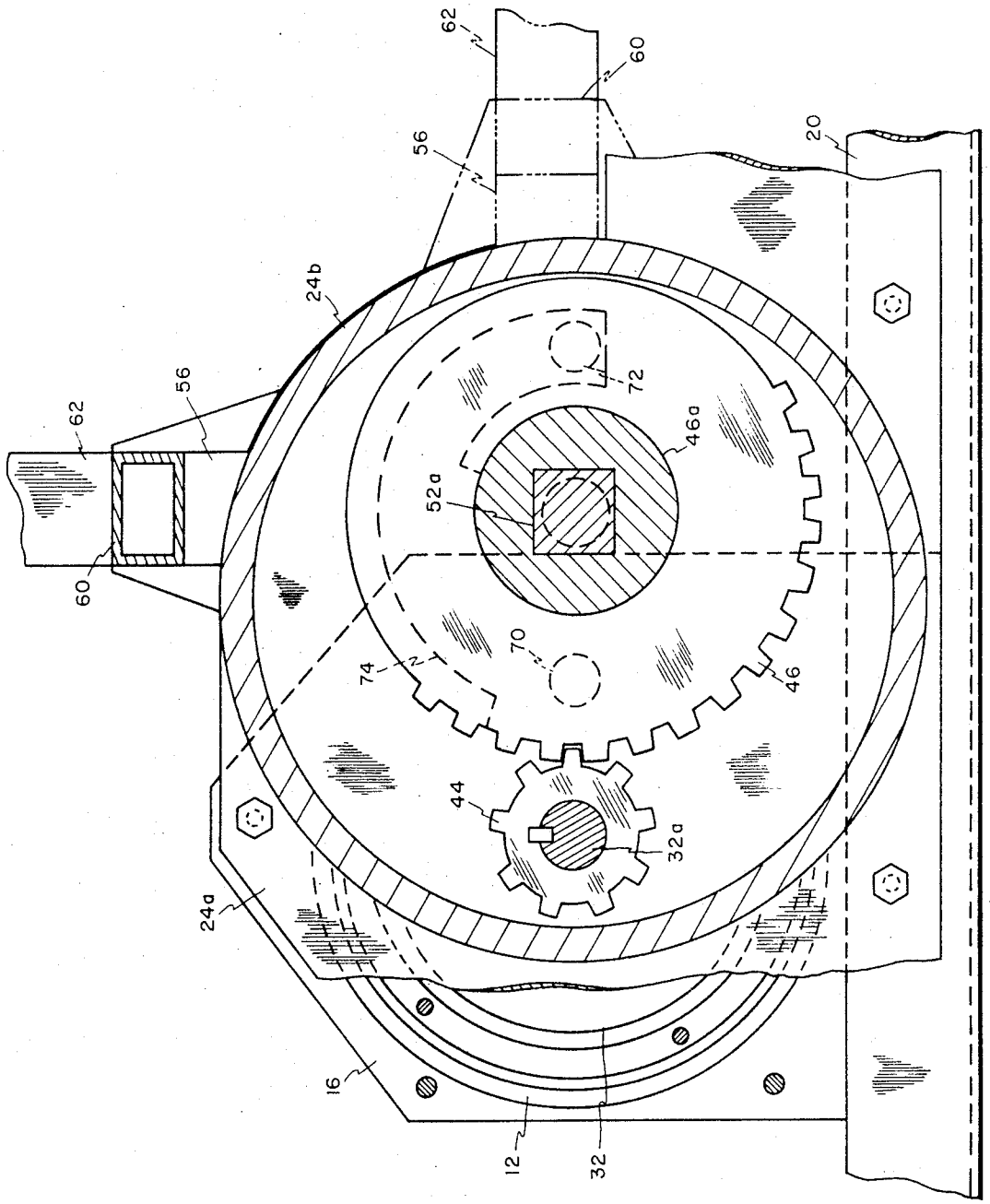

FIG. 3

TORSION BAR FOR RAISING AND LOWERING A TARGET

BACKGROUND OF THE INVENTION

This invention relates to target devices, and more particularly to an improved target raising and lowering mechanism suitable for use with targets of substantial size, say seven by nine feet, in the training, for example, of tank gunners.

Target raising and lowering mechanisms have been proposed heretofore which are electrically driven and operate through gears, levers and the like to move targets of plywood or the like between horizontal and vertical plane positions. Such mechanisms are typically used in military field training maneuvers wherein the mechanisms are exposed to extremes of weather including high winds, rain, snow, and heat, as well as shock, dirt, and flying debris from explosions of training rounds and the like. Experience with the prior mechanisms has shown that such conditions result in so many mechanical and electrical failures that the usefulness of the devices was severely limited.

Moreover, such devices have been expensive, bulky, difficult to maintain, and have required greater electrical power for operation than is desirable for field use where batteries and/or portable electric generators are the source.

SUMMARY OF THE INVENTION

With the foregoing in mind, it is a principal object of this invention to provide an improved electrically driven target raising and lowering mechanism which has great mechanical and electrical reliability even under the adverse conditions set forth above.

Another object of the invention is to provide an improved target positioning mechanism which has a low profile, is reasonably economical to manufacture, and has modest electrical power requirements.

As another object this invention aims to provide a mechanism of the foregoing character which utilizes a torque tube and torsion bar combination to store energy while the target is being lowered and to use that energy when the target is being raised.

Yet another object is to utilize the torque tube as a weatherproof housing for a drive motor and a harmonic gear drive.

The invention may be further said to reside in certain novel combinations, constructions, and arrangements of parts whereby the foregoing objects and advantages are achieved, as well as others which will become apparent from the following detailed description of a preferred embodiment when read in conjunction with the accompanying sheets of drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a target raising and lowering mechanism embodying the present invention, and having some moveable parts thereof shown in broken line positions:

FIG. 2 is a view on an enlarged scale, partly in elevation, partly in section, and with some parts broken out, taken substantially along line 2 — 2 of FIG. 1; and

FIG. 3 is a sectional view taken substantially along line 3 — 3 of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the form of the invention illustrated in the drawings and described hereinafter, as an example, there is provided a target raising and lowering mechanism generally indicated at **10** in FIG. 1 and which serves to move a target T in both directions between a raised or full line position and a lowered position as shown in phantom. The mechanism **10** comprises a frame including an aluminum torque tube **12** having plates **14** and **16** welded to opposite ends thereof. The plate **14** closes the end of the tube **12** to which it is welded and also provides a flange to which an angle member **18** is bolted to serve as a transverse support base. The plate **16** does not close the end of the tube **12** to which it is welded but **16** serves as a flange to which is bolted a housing **24** for a final gear drive later described in detail. A transverse support base in the form of an angle member **20** is bolted to a plate portion **24***a* of the housing **24**.

Mounted within the torque tube **12** is a reversible electric motor **30** (FIG. 2) which is directly coupled to a reduction gear **32** of the harmonic type. In the present example the motor **30** operates at 1,725 RPM, and the harmonic reduction gear **32** reduces that by 180 to 1. The reduction gear therefore drives at a rate of 9.58 RPM at its output shaft **32***a* in the plate **24***a* forming part of that housing.

The plate **24***a* serves to close the end of the torque tube **12** and a motor and harmonic gear securing collar **36** which is secured to an adapter ring **38**. The housing **24** further comprises an annular member **24***b* welded to the plate **24***a* and laterally offset from the axis of the tube **12**. A circular cover member **24***c* is secured to the annular member **24***b* as by screws **40**, and this cover member carries a plain bearing **42** which receives the outer end of the harmonic drive output shaft **32***a*.

Fixed on the shaft **32***a* for rotation therewith is a pinion gear **44** which is in mesh with a gear or gear sector **46**. The outer end of the shaft **32***a* is conveniently supported by a plain bearing **45** carried by the housing cover **24***c*, while the gear sector **46** is provided with a central boss **48** which is conveniently journalled in a plain bearing **50** carried by the housing cover **24***c*.

The gear sector **46** and boss **48** thereof are provided with a square central aperture through which extends one squared end portion **52***a* of a torsion bar **52**, which runs parallel to the tube **12**. The squared end portion also extends through a bearing **53** in the plate **24***a* and through an opening in the cover **24***c* to the exterior of the latter.

The opposite end of the torsion bar **52** has a squared portion **52***b* extending through a corresponding opening in the plate **14** and reinforcing weldment **14***a*, and a round, terminal portion **52***c* extending through and beyond a spacer **54**.

A pair of arms **56** and **58** are mounted on opposite ends of the torsion bar **52**, the arm **58** having a squared opening receiving the square portion extending beyond the cover **24***c*. The arm **58** is spaced from the cover by a spacer **59**. The arm **56** is rotatable freely on the projecting round end portion **52**c of the torsion bar. A box member **60** interconnects the arms **56** and **58** so that they are required to move in unison about the axis of the torsion bar. The arms **56** and **58** have channels formed in the outer surfaces thereof to receive struts or

legs 62 of a target supporting clamp 64 in which a target T is removably secured.

First and second limit switches 70 and 72 are mounted through the plate 24*a* with their operating plungers directed inwardly of the housing 24 for actuation by a cam surface 74 carried by the gear sector 46. These limit switches are electrically connected into a control circuit (not shown) for the electric motor 30 and serve to limit the up and down positions to which the target T is moved.

The union between the plate 24*a* of the housing 24 and the tube 12 is provided with an elastomeric sealing ring 80 of the type referred to as an O-ring, whereby the motor 30 and reduction gearing 32 are effectively protected against intrusion of dirt and moisture. Sealing rings are also provided as shown at 82 between the cover 24*c* and member 24*b*, at 84 and 86 between the pinion 44 and the housing 24, and also at 88 and 90 between the gear sector 46 and the housing 24. The housing 24 is preferably charged with a quantity of grease or oil through a suitable fitting (not shown).

A plurality of ground anchors, one of which is shown at 90 in FIG. 2, may be provided to secure the angle support members 18 and 20 to the ground. These anchors are preferably of the auger type and comprise a block 90*a* which overlies a portion of the support member, a vertical shaft 90*b* journalled in the block, an auger plate 90*c*, and a cross-bar 90*d* for rotating the shaft to screw the auger plate into the ground.

In operation of the mechanism 10, when the target T is hit a control circuit is actuated to energize the motor 30 in a direction which causes the pinion 44 to drive the gear sector 46 so as to lower the target toward the broken line position of FIG. 1. When that position is attained the switch 72 is actuated causing the motor 30 to be deenergized until the control circuit re-energizes it in the reverse direction.

It will be recognized that during lowering of the target the torsion bar 52 will be twisted or "wound-up," thereby storing potential energy derived in part from the change of position of the target mass. When the motor 30 is energized in the reverse direction to raise the target, the torsion bar unwinds and contributes the stored energy to the job of moving the target to the raised position.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A mechanism for moving a target between raised and lowered positions, said mechanism comprising:
- a frame including a horizontally extending torque tube and a gear housing mounted at one end of said tube;
- reversible electric motor means and reduction gear means disposed in said tube and having an output shaft extending outwardly from said one end of said tube into said drive gear housing;
- a pinion disposed in said housing and mounted on said shaft for rotation therewith;
- driven gear means mounted in said housing for rotation by said pinion;
- a torsion bar having one end extending through said housing and connected to said gear means for rotation therewith, the opposite end of said torsion bar being fixed against rotation at the end of said tube opposite said one end; and
- arm means extending radially from said torsion bar for carrying target means to be raised and lowered, said arm means being fixed to said one end of said torsion bar for movement therewith;
- said motor means being operable through said reduction gear means and said pinion to drive said driven gear means so as to wind said torsion bar while moving said arm means and target from said raised position to said lowered position and so as to permit unwinding of said torsion bar while moving said arm means and target to said raised position.

2. A mechanism as defined in claim 1, and wherein:
- said frame further comprises first plate means forming a flange about said one end of said tube;
- second plate means closing said opposite end of said tube and forming a flange thereat;
- support means fixed to said flanges; and
- said gear housing being fixed to said second plate means in closing relation to said one end of said tube, whereby said tube, plates and housing provide an enclosure for said motor means and reduction gear means which is sealed against intrusion of dirt and moisture.

3. A mechanism as defined in claim 2, and further comprising:
- first and second limit switch means mounted on said housing and having actuator elements directed inwardly of said housing; and
- said driven gear means comprises a gear sector carrying cam means cooperable with said actuator elements to activate said first and second limit switches at predetermined limits for said raised and lowered positions, respectively.

4. A mechanism as defined in claim 3, and wherein:
- said arm means comprises first and second arms which parallel to one another and are interconnected by a transverse member for movement in unison about the longitudinal axis of said torsion bar.

5. A mechanism as defined in claim 4, and wherein:
- said torsion bar has its longitudinal axis parallel to the longitudinal axis of said torque tube;
- said torsion bar has opposite end portions of noncircular section, one end being received in matching openings in said gear sector and said first arm, the other end portion being received in a matching opening in said flange formed by said second plate means;
- said torsion bar having a terminal end of circular section extending beyond said flange formed by said second plate means; and
- said second arm being freely journalled on said terminal end.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,733,073 Dated May 15, 1973

Inventor(s) KEITH GUILER

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On the cover sheet [19] and [75], "Gutler" should read -- Guiler -- .

Signed and sealed this 22nd day of January 1974.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

RENE D. TEGTMEYER
Acting Commissioner of Patents