Sept. 17, 1957 R. C. GOERTZ 2,806,610

ANTI-SWING CRANE

Filed Oct. 27, 1953 2 Sheets-Sheet 1

FIG. 1

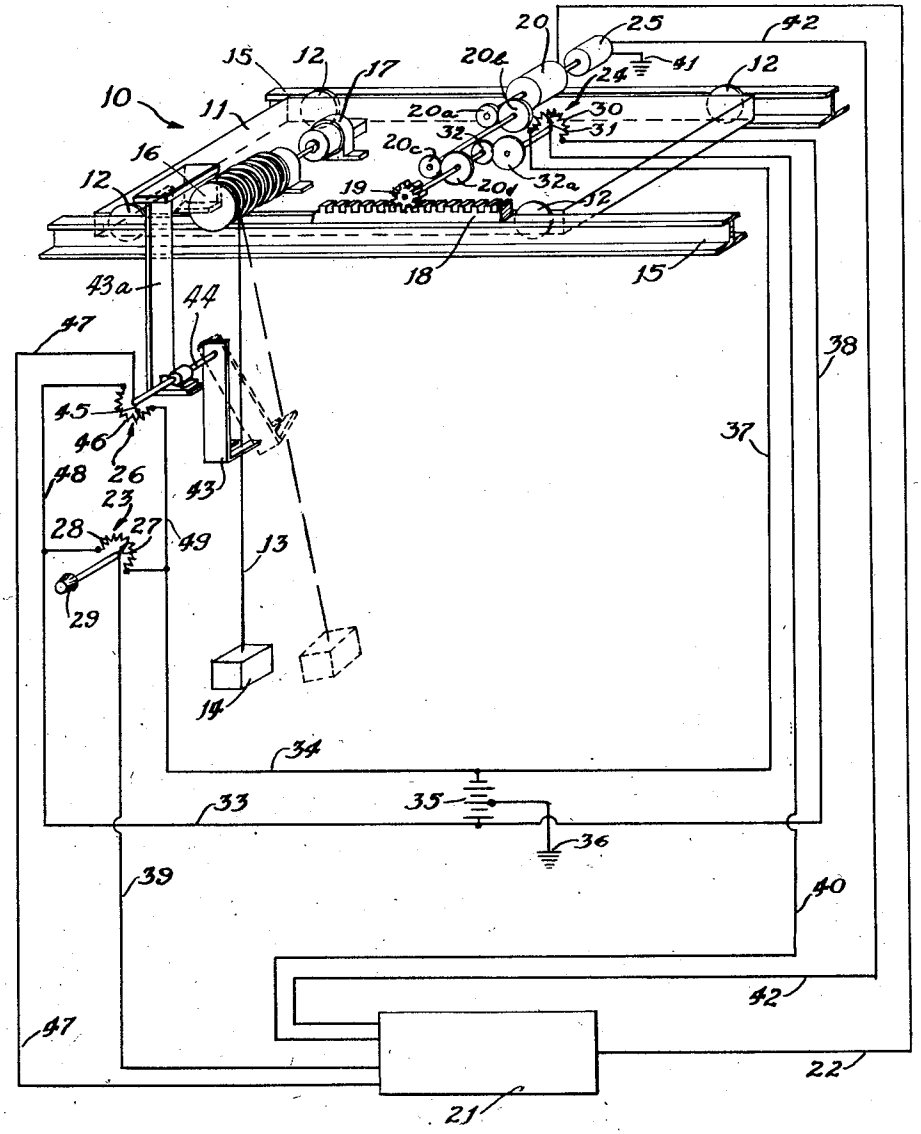

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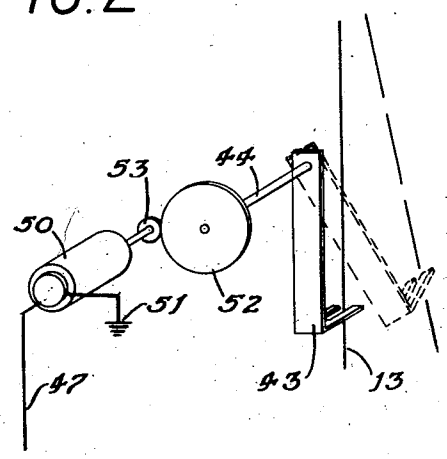
FIG. 2



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ANTI-SWING CRANE

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4 Claims. (Cl. 212—131)

This invention relates to an apparatus for remotely positioning objects and more particularly an apparatus employing a cable or other flexible element for suspending objects to be transported from one place to another.

When a crane with a cable is used to transport an object from one place to another, the object has a tendency to swing after horizontal motion of the crane has been started or stopped. If the object being transported is thermally or radioactively hot, it may not be feasible for a rigger to stop the swinging by handling the object or the cable in the vicinity of the object. A special device that will reach down toward the object to dampen the swing may be costly and complicated.

I propose to prevent or reduce the swinging of the object on the cable by specially controlling the movement of the crane itself. According to the present invention, the tendency of the cable to swing on starting or stopping of the horizontal movement of the crane is used to generate a signal that modifies the movement of the crane.

In the drawing:

Figure 1 is a diagrammatic and perspective view of a crane and controls for moving the crane and inhibiting swinging of the cable hanging from the crane;

Figure 2 is a perspective and diagrammatic view of a modified form of device for generating a signal from the swing of the cable.

In Figure 1, reference character **10** designates a crane that comprises a carriage **11**, a plurality of wheels **12**, and a cable **13** from which an object **14** is suspended. The wheels **12** ride on flanges of beams **15** which constitute horizontal rails for the crane. The cable **13** may be shortened or lengthened by means of a drum **16** of which it is trained and which is controlled by means of a motor **17** mounted on the carriage **11**. The carriage **11** is shifted along the rails **15** by means of a rack **18** secured to one rail **15** and a pinion **19** meshing with the rack **18**. The pinion is driven by a servo-motor **20** acting through reducing gears **20***a*, **20***b*, **20***c*, and **20***d*. The servo-motor is driven from an amplifier **21** connected thereto by a line **22**.

The amplifier **21** receives signals that cause the motor **20** to be driven from four different sources; a position control **23**, a position transducer **24**, tachometer generator **25**, and, according to the present invention, a swing-angle transducer **26**.

In the form of the apparatus illustrated in Figure 1, the position control **23** and the position transducer **24** take the form of potentiometers. The position control **23** comprises a spiral resistor **28**, a movable arm **27** slidable along the resistor **28**, and a control knob **29** for positioning the arm **27**. The position transducer **24** comprises a spiral resistor **30** and a movable arm **31** slidable along the resistor **30**. The arm **31** is connected with the pinion **19** through reducing gears **32** and **32***a* so as to be angularly shifted along the resistor **30** in accordance with movement of the carriage **11** along the rails **15**. The ends of the position-control resistor **28** are connected through lines **33** and **34** with a battery **35**, which is connected at an intermediate point to a ground **36**. Lines **37** and **38** connect

the ends of the position-transducer resistor **30** with the battery **35**. The position-control arm **27** is connected by a line **39** with the amplifier **21**. The position-transducer arm **31** is connected through a line **40** with the amplifier **21**. The tachometer generator **25** is driven by the servo-motor **20** and is connected to ground as indicated at **41** and with the amplifier through a line **42**.

According to the present invention, the swing-angle transducer, which is the embodiment illustrated in Figure 1 takes the form of a potentiometer, is controlled by means of a slotted follower **43** which straddles the cable **13** so as to follow it when it swings as indicated by the full-line and dotted-line positions illustrated in Figure 1. The follower **43** is mounted by means of support **43***a* so as to be movable bodily with the carriage **11** as it goes along the rails **15** and to swing about a horizontal axis as the cable **13** swings. The follower **43** carries a shaft **44** which contains the axis about which the follower is mounted to swing and connects the follower with a movable arm **45** which forms part of the swing-arm transducer **26**. The arm **45** slides over a spiral resistor **46** which also forms part of the transducer **26** and is connected with the amplifier **21** through a line **47**. The ends of the resistor **46** are connected with the battery **35** through lines **33** and **34** through lines **48** and **49** which are connected to the lines **33** and **34**.

When the carriage **11** is in a fixed position and object **14** suspended by cable **13** is in a steady state, the position control **23** and the position transducer **24** are in a balanced condition, their respective moveable arms **27** and **31** contacting their respective resistors **28** and **30** so that signals of equal potential are transmitted to the amplifier **21**. The slotted follower **43** is in a vertical position causing the arm **45** to be at the central resistive point of resistor **46** so that no signal is being transmitted therefrom to the amplifier. Since the motor is not operating the tachometer generator **25** is not rotating and no signal is being transmitted therefrom. When the object **14** suspended from the carriage **11** and the cable **13** is to be shifted to a new position, the control knob **29** is twisted to a position representative of such new position. This causes the signal transmitted to the amplifier **21** through the line **39** to be different from that transmitted from the position transducer **24** through the line **40**, and so the amplifier drives the servo-motor **20** in the appropriate direction for bringing the carriage **11** to the new selected position. As the servo-motor **20** rotates, it causes the tachometer generator **25** to rotate, sending a signal through the line **42** to the amplifier **21**, causing the amplifier to steady the servo-motor **20** and to prevent hunting when the carriage **11** reaches the position for which the position control **23** is set.

When the carriage **11** commences its movement toward the new desired position determined by the position control **23**, there is a tendency for the cable **13** to lag behind or, in other words, to assume a definite angle to the vertical. This lag angle is transmitted by the follower through the shaft **44** to the movable arm **45** of the swing-angle transducer **26**. Thus, a signal is transmitted to the amplifier **21** through the line **47**, which signal acts to cause the amplifier **21** to reduce the speed of the servo-motor or rather to make it reach its normal traveling speed more slowly. Thus the tendency for the cable **13** to lag behind is reduced. When the carriage **11** approaches the position determined by the control **23**, the relation of the signals transmitted to the amplifier through the lines **39** and **40** by the position control **23** and the position transducer **24** changes so as to slow down the servo-motor and thus to diminish the speed of the carriage **11**. This causes the cable **13** to tend to move ahead of the carriage and thus to make an angle with the vertical in the direction opposed to that occurring in starting. Thus the follower

43 causes the arm 45 of the swing-angle transducer 26 to assume a completely different position with respect to the resistor 46, and the signal transmitted from the arm 45 through the line 47 to the amplifier 21 is reversed in algebraic sign so as to alter the slowing-down process of the carriage 11 as otherwise determined by the relationship of the signals transmitted from the position control 23 and the position transducer 24. This means that the tendency for the cable 13 to move ahead is reduced, and the swing thereof is slower and dies out more quickly. In some instances the signal transmitted by the arm 45 through the line 47 to the amplifier 21 may be such as to cause the carriage 11 to move beyond the position for which the position control 23 is set. The unbalanced condition between the position control 23 and the position transducer 24 will then restore the carriage to the desired position.

The steps between the wires in the potentiometers 23, 24, and 26 may be made very small so that the automatic servo system of Fig. 1 is essentially a continuous system.

In the modification of the apparatus of the present invention illustrated in Fig. 2, the swing-angle transducer takes the form of a tachometer generator 50 the output of which is delivered through the line 47 to the amplifier 21. The generator 50 is grounded as indicated at 51 and is driven by the follower 43 through a large gear 52 secured to the follower shaft 44 and a small gear 53 coupled to the generator 50. The strength of the signal transmitted by the generator 50 through the line 47 to the amplifier is proportional to the speed of the generator, and this speed is in turn proportional to the angle by which the cable 13 deviates from the vertical as it swings. The generator 50 is stepless and continuously transmits a signal.

The intention is to limit the invention only within the scope of the appended claims.

What is claimed is:

1. In combination, a carriage adapted to move along an elevated track, a flexible member depending from the carriage and adapted to support well below the carriage an object to be moved by movement of the carriage along the track, a control potentiometer adapted to be manually set for a position to which the carriage is to move, a location potentiometer responsive to position of the carriage, a tachometer generator, an amplifier, a source of power means electrically connecting the potentiometers and the tachometer generator with the amplifier and the source of electrical power for transmitting electrical signals to the implifier, a swing potentiometer responsive to angle of the flexible member to the vertical, means electrically connecting the swing potentiometer with the source of power and the amplifier, for transmitting an electrical signal to the amplifier, a motor and means for driving the motor from the amplifier in accordance with the aforementioned signals transmitted thereto, whereby the swing of the flexible member is reduced to zero when the carriage has reached its intended position and the swing is greatly reduced in magnitude when the carriage is being moved to its intended position.

2. In an assembly a combination comprising a movable carriage, a flexible element depending from the carriage for supporting an object to be moved by the carriage, a motor for moving the carriage, an amplifier for operating the motor, means for transmitting electrical signals to the amplifier responsive to the actual position, the intended position, and the speed of the carriage, and means responsive to the angle of the flexible element to the vertical for transmitting an electrical signal to the amplifier to modify the effect of the previously mentioned electrical signals upon the amplifier.

3. In an assembly a combination comprising a movable carriage, a flexible element depending from the carriage for supporting an object to be moved by the carriage, a motor for moving the carriage, an amplifier for operating the motor, means for transmitting electrical signals to the amplifier responsive to the actual position and the intended position, and means responsive to swinging of the flexible element for transmitting an electrical signal to the amplifier to modify the effect of the previously mentioned electrical signals upon the amplifier.

4. In an assembly a combination comprising a movable carriage, a flexible element depending from the carriage for supporting an object to be moved by the carriage, a motor for moving the carriage, an amplifier for operating the motor, means for transmitting electrical signals to the amplifier responsive to the actual position, the intended position, and the speed of the carriage, and means responsive to the speed of swing of the flexible element for transmitting an electrical signal to the amplifier to modify the effect of the previously mentioned electrical signals upon the amplifier.

No references cited.