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(54) MAGNETIC RECORDING/REPRODUCING APPARATUS

(71) I, ITSUKI BAN, a Japanese Subject, of 829 Higashioizumi-machi, Nerima-ku, Tokyo, Japan, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to magnetic recording and/or reproducing apparatus and more particularly to an apparatus for changing operational modes such as stop, reproduction, fast-feed, rewind and the like in a cassette magnetic tape recorder, wherein mode changeover is performed by push-buttons which require a small operating force.

In a known mode changeover apparatus, a support carrying a magnetic head and a pinch roller is moved into or out of contact with a tape in a cassette directly by the force applied to the pushbutton. Accordingly, a large force is required to depress a pushbutton and the mode changeover tends to be noisy. Another known apparatus utilizes electrical push-button switches for mode changeover. This is, however, costly because a large electromagnetic plunger is needed and this generates a striking noise and consumes a large amount of electric power, making the apparatus unsuitable for small magnetic recording unsuitable for small magnetic only batteries as a power source.

According to the present invention magnetic recording/reproducing apparatus comprises a capstan for driving a magnetic tape, a plurality of push buttons corresponding to a plurality of operational modes of the apparatus, a reciprocal member movable in response to movement of a rotatable idler biased into driving contact with the capstan, a locking device for holding the idler out of engagement with the capstan and releasable by operation of one of the push buttons to

permit driving of the idler through one revolution and movement of the reciprocating member through one cycle after which the locking device re-engages, and a mode changeover actuating bar associated with each push button, the bar corresponding to a selected mode being connectable for movement with the reciprocating member, upon operation of the associated push button, to an operative position wherein it is locked by an interlock mechanism.

The idler is rotated by the capstan means when in contact therewith and the reciprocating member is reciprocated in response to the rotation of the idler to separate the idler from the capstan means by the movement of the reciprocating member. The actuating bar, when in engagement with the reciprocating member, is moved by the latter and is selected and locked in position by the interlock mechanism, thus effecting corresponding mode changeover. The idler is brought into contact with the capstan means by depressing a desired push button and the corresponding actuating bar is brought into engagement with the reciprocating member.

A simple and compact mechanism for braking the reel-shaft drive wheels which supply and take up the magnetic tape can be employed. Remote control can be performed easily. The present invention aims to avoid the drawbacks of conventional mode changeover apparatus. Mode changeover can be performed by applying a force as small as for an electrical push-button switch, with little mechanical noise, and without particularly large consumption of electric power. Further, the apparatus can be simple in construction, small in size and economical.

Embodiments of the invention will now be described by way of example with

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reference to the accompanying drawings, of which:—

Figure 1A is a perspective view of a casing for apparatus of the invention;

Figure 1B is a perspective view of apparatus of the invention including the casing of Figure 1A;

Figure 2 is a plan view showing the internal construction of the apparatus of Figure 1B;

Figure 3 is a plan view showing a mechanism for driving reel shaft drive wheels;

Figure 4 is a vertical section of the apparatus of Figure 1B;

Figure 5 is a plan view of a mode changeover mechanism;

Figure 6 is a side view of another example of push-button mechanism;

Figure 7A is a plan view similar to Figure 2 but of another embodiment of apparatus according to the invention;

Figure 7B is a side view of another example of mechanism for driving reel shaft drive wheel;

Figure 7C is a side view of a part of the apparatus shown in Figure 1A;

Figure 8 is a vertical section of the apparatus of Figure 7A;

Figure 9 is a plan view of another example of mode changeover mechanism;

Figure 10 is a side view illustrating in detail a part of the mechanism of Figure 9;

Figure 11 is a plan view of a transmission mechanism;

Figure 12 is a side view of still another example of push-button mechanism; and

Figure 13 is a plan view of a braking mechanism.

Referring to Figure 1A, a casing 91 made by press-forming aluminium plate is an inverted channel and has in its upper wall a group of small holes 91a for the passage of sound from a loud-speaker. A body 92 is inserted into the casing 91 as shown in Figure 1B, flanges 91d and 91e along both sides of the bottom of the casing serving to guide the body. Figure 1B shows the body fully extended in the direction of arrow A, the body being prevented from further movement by a stop member (not shown). In this position, a cassette 96 on the reel-shafts 81 and 81a can be replaced or turned over. After replacement or turning of the cassette, the body 92 is pushed back into the casing 91. Volume and tone controls 97 and 98 and jack sockets 99 and 95 for a microphone and an earphone are provided in the front wall of the body 92. In the wall of the cassette 96 there are holes 82 and 83 for receiving a capstan and guide holes 84 and 85 for receiving pins mounted on a deck to locate the cassette 96. The capstan fits into either hole 82 or hole 83 depending upon which side of the cassette is to be

used. A microphone P is built in the body 92, a changeover switch for recording/reproduction being not shown. Push-buttons 41, 42, 43 and 44 provided on the body are designated respectively "stop", "reproduction" (or "recording"), "rewind" and "fast-feed", as will be described with reference to Figure 2. Batteries can be fitted in the body 92 from beneath.

The interior of the body 92 will now be described with reference to Figure 2, in which the cassette 96 is shown by dotted line, the casing 91 is omitted and which shows an empty space 89 for batteries, accessible by opening a cover (not shown) at the rear of the body 92. A metal deck 88 fixed to the body 92 by bolts at 88a, 88b and 88c etc. carries a bearing in which a capstan 24 is rotatably supported. A fly-wheel 24b is fixed to the under side of the capstan. Reel-shafts 81 and 81a and reel-shaft drive wheels, 20 and 20a are rotatably supported on the deck by shafts 45 and 45a.

An electric motor M fixed to the deck 88, drives a pulley 35 connected to fly-wheel 24b by a drive belt 21. A magnetic head 22 is fixed to a support 26 which is rotatably supported by a shaft 26a mounted on the deck 88. On the free end of the lever 25, which is pivoted at its central portion on the support 26, there is a pinch roller 23. The support 26 is elastically biased clockwise as shown by arrow B by a spring (not shown) and the lever 25 is elastically biased counterclockwise as shown by arrow C by a spring (not shown) so that the pinch roller 23 presses against the capstan 24 to pinch a magnetic tape placed therebetween. An erase head 27 is fixed to the support 26 which is rotatably supported at its end by the shaft 26a and when the support 26 is rotated counterclockwise, the pinch roller 23 separates from the capstan 24, and the magnetic head 22 and the erase head 27 separate from the cassette 96. At this time, the free-end 25a of the lever 25 abuts a stop pin 28 mounted on the deck 88, and the lever 25 is rotated clockwise against the force of the spring biasing the lever in the direction of arrow C. Consequently, a relatively small rotation of the support 26 causes wide separation of the pinch roller 23 and the capstan 24. When the support 26 is in the position shown in the figure, the apparatus is in the reproduction mode, and when the support 26 rotates counterclockwise, it is in a non-reproduction mode. The fly-wheel 24b protrudes into a cut-out 88-1 in the deck 88. The deck 88 is bent at 88-2 with its right-hand portion being stepped (see also Figure 4). The cassette 96 (shown dotted) can be set in the body by fitting hubs in the cassette over the reel-shafts 81 and 81a, and is

located by guide pins 84a and 85a which pass through the guide holes 84 and 85 as shown in Figure 1B.

Referring now to Figure 3, a drive mechanism for the reel-shaft drive wheels 20 and 20a includes a pulley 24d fixed to the capstan 24, which is rotatably supported by a shaft 24a mounted on the deck 88 (see also Figure 4). A generally Y-shaped lever 32 is rotatably supported at its centre by a shaft 32-1 mounted on the deck 88, and pulleys 37, 38 and 39 are supported respectively by shafts 37-1, 38-1 and 39-1 mounted on respective ends of the arms of the Y-shaped lever 32. A drive belt 31 passes over a pulley 36 supported by a shaft mounted on the deck 88 and is wound round the pulleys 24d, 37, 38 and 39, the tensions in portions 31a and 31b of the belt 31 being substantially equal when the capstan 24 is stationary. A wheel 40 is frictionally coupled to the pulley 39 by a conventional slip mechanism. When the capstan 24 rotates counterclockwise, the tension in the portion 31b becomes larger than that in the portion 31a due to the friction between the pulleys 37, 38 and 39 and their respective shafts and to the torque on the wheel 40.

Consequently, the lever 32 rotates counterclockwise so that the wheel 40 presses against a rubber ring around the periphery of the reel-shaft drive wheel 20. Accordingly, the reel-shaft drive wheel 20 is rotated counterclockwise, and the magnetic tape is taken up by the hub through the reelshaft 81, thereby enabling reproduction or fast feeding. During reproduction, slip occurs between the wheel 40 and the pulley 39, and the motor M rotates in the forward direction at a constant speed. When a governor for the motor M is inoperative, the motor rotates at high speed (fast feed mode). The centre distances between the shafts 32-1 and 37-1 and between 32-1 and 38-1 are made larger than that between the shafts 32-1 and 39-1, so that the force with which the wheel 40 presses against the reel-drive wheel 20 is high. The reaction of the driving force on the drive wheel 20 applies a counterclockwise torque to the lever 32 and the larger load on the wheel 40 applies pressure against the reel-drive wheel 20.

When the motor M is reversed, the tension in the portion 31a of the belt 31 becomes larger than that in the portion 31b, so that the lever 32 and wheel 40 rotate clockwise. Consequently, the wheel 40 rapidly swings away from the reel-drive wheel 20 to press against the reel-drive wheel 20a. Accordingly, the reel-drive wheel 20a is driven clockwise to take up the magnetic tape through the reel-shaft 81a. In this mode (rewind mode), the governor for

the motor M is inoperative, i.e. the rewind mode is existing.

As will be understood from the above, the forward/reverse rotations of the motor M selectively drive the reel-drive wheel 20 and 20a and the shafts 81 and 81a.

Referring now to Figures 4 and 5, the operation mode changeover mechanism includes a frame 51 (Figure 5) which is fixed to the body 92 and on which actuating bars 55, 56, 57 and 58, for effecting changeover of respective modes, are slidably supported for movement transversely through the frame (in right- and left-wards directions on the figure). These bars are biased by springs (not shown) in the direction of the arrow. A bar 53 supported by the frame 51 is also slidable through the frame longitudinally (in up- and down-wards directions in the figure) and is biased by a spring 53a in the upward direction in the figure. In the state shown in the figure, the actuating bar 57 has been moved rightward and is held there by a step-shaped portion or pawl which engages behind a lock pin mounted on the bar 53. When an actuating bar 55, for example, is now moved rightward, this bar 55 is held by another lock pin on the bar 53, but in the process the bar 53 moves downwardly to release the actuating bar 57 which then moves leftward. Any one of the actuating bars 55, 56, 57 and 58, may, upon movement to the right, be locked in position by the bar 53. The above described mechanism is known as an interlock mechanism.

Pins 55c, 56c and 58c mounted respectively on the right ends of the actuating bars 55, 56 and 58 abut a slide bar 61 which is supported for movement from right to left in the direction of a slot in the bar through which guide pins 61a and 61b mounted on the deck 88 protrude. A pin 61c on the right end of the slide bar 61 abuts the support 26 which upon the rightward movement of one of the actuating bars 55, 56 and 58, is displaced counterclockwise, to establish the non-reproduction mode. The mechanism including the pinch roller 23 on the lever 25 is omitted from the figure. The left hand end of each of the actuating bars 55, 56, 57 and 58 is bent into a C-shape (Figures 4, 5 and 6) and has holes 55a, 56a, 57a and 58a respectively. In Figure 4, the interlock mechanism 49 (comprising the frame 51 and the bar 53—see Figure 5) is shown dotted. The actuating bar 58 is also shown dotted. A rod 44b associated with the push-button 44 passes through the hole 58a and rods associated with push-buttons 41, 42 and 43 pass respectively through the holes 55a, 57a and 56a, shown in Figure 5. The pushbuttons 41, 42, 43 and 44 are located respectively in depressions 41a, 42a, 43a

and 44a, as shown in Figure 2, in such a manner that the push-buttons can slide from right to left in the depressions. A member 52 is slidable relative to the body 92 from right to left along slots 52c and 52d provided therein. As seen in Figure 4, an eccentric idler 47 is supported on the right hand end of the member 52 by a shaft 47-1 and the left end of the member 52 is formed into an L-shape 52b, which is engageable with any one of the pushbutton rods. A lever 63 is rotatably supported by a shaft 63a mounted on the body 92, and is biased clockwise by a spring (not shown) and the member 52 is biased leftward by a spring (not shown). Leftward movement of the member 52 is restrained by a bent portion or a projection 63b formed at the left end of the lever 63, which abuts against the left end of the member 52 to lock the member and thereby hold the idler 47 away from a drive wheel 24c fixed to the lower end of the capstan 24.

In Figure 4, when the pushbutton 44 is depressed, the push-button rod 44b associated therewith and passing through a through-hole 44d in the member 52, pushes the lever 63 which is displaced counterclockwise to release the member 52 from the bent portion 63b. As a result the member 52 moves leftward, and a rubber ring around the periphery of the idler 47 contacts the wheel 24c and begins to rotate. This moves the member 52 together with the actuating bar 58 rightwards through the push-button rod 44b which engages with the member 52. The force required for this movement is relatively large, and the larger force creates, by its reaction, an equivalent pressure between the idler 47 and the wheel 24c, thus establishing a positive drive between the wheel 24c and the idler 47.

After about one half revolution of the idler 47, the actuating bar 58 is locked by the interlock mechanism, and the previously locked actuating bar 57 (in Figure 5) automatically moves to the left. With further rotation of the idler 47, the member 52 begins to move back leftward, and the pushbutton rod 44b is lifted by spring 44c and separates from the hole 44d. After another half revolution of the idler 47, the member 52 returns leftward to its original position and abuts with its left end the bent portion 63b of the lever 63. This mechanism is so designed that the member 52 abuts the portion 63b after slightly less than one full revolution of the idler 47, and accordingly the idler 47, upon its further slight rotation, separates from the wheel 24c whereupon rotation ceases automatically.

As will be understood from the above description, the actuating bar 58 is moved rightward by the capstan power means and

locked, and the other actuating bar returns leftward.

Other mechanisms associated with the other push-buttons 41, 42 and 43 are similar to the above and operate in a similar manner. That is, upon the depression of any of the push-buttons, the associated actuating bar is moved rightward by the corresponding push-button rod, and locked.

Figure 5 illustrates the reproduction (or recording) mode, where the capstan 24 and the pinch roller 23 (Figure 4) pinch the magnetic tape therebetween, and the magnetic heads 22 and 27 are in contact with the magnetic tape. The capstan 24 rotates counterclockwise, and so that the magnetic tape is taken up by the hub through the reel-shaft 81 as described in connection with Figure 3. Upon the depression of the push-button 44 (as described above), the actuating bar 58 moves to the right and is locked, and the actuating bar 57 returns leftward. The abutting pin 58c then pushes the bar 61 to the right, and the support 26 is rotated counterclockwise by the abutting pin 61c, to separate the pinch roller 23, the magnetic head 22 and the erase head 27 from the cassette. A projection 58b on the actuating bar 58 depresses an electric switch 64 which makes the governor for the motor M inoperative, and consequently the motor M rotates at high speed, thereby establishing the fast-feed mode.

Upon the depression of the push-button 43 (Figure 2) the actuating bar 56 moves rightward and is locked and the actuating bar 58 returns to the left. The bar 61 is held in the righthand position by the abutting pin 56c, and the support 26 is held in the angular position reached during counterclockwise rotation, that is, the position corresponding to the non-reproduction mode. A projection 56d on the actuating bar 56 makes an electric switch 62a while the switch 64 is kept operative by the projection 56b. The switch 62a reverses the motor M, thus establishing the rewind mode in which the magnetic tape is taken up at high speed by the hub through the reel-shaft 81a as described in connection with Figure 3.

Upon depression of the push-button 42 (Figure 2), the actuating bar 57 is moved to the right by the associated pushbutton rod and locked, and the actuating bar 56 is returned. The switches 62a and 64 become inoperative so that the motor M rotates in the forward direction at normal speed. At the same time, the bar 61 returns leftward, and the support 26 rotates clockwise to establish the reproduction mode. A hole 42d in the member 52 as shown in Figure 5, permits the lower end of the rod associated

with the push-button 42 to pass through the member and push the lever 63 to release locking of the member 52.

Upon depression of the push-button 41 (Figure 2) the associated rod releases the member 52 which then makes one reciprocating movement by virtue of the idler rotation, and the actuating bar 55 moves rightward and is locked. At the same time the actuating bar 57 moves leftward. An electric switch 62 is opened by a projection 55b on the actuating bar 55. The support 26 is rotated counterclockwise through the abutting pin 55c and the bar 61 moves to a position corresponding to the non-reproduction mode. At this time, an electric switch 65 is opened by the support 26, switches 65 and 62 being source line switches connected in parallel to each other, thus forming AND circuit. Accordingly, by closing any one of these switches, electric power is supplied to the apparatus from the source, and the power supply is shut off only when both the switches open. In the above mentioned state, both the switches 65 and 62 are open and there is no power supply, thus establishing the stop mode. The idler 47, having completed one half revolution, is rotated further by the flywheel 24b until the member 52 abuts the bent portion 63b of the lever 63, when the idler 47 is separated from the wheel 24c and rotation ceases.

As will be understood from the above description, by depressing one of the push-buttons 41, 42, 43 and 44, any desired mode (stop, reproduction, rewind and fast-feed) can be established. The push-buttons can be depressed with the small force necessary to overcome the biasing force of the spring 44c, for example. The spring biasing the member 52 to the left may be a light spring, and accordingly, the member 52 can be released by the application of only a small force, because when the member 52 has moved to the left and the idler 47 has come into contact with the wheel 24c, the idler is subjected to substantially no load and can rotate lightly. It is when the member 52 begins to move to the right during rotation of the idler 47, that the load on the idler begins to increase. Mode changeover is performed by utilizing the capstan power means which rotates at a stable speed for a predetermined period of time, and accordingly the operation is positive and generates little noise. The apparatus can be of simple construction, economical in manufacture, small in size and flat in shape. Further, as seen in Figure 2, the push-buttons are held in the depressed position to provide an indication of the existing mode.

Figure 6 shows another example of push-button. The construction is similar in

general to that of Figure 4 except that a compressed spring 44e is provided for upwardly biasing the rod 44b associated with push-button 44 and an electromagnetic device is associated with the pushbutton rod. A soft steel plate 44g is fixed to the underside of the push-button 44. There is also an exciting coil 70a in a yoke (of soft steel) 70 which is fixed to the body, and through the centre aperture of the yoke passes the push-button rod (of soft steel) 44b. Upon depression of the push-button 44, the lever 63, the member 52 and the actuating bar 58 are operated in a manner similar to that in the embodiment of Figure 4, thus establishing the fast-feed mode. Alternatively, by supplying current for a short period of time through terminals 70d and suitable switch, the plate 44g is attracted toward the yoke and the push-button 44 and the rod 44b are lowered, thus initiating changeover to the fast-feed mode by the previously described action of the lower end 44f of the rod 44b. The lowering of the push-button rod 44b requires a small force sufficient to overcome the biasing force of the light spring 44e so that the current required is small and the electromagnetic device may be small and light. Similar electromagnetic devices are associated with the other push-buttons 41, 42 and 43 (Figure 2).

In Figures 7A to 7C, similar parts of the above described embodiment are indicated by the same reference numerals except that push-buttons 42 and 43 are in this embodiment respectively "rewind" and "reproduction". On the deck 88 are rotatable reel-shafts 181 and 181a and reel-shaft drive wheels 120 and 120a interconnected by shafts 145 and 145a. Upon setting the cassette 96 (shown dotted) in the body from above, the hubs in the cassettes fit respectively on the reel-shafts 181 and 181a. Brake members 129 and 129a which are pressed against the peripheries of the reel-shaft drive wheels 120 and 120a to brake them, are described below with reference to Figure 13. An idler 133 is pivoted on the free end of a lever 136 rotatably supported on the deck by a shaft 136a. A lever 137 is rotatably supported by a shaft 137a mounted on the reverse side of the deck 88. A sleeve 134 and a pulley 130 fixed thereto are rotatably supported by a shaft 134a mounted on the free end of the lever 137. The sleeve 134 protrudes through a cut-out 135 in the deck 88. A plate spring 138 is fixed at its central portion to the left end of the lever 137.

Referring to Figure 7C, on a rotating shaft 135f of the motor M extending downwardly from the motor, the pulley 35 is secured and a pulley 135a is loose fit. A disc 135b is secured to the shaft 135g and

between the disc 135b and the pulley 135a is a felt sheet 135c, the pulley 135a being biased against the felt sheet 135c and the disc 135b by a plate spring 135e to produce a frictional coupling between the pulley 135a and the rotating shaft 135f. A rubber drive belt 131 is wound round the pulley 135a and the pulley 130 (Figure 7B).

When depressed, the push-button 43 moves to the right to take up the position shown in Figure 7a. At the same time, the plate spring 138 is deflected in the direction of arrow F and by the reaction thereof the lever 137 is driven counterclockwise. As a result, the sleeve 134 presses the idler 133 against a rubber ring 146 around the periphery of the reel-shaft drive wheels 120. The sleeve 134 is rotated counterclockwise by the pulley 130 and the rubber drive belt 131, and consequently the reel-stand 120 is driven counterclockwise. Accordingly, the magnetic tape driven by the capstan 24 and the pinch roller 23 is taken up by the hub on the reel-shaft drive wheels 120, so that reproduction output is obtained through the magnetic head 22. That is, a suitable slip occurs between the pulley 135a and the rotating shaft 135f (Figure 7C), and thus the reel-stand 120 acts as a take-up reel and the reel-stand 120a as a supply reel.

Upon depression of push-button 41, the pushing force in the direction of arrow F is eliminated, the push-button 41 is moved to the right in the direction of arrow D, the push-button 43 returns leftward, and the support 26 is driven counterclockwise by the force in the direction of arrow D. Accordingly, the pinch roller 23 separates from the capstan 24, and the magnetic head 22 and the erase head 27 separate from the cassette 96. At the same time current supply is shut off, thus the stop mode is established.

Upon depression of the push-button 42, the push-button 42 is moved rightward, and the push-button 41 is released. The plate spring 138 is pushed in the direction of arrow E and the lever 137 is driven clockwise. Accordingly, the sleeve 134 is pressed against a rubber ring 146b around the periphery of the reel-stand 120a to rotate it clockwise. The support 26 is held in the position to which it is driven by the pushing force in the direction of arrow E. The governor for the motor M is then made inoperative, so that the motor M rotates at high speed (for example, four to six times the normal speed). As a result, the magnetic tape is taken up on the hub by the reel-stand 120a, the rewind mode being established.

Upon depression of the push-button 44, the push-button 44 is moved to the right and the push-button 42 moves to the left.

The plate spring 138 is pushed rightward in the direction of arrow G, and the reel-shaft drive wheel 120 is driven to take up the magnetic tape. The support 26 is held in the position to which it is driven by the pushing force in the direction of arrow G, and the governor is inoperative, so that the fast-feed mode is established.

Referring now to Figures 8 and 9, a frame 151 is fixed to the body 92, and actuating bars 155, 156, 157 and 158 are supported by the frame 151 for sliding from right to left and vice versa as shown in Fig. 9 and are biased leftward by springs (not shown). A bar 153 supported by the frame 151 is slidable in the up- and down direction as shown in Fig. 9, and is biased upward by a spring 153a. In the state shown in the figure, the actuating bar 157 is locked by a step-shaped portion formed thereon which engages pin on the bar 153. When the actuating bar 155 is moved to the right, this bar 155 is locked by a pin on the bar 153, and the actuating bar 157 is released and moves back to the left. That is, when any one of the actuating bars 155, 156, 157 and 158 is moved to the right, the selected bar is locked in that position.

Pins 155c, 156c and 158c mounted respectively on the right hand ends of the actuating bars 155, 156 and 158 are in abutment with the slide bar 61 which is supported on the deck 88 for sliding movement from right to left along a slot through which protrude the guide pins 61a and 61b mounted on the deck 88, the pin 61c mounted on the right end of the bar 61 being in abutment with the support 26. Rightward movement of any one of the actuating bars 155, 156 and 158 causes counterclockwise rotation of the support, thus setting the non-reproduction mode. An abutting pin 156b at the middle of the actuating bar 156 and an abutting pin 157b at the right end of the actuating bar 157 are so located that they abut respectively against both ends of the plate spring 138. When the actuating bar 156 is moved, the lever 137 turns clockwise to drive the reel-shaft 181a (Figure 7A) and when the actuating bar 157 is moved to the right, the lever 137 turns counterclockwise to drive the reel-shaft 181, thus setting the reproduction mode and fast-feed mode respectively. A lever 148 is pivotally supported at an end thereof by a shaft 148a mounted on the body 92, and is elastically biased by a spring (not shown) clockwise in the direction of arrow K. An eccentric idler 147 is pivoted to the middle of the lever 148. On the underside of the fly-wheel 24b is an integral sleeve-like wheel 24c as a member of the capstan power means as shown in Figure 8. The wheel 24c and the idler 147 can separate from and come into contact

with each other. A member 152 is mounted on the body 92 for sliding movement from right to left along slots in the member, through which slots guide pins 154a and 154b mounted on the body, protrude respectively. An abutting pin 152a mounted on the right hand end of the member 152 is located for abutment against the left hand side of the free end of the lever 148. In the bent portions at the left hand ends of the actuating bars 155, 156, 157 and 158 there are provided respectively holes 155a, 156a, 157a and 158a through which the rods associated with the push-buttons 41, 42, 43 and 44 (Figure 7A) pass freely. In Figure 8, the push-button 44, the push-button rod 44b and the actuating bar 158 are shown dotted. The interlock mechanism 149 comprising the frame 151 and the bar 153 is also shown dotted. In Figure 9, the left hand end of the member 152 is formed into a bent portion 152b for engagement with the lower ends of the respective push-button rods.

As the respective push-button operating mechanisms are similar, only the mechanism of push-button 44 will be described in detail with reference to Figure 10. The push-button rod 44b freely passes through the through-hole 158a (Figure 9) provided at the left end of the actuating bar 158, and is lightly biased upward by the spring 44c. 151 is the interlock mechanism. Beneath the member 152 there is a lever 163 which is pivotally mounted at its medial portion upon a shaft 163a and which is biased by a spring (not shown) in the clockwise direction of arrow N, and locks by means of a locking portion 163c at the right end thereof the free end of the lever 148. The bent portion 152b at the left end of the member 152 can abut against the lower end of the push-button rod 44b only when the push-button 44 is depressed. Also, the push-button 44b can be pushed against the left end 163b of the lever 163 through a hole 152-1 in the member 152. Accordingly, the lever 163 is driven, by the force of the push-button rod 44b, counterclockwise about the shaft 163a against the biasing force of the spring which is in the direction of arrow N, thus releasing the lever 148 from the locking of the locking portion 163c at the right end of the lever 163. Consequently, the lever 148 in Figure 9 rotates clockwise to press the idler 147 against the wheel 24c (Figure 8) and thus the wheel 147 begins to rotate. As the idler 147 is eccentrically pivoted, the lever 148 is driven counterclockwise, and thus the member 152 is moved to the right by the abutting pin 152a. Consequently, the bent portion 152b abuts the lower end of the push-button rod 44b to move the actuating bar 158 to the right and the support 26 is driven

counterclockwise by the bar 61. As a result, the pinch roller 23, the magnetic head 22 and the erase head 27 are separated from the cassette. At the same time, an abutting pin 158b on the actuating bar 158 pushes an end of the plate spring 138 so as to drive the lever 137 counterclockwise and set the fast-feed mode. The above described state is effected after a half revolution of the idler 147. During rotation the idler 147 is subjected to a large load, and by the reaction thereof the idler 147 is pressed strongly against the wheel 24c thereby reducing slip therebetween. The spring for biasing lever 148 in the direction of arrow K may be a light spring, because at the onset of rotation of the idler 147 there is little load on the idler and therefore a small pressure between the idler 147 and the wheel 24c is sufficient.

The force required for releasing the lever 148 from the locking through the push-button 44 may be small. The drive of the support 26, which is the major component of the load on the idler, is effected by the capstan power means and it is an advantage that this drive is independent of the force required to depress the push-button 44. In the above state, the actuating bar 158 is locked by the interlock mechanism. When the idler 147 has turned through another half revolution, the lever 148 reverses and abuts against the locking portion 163c of the lever 163 and is locked. The idler 147, upon further slight rotation, separates from the wheel 24c to stop rotation automatically. As the bar 61 (Figure 9) is in its right hand position, an electric switch 160 (shown dotted) is operative. This switch 160 makes the governor for the motor M inoperative, and therefore the motor M rotates at high speed, thus setting the fast-feed mode. As the push-button 44 stays in the right hand position, it provides a convenient indication that fast-feed mode is now set.

It will be understood that the force required to depress the push-button 44 is small, the mode changeover operation may be carried out in about 1/3 second, and little mechanical noise is produced because no impact occurs. This applies equally to the other push-buttons 41, 42 and 43. Upon depression of the push-button 41, for example, the lever 148 releases the lever 163, and accordingly the idler 147 makes one rotation and stops. The push-button 41 and the actuating bar 155 are moved to the right and locked. Accordingly, a non-reproduction state is maintained, and the actuating bar 158 and the push-button 44 move back to the left. A source line switch 159 (shown dotted in Figure 9) is depressed by a projection 155b on the actuating bar 155 to shut off current supply. The idler

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149, however, makes a further half revolution due to the inertia of the fly-wheel 24b and the motor M, and then stops. Thus the stop mode is set. The left hand end 163b of the lever 163 shown in Figure 10 has a width sufficient to engage any one of the push-button rods, thus the lever 163 can be driven by depressing any one of the push-buttons.

Then, upon depression of the push-button 43, the actuating bar 157 is moved to the right and locked and the push-button 41 and the actuating bar 155 move to the left. With the depression of the push-button 43, an electric switch 168 shown in Figure 10 is depressed to supply current from the source, and the motor M begins to rotate, thus the above described movement can be effected. When the push-button rod moves to the right to lift from the projection of the left hand end 163b, however, the switch 169 is opened. At this time, the actuating bar 155 (Figure 9) has moved to the left and closed the switch 159, and succeeding operations can be made.

With the leftward movement of the actuating bar 155, the support 26 rotates clockwise, and the pinch roller 23 comes into contact with the capstan 24, and the magnetic head 22 with the magnetic tape, thus reproduction mode is set. By associating an air cylinder 162 with the support 26 to decrease in some degree the speed of the above described return motion, mechanical noise may further be reduced.

Upon depression of the push-button 42, rewind mode is set in a similar manner. The power for driving the idler 147 may be transmitted via another capstan.

Figure 11 shows another transmission mechanism having non-eccentric idler 165 and the wheel 24c as the capstan power means. A lever 164 is rotatably supported at its end by a shaft 164a and the idler 165 (non-eccentric) is pivoted on the free end of the lever 164. The lever 164 is lightly biased counterclockwise in the direction of arrow L (in the direction away from the wheel 24c). On the idler 165 is an integral eccentric cam 166. A lever 167 is rotatably supported at its end by a shaft 167a and is lightly biased clockwise in the direction of arrow M. The free end of the lever 167 engages the abutting pin 152a of the member 152, and upon locking of this free end by the lever 163, the lever 167 is restrained from its rotation in the direction of arrow M. Upon depression of any one of the push-buttons 41, 42, 43 and 44, the lever 167 is released, rotates clockwise, and a projection 167b on a medial portion of the lever 167 pushes the cam 166 leftward. Consequently, the idler 165 is pressed

against the wheel 24c and rotated thereby. After about a half revolution of the cam 166, which is achieved by rotation of the idler 165, the lever 167 rotates counterclockwise moving the member 152 to the right. The state at this time is shown by the figure. After another half revolution of the cam 166, the lever 167 returns to its original position and is locked again by the lever 163. Upon further slight rotation of the cam 166, the cam separates from the projection 167b and the idler 165 moves to the right to separate from the wheel 165 and stops rotation. Thus, an effect similar to that when utilizing the eccentric idler, is obtained.

Figure 12 shows another example of push-button mechanism. In the figure, there is a pushbutton for fast-feed which corresponds to that of Figure 10. In a depression in the body 92, there is a vertically slidable push-button 68c and a spring 68b for biasing the push-button 68c upward. Under the push-button 68c, there is the actuating bar 158, the frame 151 and the bar 153 of the interlock mechanism. A vertically slidable rod 69 is at the left end of the actuating bar 158, and is biased upward by a spring 69b. On the top of the rod 69 there is a cap-like plate 69a for abutting the lower end 68a of the push-button 68c. With the depression of the push-button 68c, the rod 69 is pushed through the plate 69a, and the lower end 69c of the rod 69 is lowered to a position wherein it passes through hole 152-1 in the member 152 (Figure 10). With the downward movement of the rod 69, the lever 163 turns counterclockwise to release the lever 163. Accordingly, the idler 147 makes one revolution and then stops. During rotation the member 152 is moved to the right by the abutting pin 152a and the rod 69 and the actuating bar 158 are moved by the lower end 69c, to the right and are locked, and thus fast-feed mode is set as described with reference to Figures 9 and 10. One operational difference between the embodiments of Figures 10 and 12 is that the pushbutton 68c in Figure 12 does not move to the right with the actuating bar 158. Other push-button mechanisms corresponding to the push-buttons 41, 42 and 43 (Figure 9) are of similar construction and mode changeovers of reproduction, stop and rewind can be effected in a manner similar to that described above.

Referring now to Figure 13, means for braking the reel-shafts 181 and 181a will now be described. Conventional brake means, in general, include an electromagnetic plunger, and are large and costly, and because of large consumption of electric power, are unsuitable for a portable magnetic recording/reproduction apparatus having a battery power source. When a

mode changeover takes some period of time (typically from a half to a third of a second), however, positive braking can be effected by a simple mechanism utilizing the reciprocating movement of the member 152 in Figure 9, and changeover from fast-feed mode to reproduction mode can be performed smoothly with no risk of tangling the magnetic tape.

In Figure 13, an elastic plate 129c has at each end a brake member 129 and 129a for abutting respectively the reel-shaft drive wheel 120 and 120a. The middle of plate 129c is fixed to a bar 190 which is mounted on the deck 88 (Figure 7A) for sliding movement from right to left along a slot therein through which protrudes a guide pin 188 mounted on the deck 88. An abutting pin 189 mounted on the member 152 passes through a hole 190a in the bar 190. Upon the rightward movement of the member 152, the brake members 129 and 129a are pressed by the abutting pin 189, the bar 190 and the plate 129c, against the reel-shaft drive wheel 120 and 120a to brake them, and, upon the leftward movement of the member 152, the braking is released. The reel-shaft drive wheel 120 and 120a are advantageously subjected to braking only during a mode changeover period. The strong though temporary force which acts during rightward movement of the member 152, ensures positive braking.

Our co-pending application 31242/76 (Serial No. 1,534,307) which is divided from this present application, relates to the reel-shaft driving mechanism of the embodiment of magnetic tape recording and/or reproducing apparatus shown in Figures 1 to 6.

WHAT I CLAIM IS:—

1. Magnetic tape recording and/or reproducing apparatus comprising a capstan for driving a magnetic tape, a plurality of push-buttons corresponding to a similar plurality of operational modes of the apparatus, a reciprocating member movable in response to movement of a rotatable idler biased into driving contact with the capstan, a locking device for holding the idler out of engagement with the capstan and releasable by operation of one of the push-buttons to permit driving of the idler through one revolution and movement of the reciprocating member through one cycle after which the locking device re-engages, and a mode changeover actuating bar associated with each push-button, the bar corresponding to a selected mode being connectable for movement with the reciprocating member, upon operation of the associated push-button, to an operative position wherein it is locked by an interlock mechanism.

2. Magnetic recording and/or reproducing apparatus comprising a capstan for driving a magnetic tape and a plurality of push-buttons for effecting the changeover of the apparatus to stop, reproduction and the like operation modes, an idler for movement into driving contact with the capstan, means for biasing the idler toward the capstan, a reciprocating member driven by said movement of the idler, a locking device for locking the idler out of engagement with the capstan and releasable by operation of the push-buttons to bring the idler into driving contact with the capstan, the arrangement being such that after rotation through one revolution the idler is again locked out of engagement with the capstan by the locking member, mode changeover actuating bars each being movable upon depression of a push-button by a push-button rod associated therewith, an interlock mechanism for alternatively locking the actuating bars, and means for engaging the reciprocating member with an actuating bar associated with one of the push-buttons corresponding to a desired mode change, so that the reciprocating member moves the actuating bar to lock it to the interlock mechanism to effect said desired mode change.

3. Apparatus according to Claim 1 or Claim 2, wherein the idler is eccentrically pivoted.

4. Apparatus according to Claim 3, wherein the idler is pivoted on the reciprocating member and is biased into contact with the capstan by spring means biasing the reciprocating member.

5. Apparatus according to Claim 4, wherein the locking device comprises a lever having a projection for abutting and restraining the reciprocating member against the biasing force.

6. Apparatus according to Claim 5, wherein the means for releasing the locking device comprises push-button rods each of which, upon depression of an associated push-button, turns the said lever.

7. Apparatus according to any one of Claims 2 to 6, wherein the interlock mechanism comprises step-shaped engaging portions provided respectively on the actuating bars, spring means for biasing the actuating bars in one direction, and a slide bar movable in a direction perpendicular to the direction of the movement of the actuating bars, the slide bar having pins for engaging respectively with the engaging portions of the actuating bars to lock the actuating bars.

8. Apparatus according to any one of Claims 2 to 7, wherein the engaging means for making mechanical engagement of the actuating bars with the reciprocating member comprises push-button rods and



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mode changeover takes some period of time (typically from a half to a third of a second), however, positive braking can be effected by a simple mechanism utilizing the reciprocating movement of the member 152 in Figure 9, and changeover from fast-feed mode to reproduction mode can be performed smoothly with no risk of tangling the magnetic tape.

In Figure 13, an elastic plate 129c has at each end a brake member 129 and 129a for abutting respectively the reel-shaft drive wheel 120 and 120a. The middle of plate 129c is fixed to a bar 190 which is mounted on the deck 88 (Figure 7A) for sliding movement from right to left along a slot therein through which protrudes a guide pin 188 mounted on the deck 88. An abutting pin 189 mounted on the member 152 passes through a hole 190a in the bar 190. Upon the rightward movement of the member 152, the brake members 129 and 129a are pressed by the abutting pin 189, the bar 190 and the plate 129c, against the reel-shaft drive wheel 120 and 120a to brake them, and, upon the leftward movement of the member 152, the braking is released. The reel-shaft drive wheel 120 and 120a are advantageously subjected to braking only during a mode changeover period. The strong though temporary force which acts during rightward movement of the member 152, ensures positive braking.

Our co-pending application 31242/76 (Serial No. 1,534,307) which is divided from this present application, relates to the reel-shaft driving mechanism of the embodiment of magnetic tape recording and/or reproducing apparatus shown in Figures 1 to 6.

WHAT I CLAIM IS:—

1. Magnetic tape recording and/or reproducing apparatus comprising a capstan for driving a magnetic tape, a plurality of push-buttons corresponding to a similar plurality of operational modes of the apparatus, a reciprocating member movable in response to movement of a rotatable idler biased into driving contact with the capstan, a locking device for holding the idler out of engagement with the capstan and releasable by operation of one of the push-buttons to permit driving of the idler through one revolution and movement of the reciprocating member through one cycle after which the locking device re-engages, and a mode changeover actuating bar associated with each push-button, the bar corresponding to a selected mode being connectable for movement with the reciprocating member, upon operation of the associated push-button, to an operative position wherein it is locked by an interlock mechanism.

2. Magnetic recording and/or reproducing apparatus comprising a capstan for driving a magnetic tape and a plurality of push-buttons for effecting the changeover of the apparatus to stop, reproduction and the like operation modes, an idler for movement into driving contact with the capstan, means for biasing the idler toward the capstan, a reciprocating member driven by said movement of the idler, a locking device for locking the idler out of engagement with the capstan and releasable by operation of the push-buttons to bring the idler into driving contact with the capstan, the arrangement being such that after rotation through one revolution the idler is again locked out of engagement with the capstan by the locking member, mode changeover actuating bars each being movable upon depression of a push-button by a push-button rod associated therewith, an interlock mechanism for alternatively locking the actuating bars, and means for engaging the reciprocating member with an actuating bar associated with one of the push-buttons corresponding to a desired mode change, so that the reciprocating member moves the actuating bar to lock it to the interlock mechanism to effect said desired mode change.

3. Apparatus according to Claim 1 or Claim 2, wherein the idler is eccentrically pivoted.

4. Apparatus according to Claim 3, wherein the idler is pivoted on the reciprocating member and is biased into contact with the capstan by spring means biasing the reciprocating member.

5. Apparatus according to Claim 4, wherein the locking device comprises a lever having a projection for abutting and restraining the reciprocating member against the biasing force.

6. Apparatus according to Claim 5, wherein the means for releasing the locking device comprises push-button rods each of which, upon depression of an associated push-button, turns the said lever.

7. Apparatus according to any one of Claims 2 to 6, wherein the interlock mechanism comprises step-shaped engaging portions provided respectively on the actuating bars, spring means for biasing the actuating bars in one direction, and a slide bar movable in a direction perpendicular to the direction of the movement of the actuating bars, the slide bar having pins for engaging respectively with the engaging portions of the actuating bars to lock the actuating bars.

8. Apparatus according to any one of Claims 2 to 7, wherein the engaging means for making mechanical engagement of the actuating bars with the reciprocating member comprises push-button rods and

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holes in the reciprocating member through which holes the push-button rods pass.

9. Apparatus according to Claim 3, wherein the idler is pivoted on a pivoted lever, and the biasing means comprises spring means biasing the pivoted lever so as to press the idler against the capstan.

10. Apparatus according to Claim 9, wherein the locking device comprises a second pivoted lever which locks the first mentioned pivoted lever by the biasing force of the spring means.

11. Apparatus according to Claim 10, wherein the locking release means comprises push-button rods each of which, upon depression of an associated push-button, displaces the second pivoted lever.

12. Apparatus according to any one of Claims 1 to 3, wherein the idler includes an eccentric cam fixedly secured thereto.

13. Apparatus according to Claim 12, wherein the idler is rotatably supported on a third lever, the third lever being biased by spring means away from the capstan, and the first mentioned biasing means comprising a spring biasing a fourth lever engaging with the eccentric cam in such a direction as to press the idler toward the capstan.

14. Apparatus according to Claim 13, wherein the locking device comprises a separate pivotally mounted lever which locks the fourth lever through biasing force of spring means.

15. Apparatus according to any one of Claims 1 to 14, additionally comprising a plurality of electromagnetic devices each associated with one of the push-buttons and having a magnetic material and an exciting coil, whereby remote control may be performed by supplying current to the coil.

16. Apparatus according to any one of Claims 1 to 15, wherein the actuating bars are movable by pushbutton rods associated with the push-buttons, the push-button rods being arranged separately from the push-buttons through which said push-button rods are to be depressed, whereby only the push-button rods are movable by the reciprocating member.

17. Apparatus according to any one of Claims 1 to 16, including a brake member movable into contact with reel-shaft drive wheels for winding and feeding the magnetic tape, the brake member being secured to the reciprocating member.

18. Magnetic recording/reproducing apparatus according to any one of the preceding claims and constructed and arranged substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

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