

April 2, 1946.

A. G. COOLEY

2,397,535

MOVING WEB RECORDING MACHINE

Filed Dec. 13, 1941

4 Sheets-Sheet 1

Fig. 1.  
(PRIOR ART)

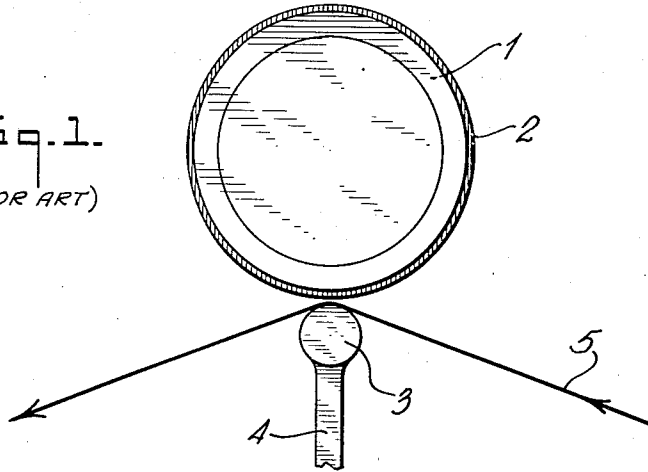


Fig. 2B.

Fig. 2A.

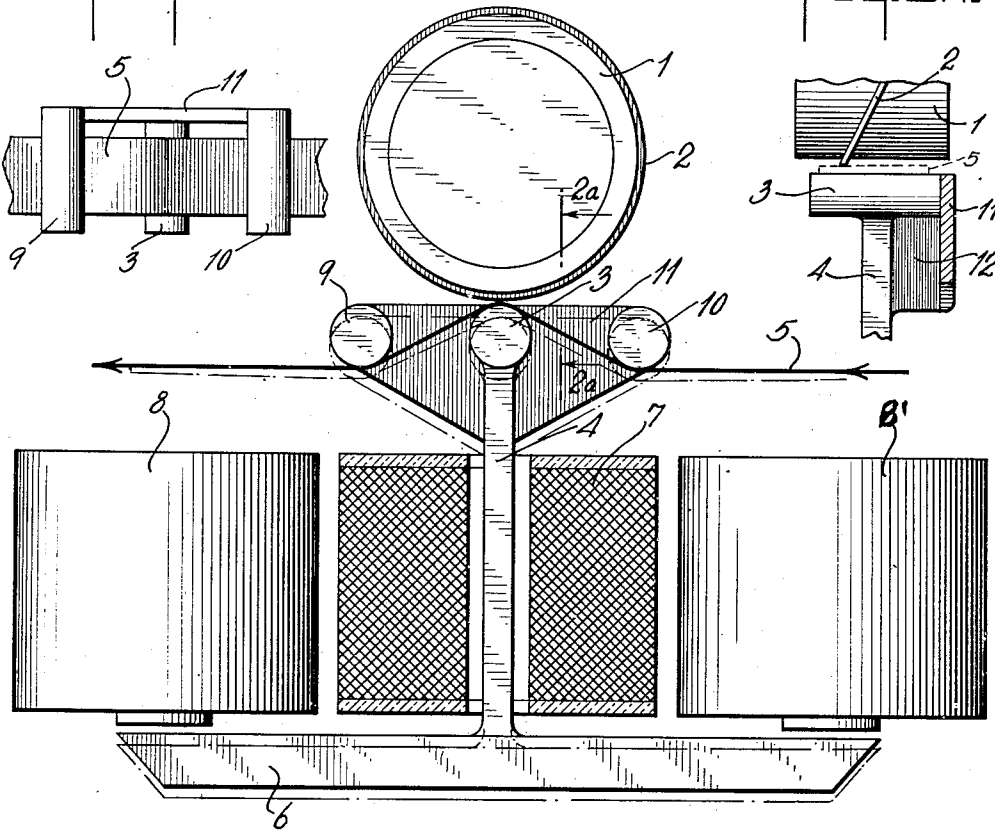


Fig. 2.

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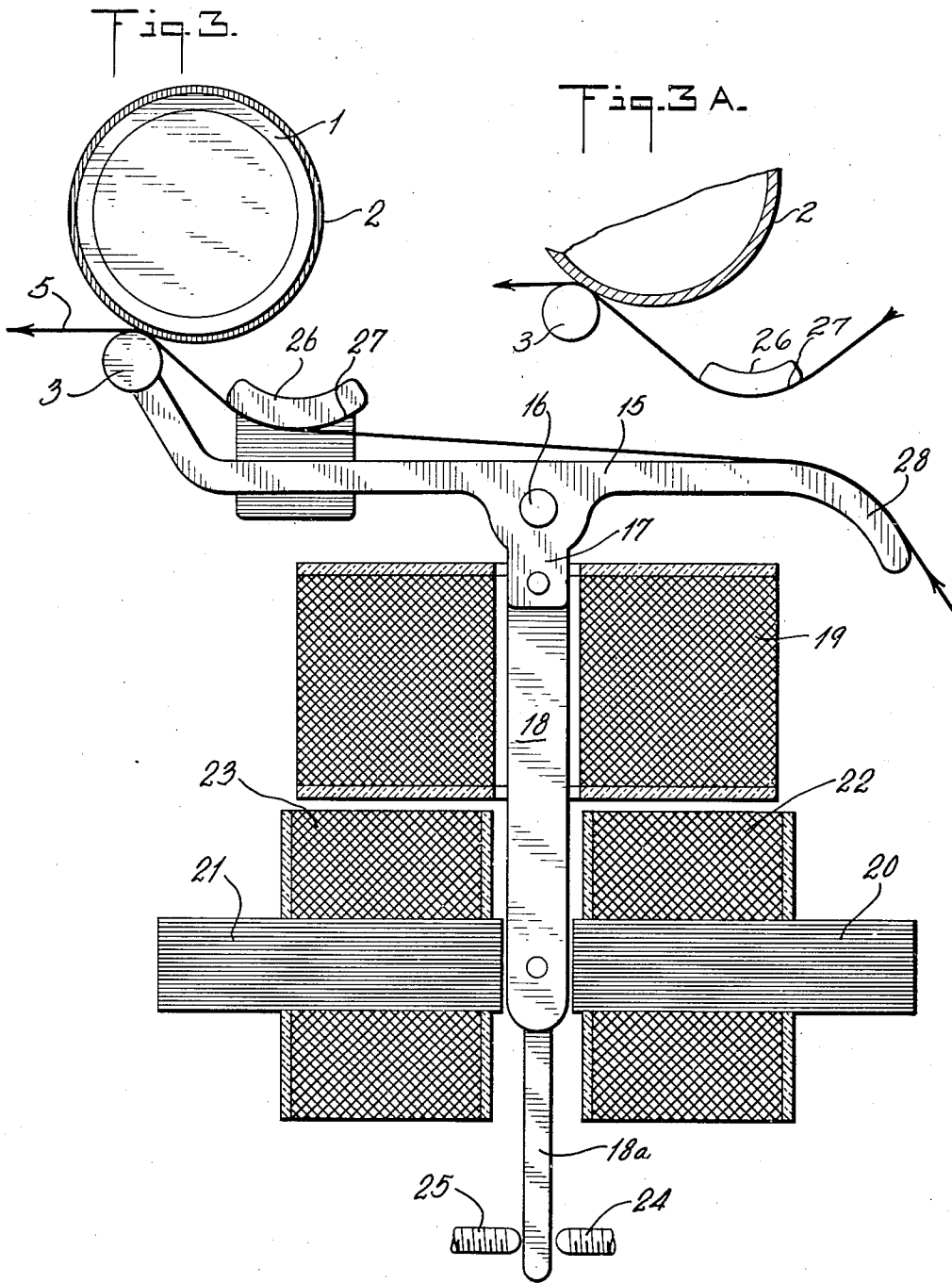
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4 Sheets-Sheet 2



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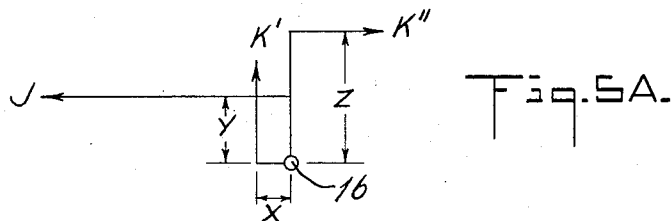
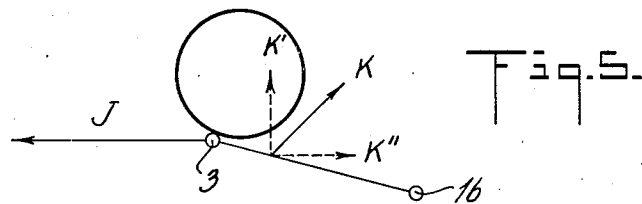
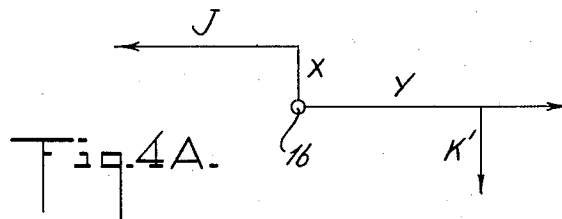
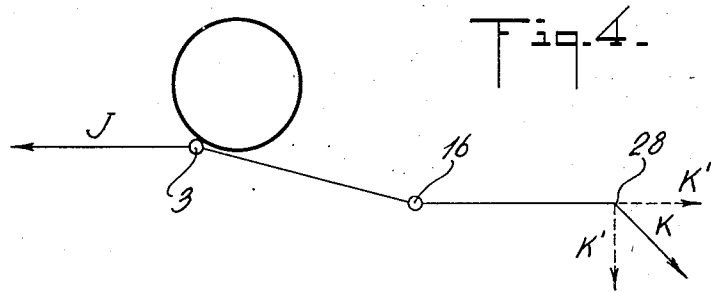
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MOVING WEB RECORDING MACHINE

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4 Sheets-Sheet 3



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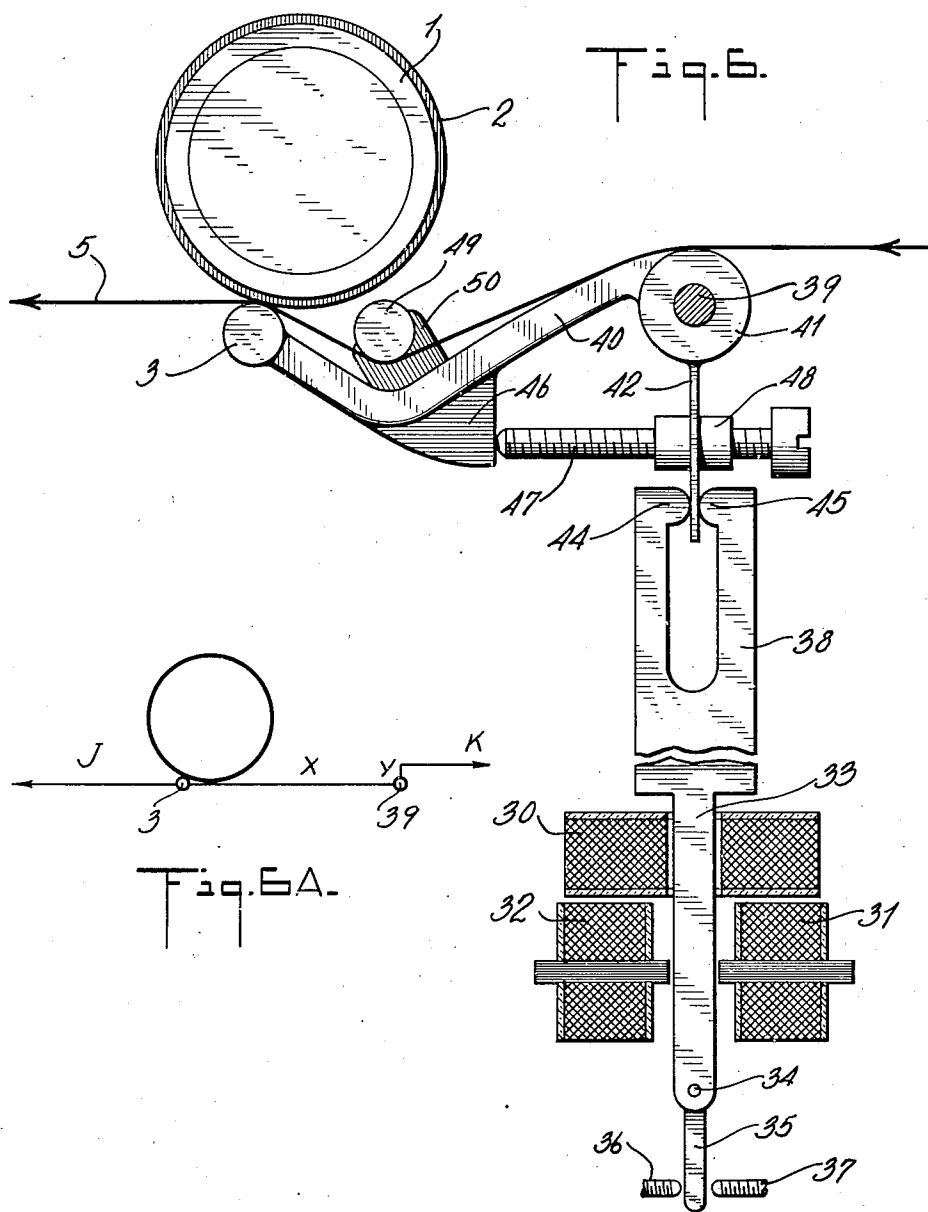
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MOVING WEB RECORDING MACHINE

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4 Sheets-Sheet 4



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## UNITED STATES PATENT OFFICE

2,397,535

## MOVING WEB RECORDING MACHINE

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Application December 13, 1941, Serial No. 422,793

14 Claims. (Cl. 234—70)

This invention relates to recording machines and more especially to machines of the type employing a travelling web or tape.

A principal object of the invention is to provide an improved recording head and tape feed arrangement for telegraph machines of the tape recording type.

One type of tape recorder machine that has been found satisfactory for telefacsimile purposes employs a so-called helix drum or platen, and an oscillatable recorder bar, with a transfer member such as a carbon ribbon or inked ribbon located between the helix and the tape. The bar is arranged with its recording edge extending transversely to the helix edge so that at any given instant of operation a single point-like area of intersection exists between the bar and helix and the pressure which is exerted thereby upon the intervening tapes causes a transfer of the carbon or ink in a minute dot on to the record receiving tape. In another type of recorder the carbon ribbon is eliminated and the helix itself is inked by an inking roller or the like. This latter type of recorder possesses the disadvantage that the ink which is entrained between the helix edge and the recording tape tends to spread beyond the desired area. This may result in the ink spreading over areas which are intended to be white or unmarked.

Accordingly, it is another principal object of the invention to provide an improved telegraph recorder of the type having an inked roller and a cooperating oscillatable recorder bar.

While the ink spreading phenomenon in the helix-bar type of recorder can be reduced by causing the tape to travel in a non-linear path adjacent the actual recording area, the fact that the recording tape must be kept taut, results in an undesirable load on the electromagnetically controlled recording unit which is connected to the recording bar. Furthermore, since the tape tension varies from time to time, it is not practical to endeavor to compensate for this additional load on the recorder, by means of springs or other similar compensating devices.

Accordingly, it is another principal object of the invention to provide an improved tape recorder of the inked helix and recorder bar type wherein the tape tension is not reflected as an undesirable load on the electromagnetic signal-controlled operating mechanism.

A feature of the invention relates to an improved tape guide and operating device whereby the tape can be led to and away from the recording point at an angle without placing any

undesirable load on the electromagnetic or similar signal-controlled operating mechanism.

Another feature relates to an improved operating and tape-guiding device for facsimile tape recorders generally.

A further feature relates to a tape recording head for telegraph tape recorders, whereby the speed of recording can be increased without danger of smudging or spreading of the recording ink on to areas which are to be free from recording marks.

A still further feature relates to the novel organization, arrangement and relative location and proportioning of parts which cooperate to form a relatively simple and efficient tape recorder.

Referring to the drawings which show certain preferred forms of the invention:

Fig. 1 is a generalized schematic diagram of the pertinent parts of a helix-bar tape recorder to which the invention is primarily applicable.

Fig. 2 is a typical arrangement according to the invention.

Fig. 2A is a sectional view of part of Fig. 2 taken along the line 2A—2A thereof.

Fig. 2B is a top-plan view of the tape-guiding device of Fig. 2.

Fig. 3 is a modification of Fig. 2.

Fig. 3A represents a modification of Fig. 3.

Fig. 4 is a composite schematic-vector diagram explanatory of Fig. 3.

Fig. 4A is an equivalent vector diagram corresponding to Fig. 4.

Fig. 5 is a modification of the tape feed of Fig. 3 represented schematically.

Fig. 5A is a simplified vector diagram corresponding to Fig. 5.

Fig. 6 is a further modification of Figs. 2 and 3.

Fig. 6A is a vector diagram corresponding to Fig. 6.

Referring to Fig. 1, there is schematically shown the more important parts of a recording head of one known form of helix-bar facsimile tape recorder including amongst other elements, a cylindrical drum or platen 1 having a helical rib 2 on the exterior thereof. Extending parallel to the rotational axis of drum 1, is a recording bar 3, which is carried by an arm 4 adapted to be moved vertically under control of a signal-controlled electromagnet or the like (not shown). A recording tape 5 is arranged to pass between the member 3 and rib 2, there being sufficient tension on the tape to hold it against the bar 3. If the recorder is of the type wherein the

rib 2 is inked, then a suitable inking roller (not shown) is provided for transferring ink to the said rib. For a more detailed description of a recorder head of this general type, reference may be had to my application Serial No. 418,172, filed November 7, 1941, now Patent No. 2,363,398, issued November 21, 1944.

With such a recorder, the "marking" area on the tape 5 at any given instant, is determined by the intersectional area between the bar 3 and rib 2. Normally, or when no marking signal is being received, the arm 3 is in its lower position whereby a clearance is provided between the tape 5 and the helix rib. In order to produce accurate recorded copy, it is necessary that the tape be maintained at a minimum tension at the recording point so that it does not "flutter" or accidentally move with respect to the members 2 and 3. It is desirable that the tape should be fed to and away from the recording point with a minimum of back pressure on the bar 3, which pressure would represent an undesirable load on the electromagnetic operating mechanism connected to member 4. One way of reducing this load is to feed the tape to and away from the recording point in a straight line or single plane substantially perpendicular to the arm 4. However, this method of tape feed has a number of disadvantages, one of which is that the opening angles between the tape and the rib 2 adjacent the recording point are sufficiently small to cause entrained ink to spread itself over a larger area than that intended for marking. This may result in the formation of a continuous line or in the spreading of the ink to areas which are intended to be white or unmarked. Furthermore, in order to prevent accidental fluttering of the tape, it must be kept under a certain minimum tension at the recording point and it is very difficult to effect this tension without exerting some back pressure on the arm 4. The above disadvantages can be overcome to a certain extent by leading the tape to and away from the recording point at an angle as represented by the full line position of the tape 5 in Fig. 1. However, because of the tension on the tape there is a considerable downward component which acts as an undesirable load on the operating mechanisms for the members 3 and 4. Since the degree of tape tension may vary considerably from time to time, ordinary compensating devices such as springs or the like are not practical with this arrangement.

I have found that the desirable results of the angularly fed tape can be utilized while also avoiding reaction of the tape tension on the recorder control mechanism, even though the tension varies considerably. This is accomplished by guiding the tape through a device which forms an integral part of the recorder arm mechanism. A typical arrangement for accomplishing this object is illustrated in Fig. 2, wherein the parts corresponding to those of Fig. 1 are similarly designated. In Fig. 2 the full line showing of the members 3, 4, 6, 9, 10 and 11 represents their position when the magnets 8 and 8' are energized to press the tensioned web 5 against the printing rib 2. When the magnets are de-energized the position of the parts is represented by the dot-dash lines. The recorder bar 3 and its operating arm 4 are fastened to a magnetic armature 6 which is arranged to be polarized by a D. C. magnetizing winding 7 surrounding the arm 4. A pair of signal-controlled magnets 8, 8', having wind-

ings energized by received signals, act on the armature 6 to raise it vertically causing the tape 5 to be pressed against the inked rib 2. It will be understood that a suitable adjustable stop (not shown) is provided below armature 6 to adjust its normal downward or non-marking position whereby the tape 5 is spaced from rib 2. Integrally carried by the upper end of arm 4 is a rigid plate 11 which is preferably cast integrally with the arm 4 by means of a web 12. Fastened in the plate 11 in alignment with the bar 3 are two rounded bars 9 and 10. Preferably, although not necessarily, the members 3, 4, 9, 10 and 11 may be cast as a single unit. The tape 5 which is fed in the direction of the arrows and is maintained taut by any well-known means, passes under the bar 10, is then inclined upwardly to pass over bar 3, from whence it is led downwardly under bar 9. It will be seen therefore, that any downward component of the tape tension tending to react on arm 4 is compensated for by equal and opposite components tending to pull the arm upward, these latter forces being produced by the engagement between the taut tape and the under side of members 9 and 10. By appropriate design of the diameters of the members 9 and 10 and their position with respect to bar 3, the tautness of the tape is not reflected as a load on the armature 6. Thus as shown in the drawings the bars 9 and 10 are preferably, although not necessarily, of the same diameter and are equally spaced on opposite sides of the bar 3 with their lower edges in substantially the same plane. Preferably, the armature 6 is provided with vertical guides (not shown) to prevent it from tilting so that it is constrained to move in a substantially vertical direction when the magnets 8 and 8' are energized.

Fig. 3 shows a modification of Fig. 2 employing a pivoted armature and in which the forces applied to the tape are substantially balanced out and cause no load on the electromagnetic driving system. The recorder arm 3 is mounted at one end of a rocker arm 15 which is supported for rotation on and around a fixed fulcrum pin 16. Rocker 15 has a downwardly extending portion 17 to which is rigidly fastened the magnetic armature 18. Armature 18 is surrounded by a D. C. polarizing electromagnet 19 whereby the armature is steadily polarized. Adjacent the lower end of the armature and on opposite sides thereof are the pole pieces 20, 21, with their individual magnetizing windings 22, 23, which are adapted to be energized respectively under control of spacing and marking signals, for example as described in detail in application Serial No. 397,513, filed June 11, 1941, issued as Patent No. 2,328,056. Thus when winding 23 is energized by a marking signal, it rotates the armature 18 in a clockwise direction around fulcrum 16 thus causing arm 3 to engage the tape 5 with the inked helix 2. When a spacing signal occurs, winding 22 takes control whereby the tape 5 is disengaged from helix 2. Suitable adjustable stops 24 and 25 are provided in cooperation with the armature extension 18a to limit the movement of the armature in known manner. The rocker 15 carries an integral tape guide 26 having a curved guiding wall 27 vertically spaced from the arm 15. Similarly the right-hand end 28 of rocker 15 is curved downwardly to be engaged by the tape as indicated by the full line position of Fig. 3. The members 3, 26 and 28 correspond to the members 3, 9 and 10 of Fig. 2 in so far as they

control the direction of feeding movement of the tape and in so far as they cooperate with the tape to compensate for the load which the tape tension would normally tend to exert on the armature 18a. By proper proportioning of the various dimensions of rocker 15 with respect to pivot 16 and guide 26 and inclination of member 23, it is possible to prevent the tape tension from being reflected as a non-useful load or bias on the armature 18. In other words, the tape tension acting on the right-hand end of lever 15 tends to rotate the lever around pivot 16 in a clockwise direction, thus tending to bias the armature 18 so as to maintain bias pressure between 18a and 25. On the other hand, the tension of the tape acting on the bar 3 tends to rotate the lever 15 in a counter-clockwise direction thus tending to maintain the member 18a in bias pressure against member 24. These two forces can be balanced against each other.

Assuming that the tape is entering along the full line position of Fig. 3, then the relation of the various parts is schematically illustrated in Fig. 4 where the corresponding parts are similarly designated. Since the guide 26 is a rigid unit with lever 15, it exerts no rotational moment on the lever 15. However, it does serve to control the angle at which the tape approaches the bar 3. Before analyzing the forces, it should be observed that the tension on the tape as the tape leaves arm 3 is greater than the tension on the tape as it enters guide 26. The total tension on the emerging tape is schematically illustrated in Fig. 4, by the vector J, while the "hold-back" tension is represented by vector K. J is greater than K because of the added load resulting from the friction of the tape as it moves over members 28, 26 and 3. The "hold-back" tension K can be resolved into two components K' and K''. It will be observed therefore, that the component K'' being directly in line with the fulcrum 16, produces no rotational moment therearound. However, by properly proportioning the component K', the resultant moment about fulcrum 16 due to the tension of the tape will be neutralized. This will be clear from the equivalent moment diagram of Fig. 4A, wherein the moment JX equals the moment K'Y where X and Y are respectively the distances from the fulcrum 16 to the point where the various forces are applied. Therefore, considering the effect on the armature 18, the tension of the tape exerts little if any undesired bias on the position of the armature 18 and exerts very little if any load on the pivotal contact between the lever 15 and its pivot point 16.

It is not necessary that the tape be fed into the guide below the horizontal, for example the tape may be fed into the guide along the path shown in Fig. 3A. The equivalent diagrams for this condition are illustrated in Figs. 5 and 5A. The total "hold-back" tension K can be resolved into its two components K' and K'', while the tension on the tape leaving the point 3 is represented by J. An examination of the equivalent moment diagram of Fig. 5A will show that when the moment  $J \cdot Y = (K'' \cdot Z - K' \cdot X)$  the rotational forces resulting from the tape tension tending to rotate the armature around the pivot 16 are balanced so that the position of the armature is entirely under control of the magnets 22 and 23.

Referring to Fig. 6, there is shown a modification wherein a system of electromagnets 30, 31, 32, similar to magnets 19, 22 and 23 (Fig. 3) are provided, the magnet 30 being the steady polarizing magnet and the magnets 31 and 32 being

the signal-controlled magnets. A magnetic armature 33 is pivoted and supported adjacent its lower end on a pivot pin 34 and has an extension 35 cooperating with the adjustable stops 36, 37. Armature 33 carries at its upper end a rigid bifurcated extension 38. Pivotaly supported on a fixed fulcrum pin 39 is a V-shaped rocker arm 40. Attached to the hub 41 of the rocker arm is a substantially flexible flat metal member 42 whose lower end extends between the rounded right angled members 44, 45 of extension 38. The members 44 and 45 are spaced apart to provide sufficient clearance to receive member 42 without binding.

Rocker 40 has an integral shoulder 46 adapted to engage the end of an adjusting screw 47 threaded through a boss 48 carried by member 42. The relative position of the recorder bar 3 with respect to points 44, 45, is controlled by adjustment of screw 47. A rounded tape guide bar 49 is carried by a lug 50 integrally attached to rocker 40. If desired, the members 40, 41, 42, 49 and 50, may be cast in a single piece. Assuming that the tape 5 is fed to the device as indicated by the arrows, then Fig. 6A represents the equivalent vector diagram in which J represents the tension on the tape as it leaves the arm 3 and K is the "hold-back" tension on the tape. The force J is directly in line with the arm X, and therefore exerts no rotating moment about the fulcrum 39. The force K has a slight rotational moment K.Y which tends to compensate for the mechanical unbalance of the arm 40 about the pivot 39.

While in the embodiment of Fig. 6 the rocker arm itself is mechanically unbalanced and is compensated for by the tape tension acting through the lever arm Y (Fig. 6A), it will be understood that the mechanical unbalance can be compensated for by an additional arm similar to the arm 28 of Fig. 3. However, in the diagrammatic view of Fig. 6A where the mechanical unbalance is compensated for directly by the tape tension, the mechanical inertia of the moving system controlled by the magnets 31 and 32 is considerably reduced.

While in the foregoing embodiments it has been mentioned that the reactive effect of the tape tension on the armature mechanism is entirely compensated for, it will be understood that the parts may be proportioned so as to achieve either full compensation, partial compensation or over compensation as may be desired. Thus the parts may be proportioned so that the tension of the tape which tends to bias the printing mechanism in one direction by reason of the engagement of the tape with the printing bar, can be neutralized either partially or completely by an opposite bias resulting from the tensioned tape engagement with the tape guide. Furthermore, while the invention finds its primary utility in a tape recorder of the inked-helix type, it will be understood that the invention is useful in any recorder where a record receiving tape is held under tension and is adapted to be moved in a direction transverse to the tension forces. Thus, instead of employing an inked helix, the helix may be dry and a carbon tape or ribbon can be interposed between the record receiving tape 5 and the helix.

What I claim is:

1. A guiding and operating mechanism for a tensioned record receiving web; comprising a signal-controlled electromagnet armature, a web guide and operating device mounted for operation by said armature for movement in unison therewith, said device including a rigid unit hav-

ing three spaced members for engaging the web at three regions two of said members engaging one face of the web and the third of said members engaging the opposite face of said web to cause it to follow a crooked path adjacent the recording area and the component of the tape tension force which tends to act as a load on said armature being substantially neutralized.

2. A guiding and operating mechanism for a tensioned record receiving web; comprising a signal-controlled electromagnet armature, a lever mounted for operation by said armature, a main recording bar carried by said lever, a web guide also carried by said lever, said web having its opposite faces engaging respectively said guide and bar so that it is flexed in opposite directions, the web being tensioned and fed at an angle to said guide so that it presses against said guide to exert one rotational moment on said lever and presses against said bar to exert a substantially opposite and equal rotational moment on said lever.

3. A guiding and operating mechanism for a tensioned record receiving web; comprising a signal-controlled electromagnet armature, a lever operatively engaging said armature for movement thereby, a recorder bar carried at one end of said lever, a web guide also carried by said lever between said bar and the lever fulcrum, said guide having a guiding surface in spaced relation to the lever, said web engaging said bar and said guide at different angles whereby the rotational moments on said lever resulting from the tape tension are substantially balanced.

4. A guiding and operating mechanism for a tensioned record receiving web; comprising a signal-controlled electromagnet armature, a lever operatively connected to said armature, a web guide carried by said lever having a guiding surface in spaced relation to the lever surface, said web extending along said lever and engaging it adjacent one end to exert one direction of rotational moment thereon, said web also engaging said guide to exert a rotational moment on said lever which is opposed to the first mentioned moment.

5. In a telegraph tape recorder of the type having a printing platen and a movable printing bar between which a tensioned record receiving tape is fed; a magnetic armature, an electromagnet system for moving said armature in response to telegraph signals, a pair of tape guides disposed in parallel spaced relation to said bar and movable as a unit therewith, said tape having its leading portion flexed under one of said guides and its trailing portion flexed over the other of said guides, the portion of the tape adjacent the recording point being flexed over said printing bar.

6. A telegraph tape recorder according to claim 5 in which said platen has an inked helical ridge, and said printing bar extends so as to intersect said ridge, the tape being located between said ridge and bar with its leading and trailing portions adjacent the recording point being inclined away from the surface of the platen so as to confine the contact of the tape with said ridge to substantially the point of intersection between said bar and ridge.

7. In a telegraph tape recorder of the type having a platen and a movable printing bar between which a tensioned record receiving tape is fed; a magnetic armature, an electromagnet system for moving said armature in response to

telegraph signals, a lever connected to said armature to be oscillated thereby, the printing bar being located at one end of the lever, a tape support at the opposite end of said lever, and a tape guide located adjacent the printing bar for flexing the tape downwardly as it passes between said bar and said support.

8. In a telegraph tape recorder of the type having a platen and a movable printing bar between which the tensioned record receiving tape is fed: a rocker arm carrying said printing bar at one end, a signal-controlled electromagnet armature for oscillating said rocker arm, said arm being shaped so that the tape when tensioned engages the arm only at the end regions while being spaced from the intervening length of the arm, and a tape guide carried by the rocker arm intermediate its ends for flexing the tape toward the arm.

9. A telegraph recorder according to claim 8 in which said signal-controlled electromagnet armature has a bifurcated extension, a flexible link having one end fastened to said rocker arm and the other end located between the arms of said bifurcated extension, and an adjustable abutment for adjusting the relative position of said printing bar with respect to said flexible link.

10. In a recorder of the type employing a record-receiving web which is under tension; a marking member, another member in engagement with said web and arranged to move said web in a direction transverse to its length and towards said marking member to press the web against said marking member while said web is under tension; web guide means, said web being held by said tension and against said other member and said guide means so that the tension has a component tending to oppose said transverse web movement and another component tending to assist said movement, and a signal controlled operating mechanism for oscillating said other member, to selectively engage and disengage said web with respect to said marking member.

11. In a recorder of the type employing a record-receiving tape which is under tension and is arranged to be fed in the direction of its length; a platen and a printing bar between which said tape is positioned, mechanism for oscillating said bar toward and away from said platen to thereby oscillate said tape in a direction transverse to its feeding movement to press it against said platen while under tension, means to guide said tape to the recording point on said platen so that it follows a substantially V-shaped path with the printing bar located at the apex of the V, said guide means engaging the opposite face of said tape from that engaged by the printing bar so that the component of the tape tension which tends to oppose movement of said printing bar toward the platen is neutralized.

12. In a recorder of the type employing a helix platen and a cooperating printing bar with a tensioned web located between said bar and helix said bar being mounted for oscillating movement toward and away from said platen; electromagnetic means to control the movement of said bar to oscillate said tape in a direction transverse to its length and towards said helix, a guide for said tape movable as a unit with said bar, said guide engaging the opposite face of the tape from that engaged by said bar and causing the tape to follow a V-shaped path adjacent the recording area so that the tape tension is not reflected back as a load on said electromagnetic means.

13. In a recording mechanism of the type de-

scribed, a control bar for pressing a tensioned web in a direction transverse to its length and towards a curved printing surface while restricting the contact area between said web and printing surface, operating mechanism to oscillate said bar toward and away from said surface and thereby to oscillate said web while maintaining said web taut against the bar, and means including a web guide movable as a unit with said bar and engaging said tape on the face opposite to the face engaged by said printing bar for reducing the loading effect of the web tension on said operating mechanism.

14. In a recording mechanism of the type hav-

ing a tensioned record-receiving web; a printing platen, a printing control mechanism having an oscillatable member connected thereto which engages one face of the web whereby the web tension tends to bias said member in one direction, and another member also connected to said mechanism and engaging the opposite face of the web whereby the web tension tends to bias said first mentioned member in a direction opposite to said one direction, and means to oscillate said first-mentioned member to selectively move said web into and out of printing engagement with said platen.

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