

[54] **LEAD SCREW CONTROL FOR LINEAR DRIVE SYSTEM**

[76] Inventor: **John H. Long**, c/o United Press International, Inc., Maywood, N.J. 07607

[22] Filed: **Nov. 27, 1970**

[21] Appl. No.: **93,362**

[52] U.S. Cl. **178/7.6, 178/DIG. 27, 346/139 D**

[51] Int. Cl. **G01d 15/24, H04n 1/06**

[58] Field of Search **178/7.6, 6, DIG. 27; 346/139 D**

[56] **References Cited**

UNITED STATES PATENTS

2,601,236	6/1952	Asten	178/7.6 X
3,280,251	10/1966	Nakahara	178/7.6 X

Primary Examiner—Howard W. Britton

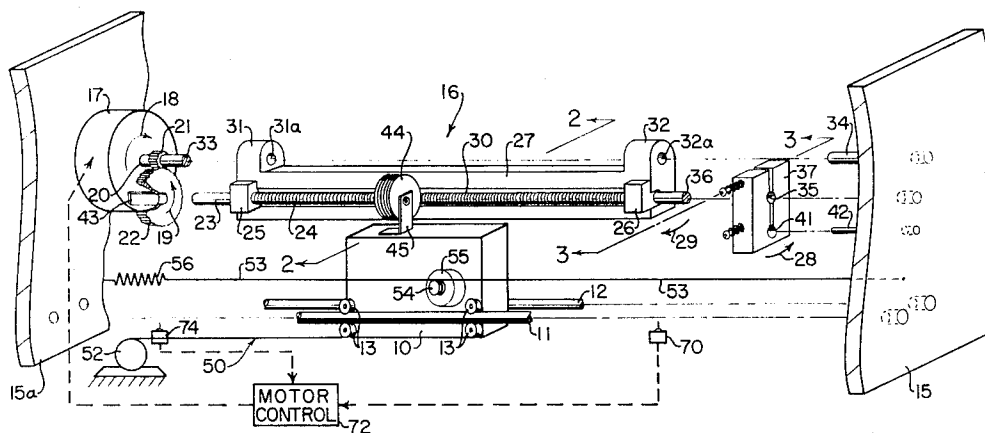
Attorney—Meyer, Tilberry and Body

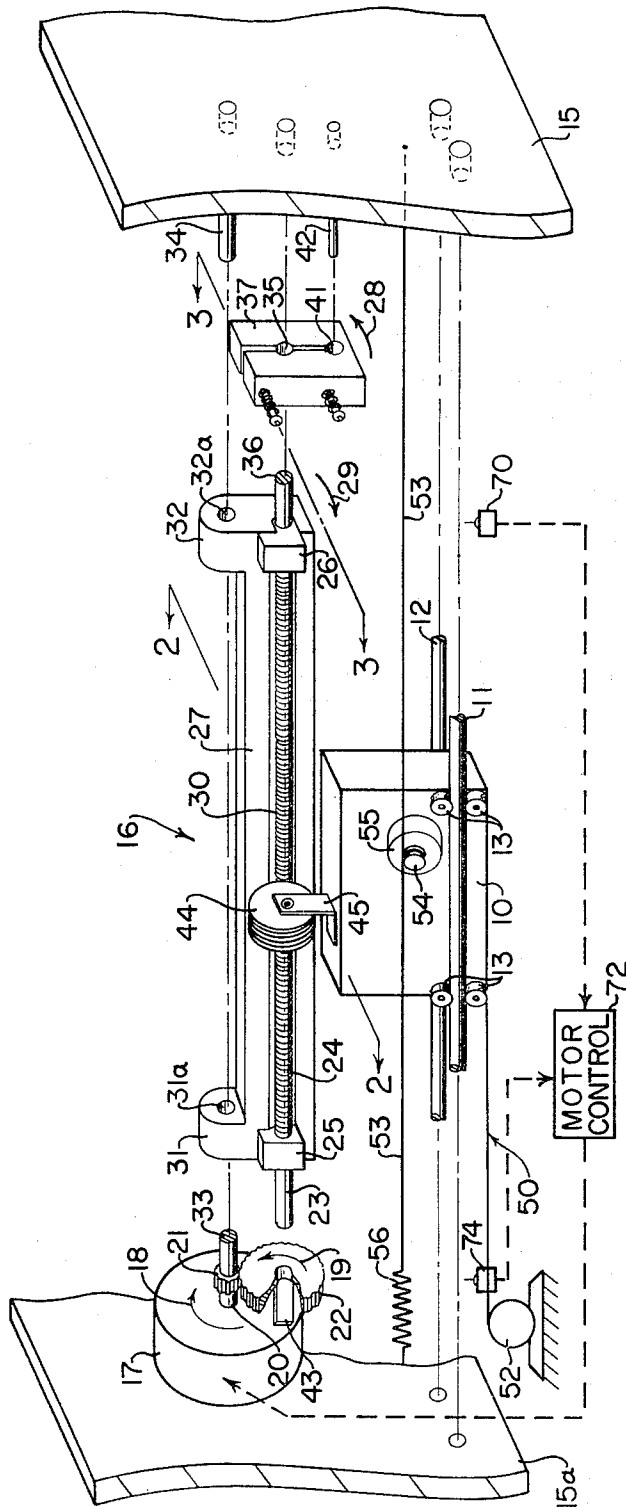
[57]

ABSTRACT

A lead control of a linear drive system particularly adapted to a drum type facsimile scanner is provided. The scanner head assembly is mounted for free movement on rails extending parallel to the axis of the drum. A half nut is affixed to the head assembly and engages a lead screw which is driven to linearly advance the head assembly. The lead screw is pivotally connected to the machine frame for rotation about an offset axis parallel to the axis of the lead screw. A friction clutch is provided between the lead screw and the machine frame and the reaction force produced by this clutch when the lead screw is rotated in a first direction causes the lead screw to pivot to bring the lead screw into meshing engagement with the half nut to effect a linear motion to the lead assembly relative to the drum. Rotation of the lead screw in the opposite direction produces an opposite reactive force through the friction clutch to pivot the lead screw away from the half nut, and terminate the linear motion of the head assembly.

12 Claims, 6 Drawing Figures





INVENTOR
JOHN H. LONG

BY
Meyer, Tilberry & Body
ATTORNEYS

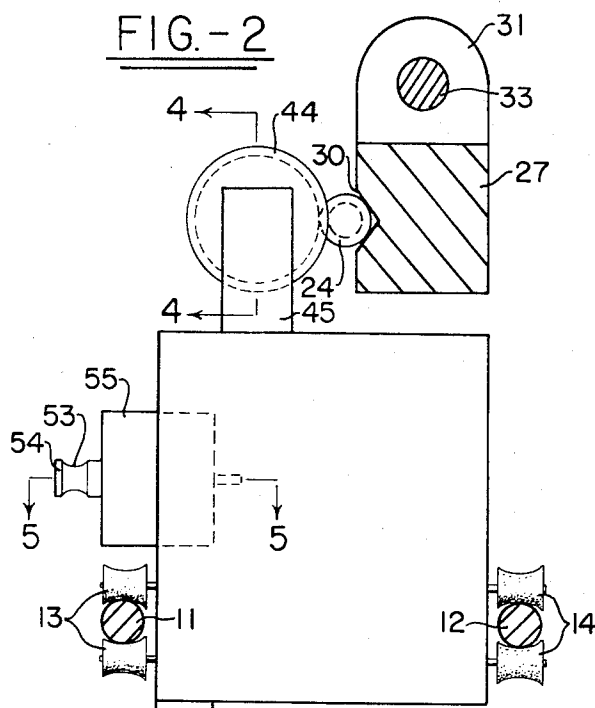
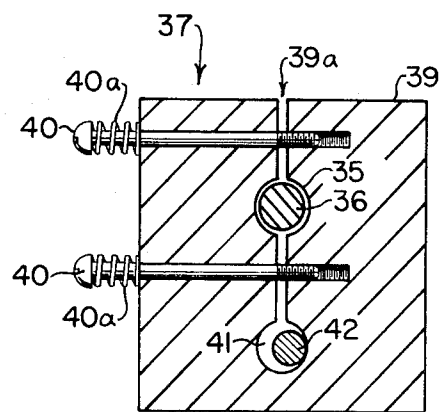


FIG.-3

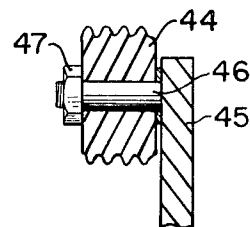


FIG.-4

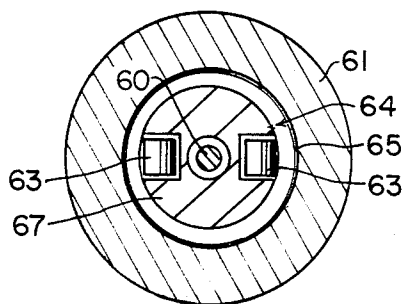


FIG.-6

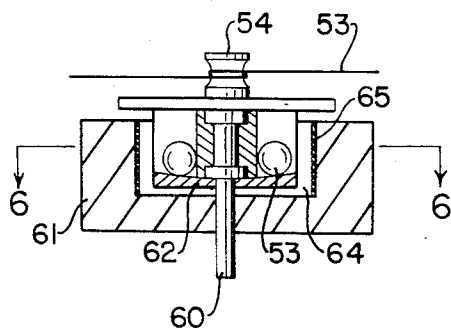


FIG.-5

INVENTOR
JOHN H. LONG

BY:
Meyer, Tilberry & Boddy
ATTORNEYS

LEAD SCREW CONTROL FOR LINEAR DRIVE SYSTEM

The present invention relates to a drum type facsimile transmitter and more particularly to an improved scanning head linear drive arrangement for such transmitters.

A facsimile transmitter normally includes a drum on which a photograph, drawing or other material to be transmitted is to be attached, a scanning head assembly which is adapted to be moved lengthwise of the drum along a path parallel to the axis thereof while generating a signal representative of the information on the photograph or other matter, drum rotating means for normally rotating the drum continuously while advancing the scanning head relative thereto to create a continuous helical spiral scan of the information on the drum. In such equipment the scanning head is normally moved in parallel relation to the rotative axis of the drum with the scanning head assembly being returned to its initial position at the completion of total information scan. In order to assure a uniform or linear drive of the scanner head to coordinate with the uniform rotation of the drum, a lead screw driving arrangement is employed. This arrangement employs a motor driven lead screw which meshes with a half nut carried on the scanner head assembly. During the return movement of the scanner head the half nut is disengaged from the lead screw and the scanner head assembly returns to its initial position by a tension device.

In the prior art scanner drive systems, the lead screw has been rigidly mounted and the release of the half nut for return movement of the scanner head has been accomplished by connecting the half nut to the scanner head assembly by an articulated mounting arrangement. In these prior art systems, the movement of the scanner head assembly has required a complicated mechanism for effecting the release of the half nut from the lead screw.

The lead screws used in the prior art scanning head drives are generally of rigid large diameter construction. Such rigid, large diameter construction has been necessary to avoid error in the linear feed due to flexing or bending of the lead screw, but obviously such lead screws are quite heavy and thus have considerable inertia and require substantial mechanical effort to move and control.

It is a primary object of the present invention to provide an improved lead screw control for a linear drive system particularly adapted for the head drive assembly of a facsimile apparatus which provides for the automatic engagement and disengagement of the half nut and lead screw so that the scanning transverse of the head is accomplished with a simple, reliable and inexpensive mechanical mechanism.

It is a further object of the invention to provide a scanning head drive arrangement having provision for the automatic release of the half nut from the lead screw which eliminates the prior art mechanism providing an articulated mounting for the half nut.

A further object of the invention is the provision of a scanning head drive assembly which utilizes a small diameter, low inertia lead screw.

Another object of the invention is the provision of a scanner head drive assembly utilizing a small diameter lead screw and having support means for the lead screw to prevent the bending, twisting, bowing, or other undesirable distortion thereof.

A further object of the invention is the provision of a circular half nut mounted on a concentric stud so that a slight rotation presents a new half nut surface to the lead screw in the event of half nut wear or damage.

The above and other objects of the invention which will become apparent in the following detailed description are achieved by providing a scanner head drive assembly which employs a motor driven small diameter lead screw carried on a mounting and support bar which bar is rotatably mounted on an axis in parallel offset relation to the axis of the lead screw. A torsion clutch engages one end of the lead screw and is connected to the machine frame to permit limited pivotal movement of the lead screw and mounting bar assembly. When the lead screw is rotated in a first direction the reactive torque through the clutch rotates the lead screw and mounting bar assembly so that the screw is brought into meshing engagement with a half nut carried in fixed relation on the scanner head assembly. Reversal of rotation of the lead screw results in an opposite reactive force through the torque clutch to pivot the lead screw and mounting bar assembly with the half nut. The mounting bar has a V groove in the surface thereof having low friction characteristics for supporting the lead screw to prevent bending over that portion subject to half nut pressure.

For a more complete understanding of the invention and of the objects and advantages thereof reference should be had to the following detailed description and the accompanying drawings wherein there is shown a preferred embodiment of the invention.

In the drawings:

FIG. 1 is a partially broken away front perspective view of a preferred embodiment of the lineal drive system of the invention;

FIG. 2 is a transverse sectional view of the head assembly taken along the line 2—2 of FIG. 1;

FIG. 3 is a transverse sectional view of the torque clutch taken along the line 3—3 of FIG. 1;

FIG. 4 is a transverse sectional view of the half nut taken along the line 4—4 of FIG. 2;

FIG. 5 is a transverse sectional view of the capstan taken along the lines 5—5 of FIG. 2; and

FIG. 6 is a transverse sectional view of the capstan taken along the lines 6—6 of FIG. 5.

It should be understood that while the linear drive mechanism of the present invention is described and illustrated with particular reference to a scanner head drive for a telephoto facsimile transmitter, such references are descriptive only and the invention is not limited to such applications, but could be adaptable to any linear drive system requirement.

HEAD ASSEMBLY 10

Referring now to the drawings, and particularly FIG. 1 thereof, there is shown a head assembly for a telephoto facsimile transmitter indicated generally by numeral 10, which is supported on parallel rails 11 and 12 by roller pairs 13 and 14, respectively, cooperatively engaging with the top and bottom of the rails. The rails 11 and 12 are supported in parallel spaced relation at the right ends by a suitable frame plate 15 and at their opposite ends by another frame plate 15a. The rails 11 and 12 permit the movement of the head assembly 10 along a straight path which in the case of a facsimile apparatus would be parallel to the axis of the document carrying drum which is not shown because it does not

comprise part of the invention. In a facsimile apparatus, the head assembly 10 would carry a suitable scanner to view the surface of the document carrying drum.

DRIVE MECHANISM 16

A drive mechanism, indicated generally by the numeral 16, and driven by a motor 17 is provided for advancing the head assembly 10 at a uniform or linear rate of speed along the rails 11 and 12. The motor 17 is a reversible motor having an output shaft 20 which carries a pinion 21. Meshing with the pinion 21 is a spur gear 22 which is slidably splined to one end 23 of an elongated lead screw 24. The lead screw 24 is journaled in suitable bearing blocks 25 and 26 which are carried by a mounting and support bar 27. As can be seen most clearly from FIG. 2, the portion of the lead screw 24 between the bearing blocks 25-26 is received and supported in a V-shaped groove 30 of the mounting bar 27, the surfaces of the groove preferably being coated with a low friction material such as Teflon.

MOUNTING BAR 27

The mounting bar 27 has upwardly projecting lugs 31 and 32 at its opposite ends which are provided, respectively, with bores 31a and 32a. The bores 31a and 32a have a common axis which is parallel to the axis of the lead screw 24. The bore 31a rotatably journals the left end of the mounting bar 27 on an axially aligned extension 33 of the motor shaft 22 while the bore 32a rotatably supports the opposite end of the mounting bar 27 on a pin 34 projecting from the frame member 15. It can be seen that this structural arrangement permits the pivotal rotation of the mounting bar 27 and the lead screw 24 about the axis of the motor output shaft 20 while maintaining the spur gear 22 in constant meshing relation with the drive pinion 21. Further, the end 24a of the lead screw 24 is ball tipped and penetrates in splined relation through spur gear 22 to impinge on an appropriate thrust plate 43 to provide a stable axial position of the lead screw 24.

TORQUE CLUTCH 37

The amount of rotation of the mounting bar 27 and the lead screw 24 is limited by a torque clutch 37. The torque clutch 37 is illustrated in more detail in FIG. 3 and consists of a block 39 having a vertically directed slot 39a extending through most of the height thereof and aligned parallel to the lead screw 34. The width or opening of slot 39a can be varied by squeezing on the open end thereof, and this is accomplished by screws 40 which carry helically coiled compression springs 40a. The block 39 has a bore 35 receiving the end 36 of the lead screw 34. The adjustment of screws 40 and their respective compression springs 40a provides an adjustable frictional grip on the end 36 of the lead screw 34. A second bore 41 in the body 39 receives a pin 42 which is supported by the frame member 15. It should be noted that the bore 41 is of larger diameter than is the pin 42, and the significance of this arrangement is more fully defined hereinafter.

HALF NUT 44

A half nut 44 is carried on a bracket 45 affixed to the head assembly 10. As best seen in FIGS. 2 and 4, the half nut 44 is circular and is carried on a stud 46 affixed to the bracket 45. While the half nut 44 normally does not rotate on the stud 46, a clamping nut 47 may

be loosened to permit rotation of the half nut 44. This arrangement permits a new surface of a half nut 44 to be brought into meshing relation with the lead screw 24 if the previous meshing surface of the half nut 44 has become worn or damaged. It also permits ready replacement of the half nut 44. Preferably, the pitch diameter of the half nut should be N integral multiples of the pitch diameter of the lead screw 24 and should contain N threads of the opposite hand from the threads of the lead screw 24 to insure proper meshing and a linear drive relationship therewith. In a preferred embodiment of this invention for a facsimile telephoto transmitter $N = 5$.

TENSION DEVICE 52

Attached to the head assembly 10 is a flexible band or cord 50 of a fixedly mounted tension device 52. The tension device 52 is of conventional construction and may include a coil spring which is wound up as the cord or band 50 is withdrawn as the head assembly 10 is moved to the right. Naturally, the cord 50 provides a constant bias to return the assembly 10 to the left or initial position.

CAPSTAN 54

A cord 53 also extends coincident with the path of travel of the head assembly 10 and is wound around a capstan 54 operatively connected to a centrifugal braking assembly 55 mounted on the head assembly 10. The cord 53 may be tensioned by a spring or other tension means 56 to maintain sufficient frictional engagement between the cord 53 and capstan 54 to insure a non-slipping relationship.

BRAKING DEVICE 55

The centrifugal braking device 55 is shown in more detail in FIG. 5. The capstan 54 is carried on a shaft 60 which is journaled in a housing 61 mounted in fixed relation to the head assembly 10 most appropriately in a hole formed therein for that purpose. Journaled on and rotating with the shafts 60 and capstan 54 is a plate 62 which is inclined to a greater thickness towards its outer circumference. Rollers 63 rest on the inclined surface of the plate 62. The plate 62 and rollers 63 are received within a cylindrical bore 64 of the housing 61. The circumference of the bore 64 is provided with a friction material lining 65 such as a rubber composition, or the like. When the capstan rotates at sufficient speed, the rollers 63 are driven radially outwardly on the inclined plates 62 to contact the friction material lining 65 of the bore 64, exerting a braking force tending to slow the rotation of the capstan 54.

DESCRIPTION OF OPERATION

Referring now to FIG. 1 and assuming that the lead screw 24 is a left hand threaded screw, the operation of the drive assembly of the present invention will be described. When the motor output shaft 20 and drive pinion 21 are rotated in the direction of the arrow 18 the spur gear 22 and the lead screw 24 are rotated in the direction of the arrow 19. The torque clutch 37 will attempt to rotate along with the lead screw 24, this rotation being in the direction of the arrow 28. However, the rotation of the torque clutch 37 is limited by the fixed pin 42. As a result, a reactive force rotates the lead screw 24 and mounting bar 27 about the axis of the bores 31a and 32a, the rotation being in the direc-

tion of the arrow 29. The lead screw 24 is thus rotated into meshing engagement with the half nut 44. Thus, the rotary motion of the lead screw 24 is transmitted through the half nut 44 into a uniform linear motion of the head assembly 10 in the direction of the arrow 38. Since the lead screw 24 is supported in the V-groove 30 of the mounting bar 27, the pressure exerted on the lead screw 24 by the half nut 44 is transmitted to the mounting bar 27, thus preventing the bending or bowing of the lead screw 24 and assuring uniform drive speed for the assembly 10 throughout the length of its traverse.

It will be noted that during the movement of the head assembly 10 in the direction of the arrow 38 the tension device 52 is being wound up. Also, the capstan 54 is being rotated in this time, but the rate of rotation is not sufficient to force the rollers 63 into frictional engagement with the lining 65 of the bore 64 and, as a result, no braking force is imposed by the assembly 55.

When the head assembly 10 has reached the limit of its travel a micro switch 70 might be contacted causing the motor 17 to either stop or be reversed by action through a motor control indicated by block 72. If the motor 17 is stopped all components remain in their last position. However, upon a reversal in the direction of rotation of motor 17, the torque clutch 37 will again attempt to rotate with the lead screw 24. The amount of rotation of the torque clutch 37 is again limited by the relative sizes of the bore 41 and the fixed pin 42. When this limit of rotation is reached, a reactive force is again applied to the end 36 of the lead screw 34, the force being applied in a direction opposite that of the arrow 29 and thus causing the lead screw 24 and mounting bar 27 to rotate about the axis of the bores 31a and 32a in a direction opposite to that of the arrow 29 so that the lead screw 24 is moved out of engagement with the half nut 44. The tension device 52 now rewinds, pulling the head assembly 10 which is returned to its initial position. The tension device 52 actually controls the initial position of the assembly 10, and at this position another micro switch 74 might be actuated to again reverse or stop the motor 17 as selectively desired through the control 72.

The actual pivotal movement of the mounting bar 27 is defined by the center to center distance between holes 35 and 41 in the torque clutch 37, and the excess of diameter of hole 41 to pin 42. Preferably these relationships are carefully determined so that the lateral movement of lead screw 24 is only slightly more than the depth of the threads of the half nut 44 or the lead screw 24. In other words, with the motor 17 driving in the normally forward direction, the lead screw 24 is moved just enough to achieve a fully mated relation with the fixed half nut 44, and with the motor 17 rotated in the reverse direction the lead screw 24 moves back so that there is a very small clearance between its outer periphery and the outer periphery of the half nut 44. There is rotational slippage of end 36 in the hole 35 of clutch 37 during rotation of lead screw 24 and this continuously exerts a reactive force through the clutch 37 to either hold the threads in or out of engagement depending on the direction of rotation of the lead screw 24.

It will be understood that while only the best known embodiment of the invention has been described and illustrated in detail, in accordance with the Patent Statutes, the invention is not so limited. Various modifica-

tions and additions may be made to the described embodiments and reference therefore should be made to the appended claims to determine the true scope of the invention.

What is claimed is:

1. A lead screw control assembly for a linear drive system which comprises

a head assembly, means to support the assembly for linear movement in a fixed path, a half nut mounted in fixed relation to the assembly, an elongated lead screw with its axis extending parallel to said fixed path, support means for said screw to effect movement thereof laterally in parallel relation to said path to and from cooperative meshed engagement with said half nut, motor means rotatably drive said lead screw, and means acting on said support means for biasing said screw into engagement with said nut when rotated in one direction and out of engagement with said nut when said screw's rotation is reversed or stopped.

2. An assembly according to claim 1 which includes means to change the fixed position of the half nut with respect to the head assembly to expose another portion of the threads thereof to the lead screw.

3. A control assembly according to claim 1 where said support means for said screw includes a V-shaped notch receiving said screw therein to support said screw along the full length thereof.

4. A control assembly according to claim 3 which includes a friction resistant layer on the surfaces of said V-shaped notch.

5. A control assembly according to claim 1 where said motor means includes a pinion rotatably driven on a driving axis, said support means for said screw comprises a mounting bar rotatably mounted in alignment with the axis of said motor means, said mounting bar rotatably supporting said lead screw in spaced parallel relation to the pivotal mounting thereof, a spur gear operatively affixed to said lead screw and engaging the pinion of the motor means, and said means responsive to the rotatable drive of said lead screw comprises a torque clutch cooperating with the mounting bar to limit the pivotal movement thereof to and from meshing relation of the screw with the half nut directly dependent upon the direction of rotation of the motor means.

6. An assembly according to claim 5 wherein said torque clutch comprises a split block, spring means to resiliently control the split opening therein, a pair of spaced holes through the split in the block, one end of the lead screw received in frictional engagement through one hole, and a fixed mounted pin operatively received through the other hole, said pin being of smaller diameter than said other hole whereby the play of said pin in the second hole limits the pivotal relation of the mounting bar.

7. A control assembly according to claim 1 for a facsimile apparatus which includes first means to define an initial position of said head assembly with respect to said means to support said assembly, said first means also returning said head assembly to said initial position whenever said lead screw is in unmeshed relation with said half nut.

8. An assembly according to claim 7 which includes a second means to provide a controlled braking to the head assembly upon its return to an initial position by said first means.

9. An assembly according to claim 8 where said first means is a wind up tension device fixedly mounted in spaced relation to said head assembly, a cord connecting the tension device to the head assembly whereby the device winds up upon movement of the assembly away therefrom by the action of the cord extending therebetween, and said second means is a centrifugally acting braking capstan assembly mounted to said head assembly, and means to actuate said capstan assembly dependent upon the linear speed of said head assembly to effect a braking action to said head assembly when the linear speed thereof exceeds a predetermined minimum.

10. A scanning head drive mechanism for a telephoto facsimile transmitter, comprising:

a scanning head assembly;

frame means supporting the head assembly for linear movement;

a lead screw having its longitudinal axis parallel to the direction of linear movement of the scanning head assembly;

a mounting bar having journals at its opposite ends for rotatably carrying the lead screw, the mounting bar being supported for rotation about an axis parallel to but offset from the longitudinal axis of the lead screw;

means for rotatably driving the lead screw;

a torque clutch connected to the lead screw and rotatable therewith through a fixed arc, the arrangement being such that further rotation of the lead screw produces a rotation of the lead screw and mounting bar through a limited arc about the axis of rotation of the mounting bar; and

a half nut fixedly carried by the scanning head assembly and having meshing engagement with the lead screw when the lead screw and mounting bar are at one extreme of their limited arc of rotation, and being a non-meshing relation when the lead screw and mounting bar are at the other extreme of their limited arc of rotation.

11. The mechanism according to claim 10 wherein the mounting bar extends along at least the threaded portion of the lead screw and is provided with a groove receiving and supporting the lead screw.

12. The mechanism according to claim 11 which includes tension means to return the head assembly to an initial position whenever the lead screw and half-nut are in unmeshed relation, and brake assembly means to effect a controlled braking of said tension means during the return of said head assembly to its initial position.

* * * * *

30

35

40

45

50

55

60

65