(12) UK Patent Application (19) GB (11) 2 186 668 (13) A

(43) Application published 19 Aug 1987

(21) Application No 8703809

(22) Date of filing 18 Feb 1987

(30) Priority data
(31) 3605088 (32) 18 Feb 1986 (33) DE

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(51) INT CL⁴
G05G 1/10

(52) Domestic classification (Edition I):
F2Y 104 3109 PD
G5R B789 B98
U1S 2065 2116 F2Y G5R

(56) Documents cited
None

(58) Field of search
F2Y
G5R
Selected US specifications from IPC sub-class G05G

(54) Rotary knob control means

(57) A control means with a rotary knob 1 for selecting different operating states comprises a fixed toroidal coil 7 and a brake disk 2 in operative connection therewith, the rotation direction, angular deviation and brake disk function being scanned and supplied to processing electronics, the latter then providing the actual control instructions to the apparatus to be controlled. Thus, the control means permits inter alia the remote control of different devices in at least two operating modes, whereof one is a speed control as a function of the rotary speed of the control means.

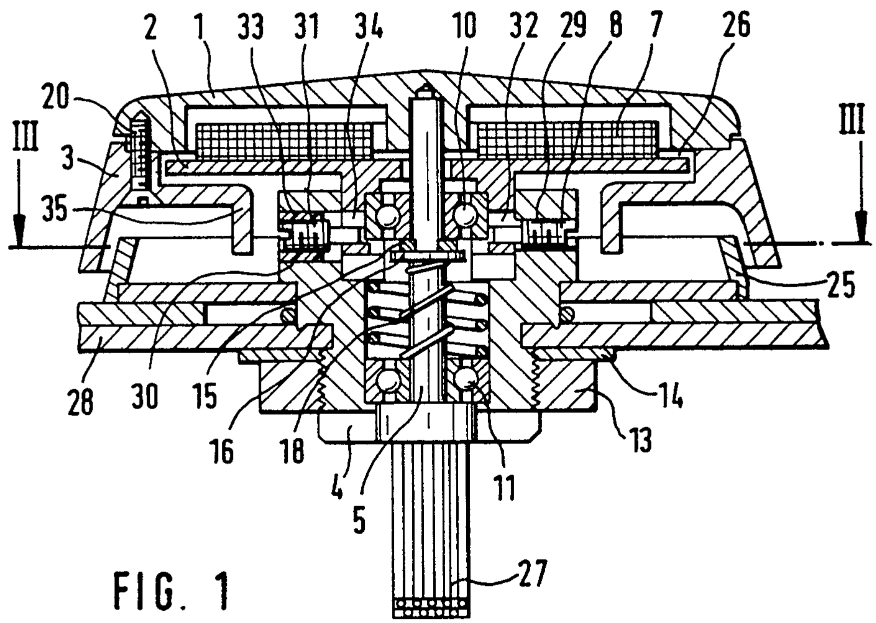

FIG. 1

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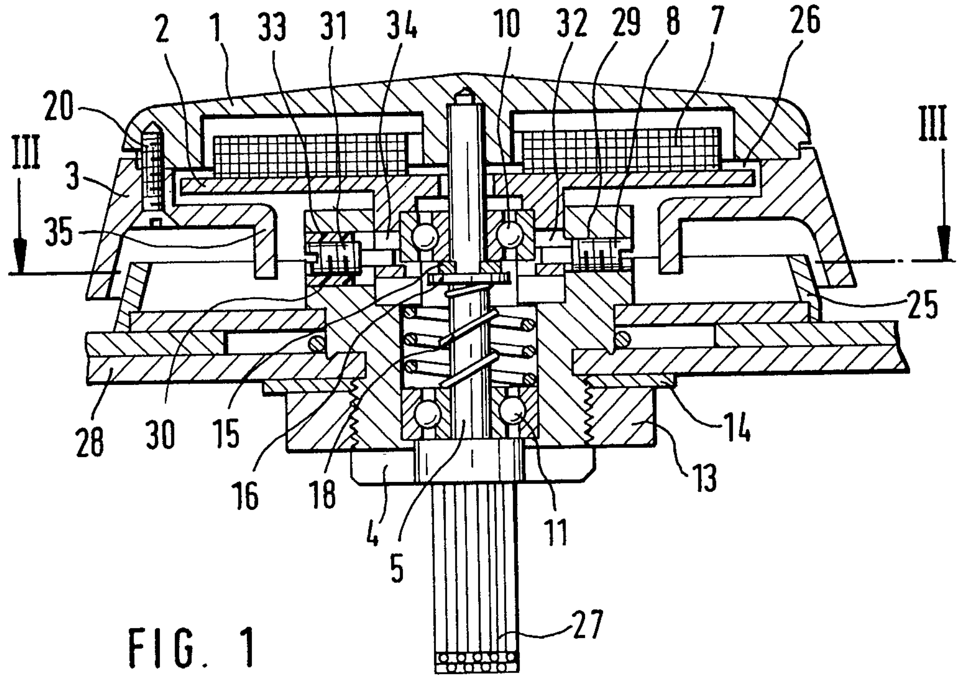

FIG. 1

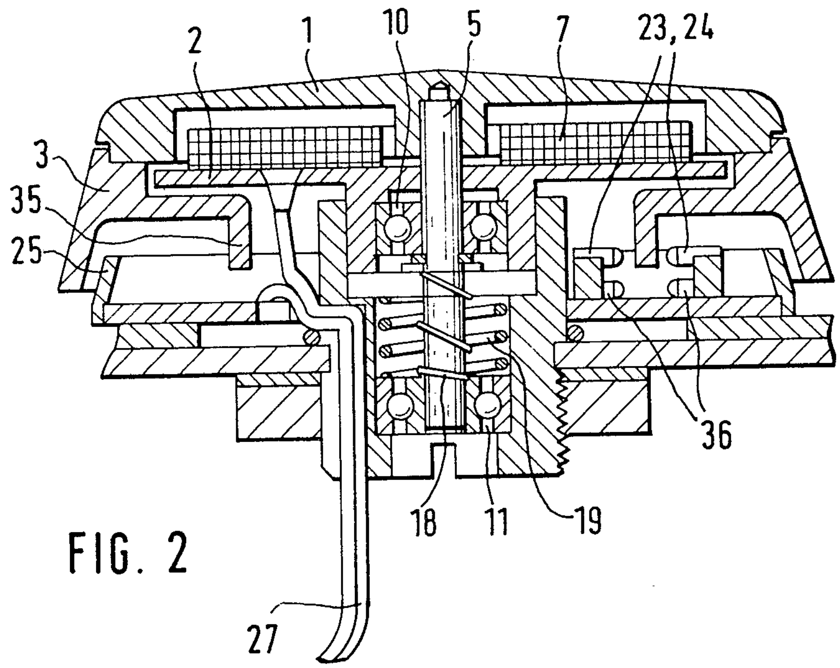

FIG. 2

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DFA

FIG. 1a

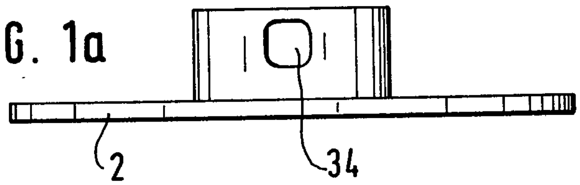


FIG. 1b

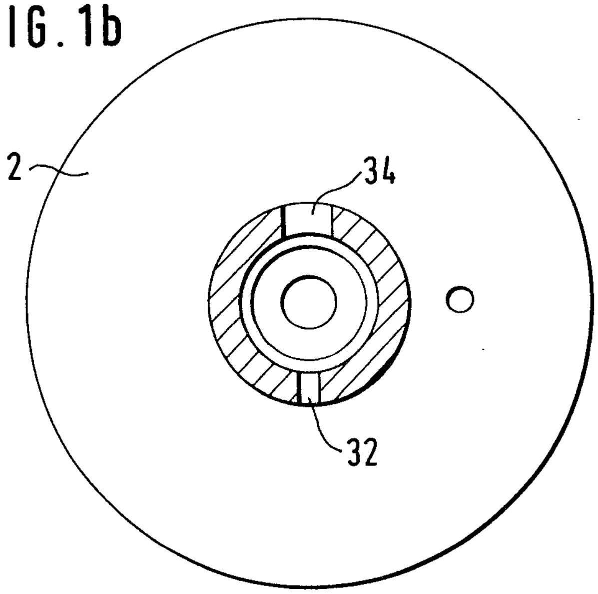
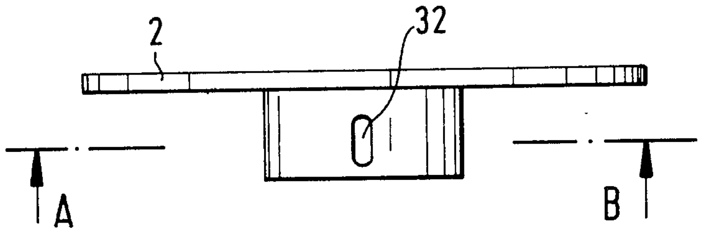


FIG. 1c



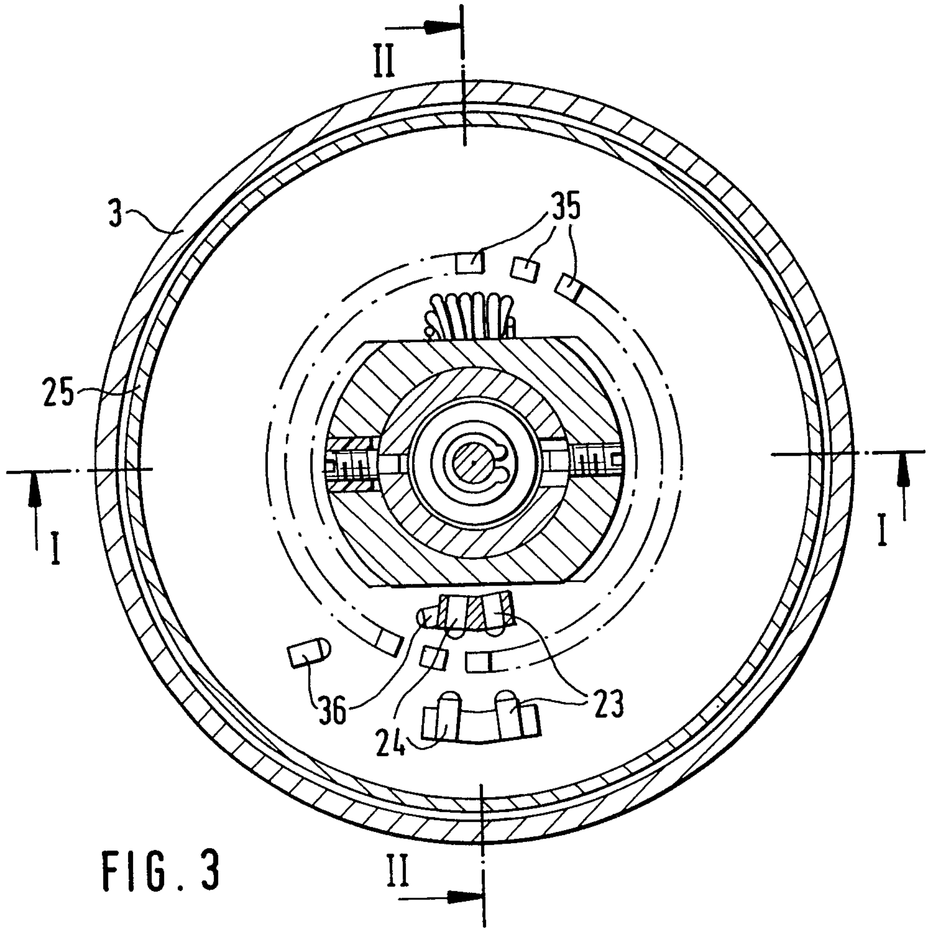

II
3
35
25
I
I
36
24
23
II

FIG. 3

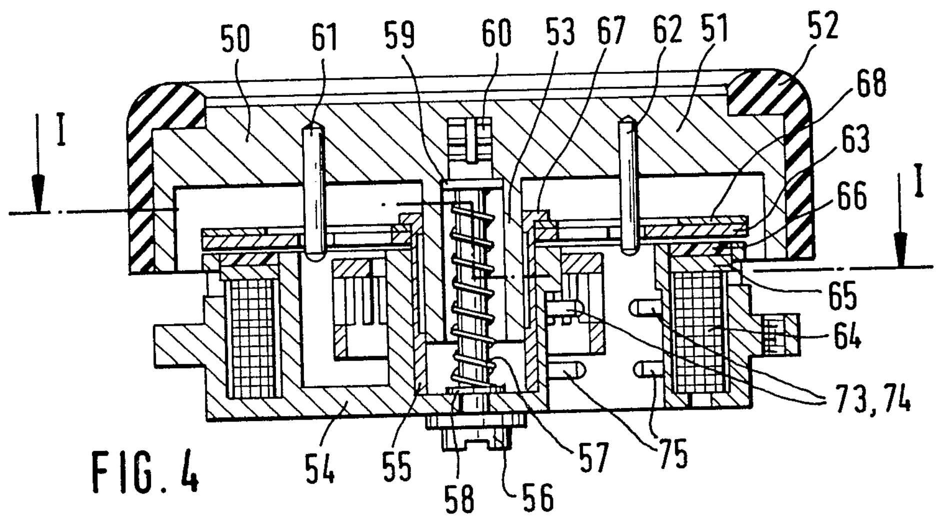

50
61
59
60
53
67
62
51
52
68
63
66
I
I
65
64
73,74
54
55
58
56
57
75

FIG. 4

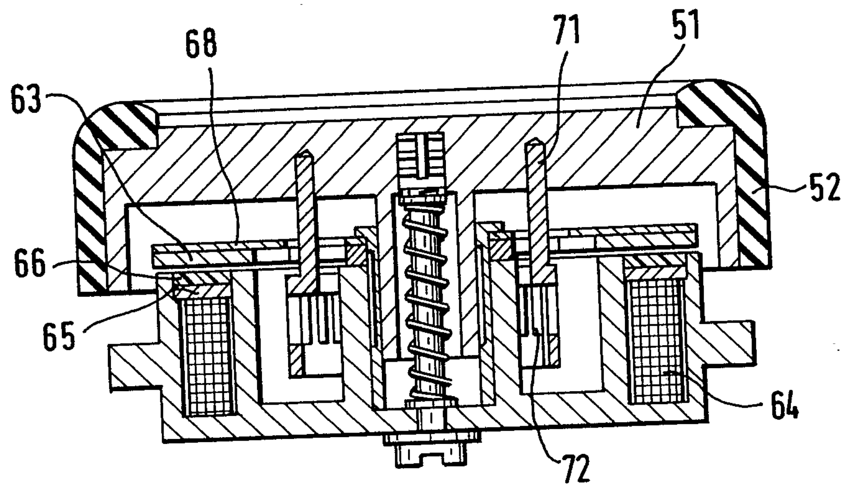


FIG. 5

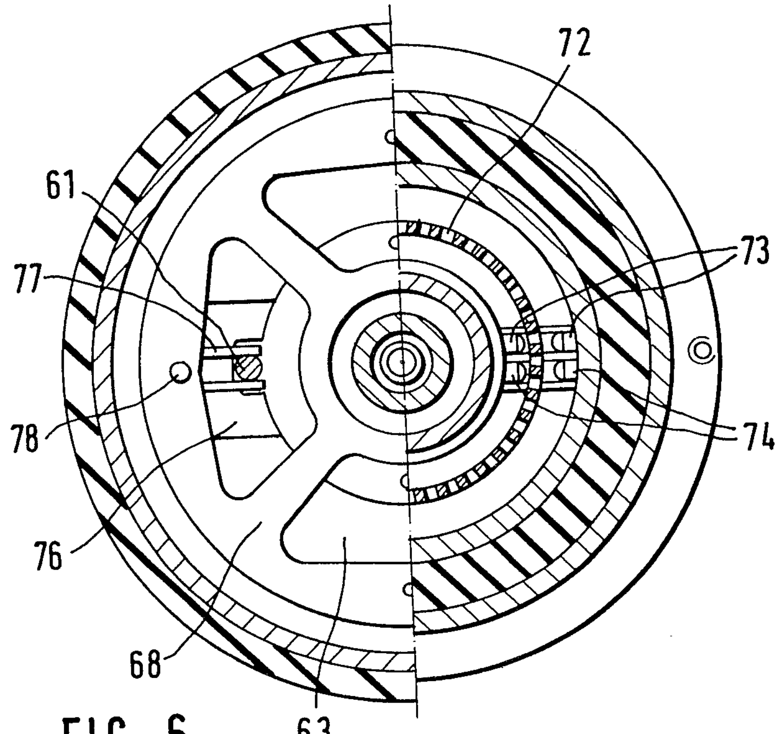


FIG. 6

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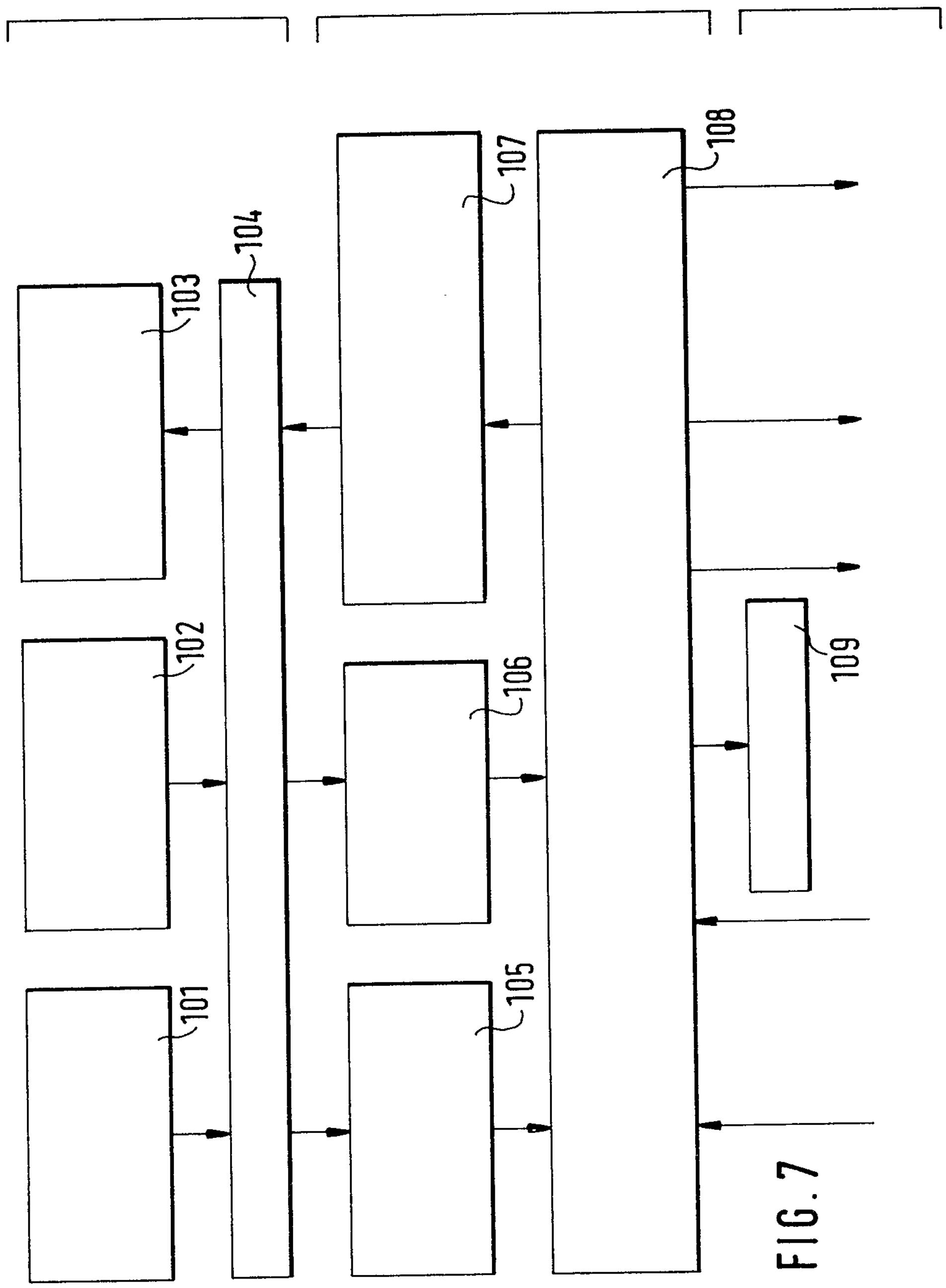

FIG. 7

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DFA

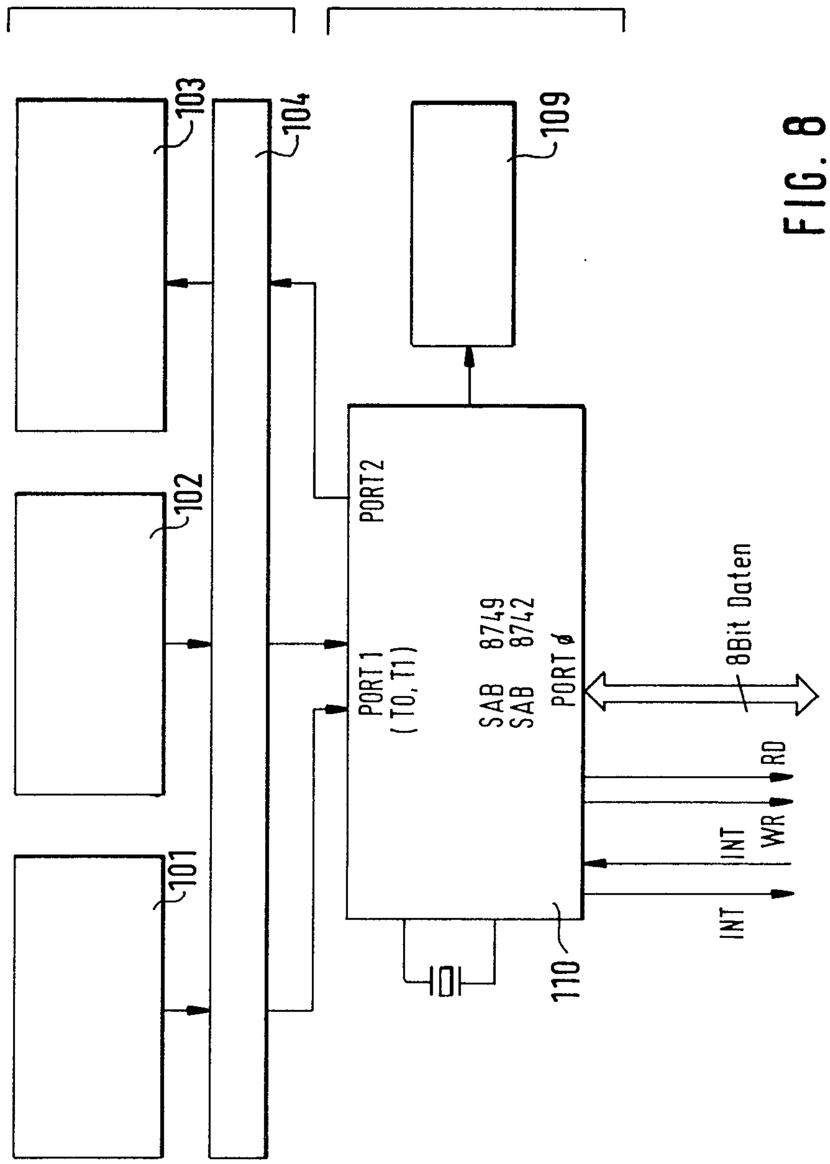

FIG. 8

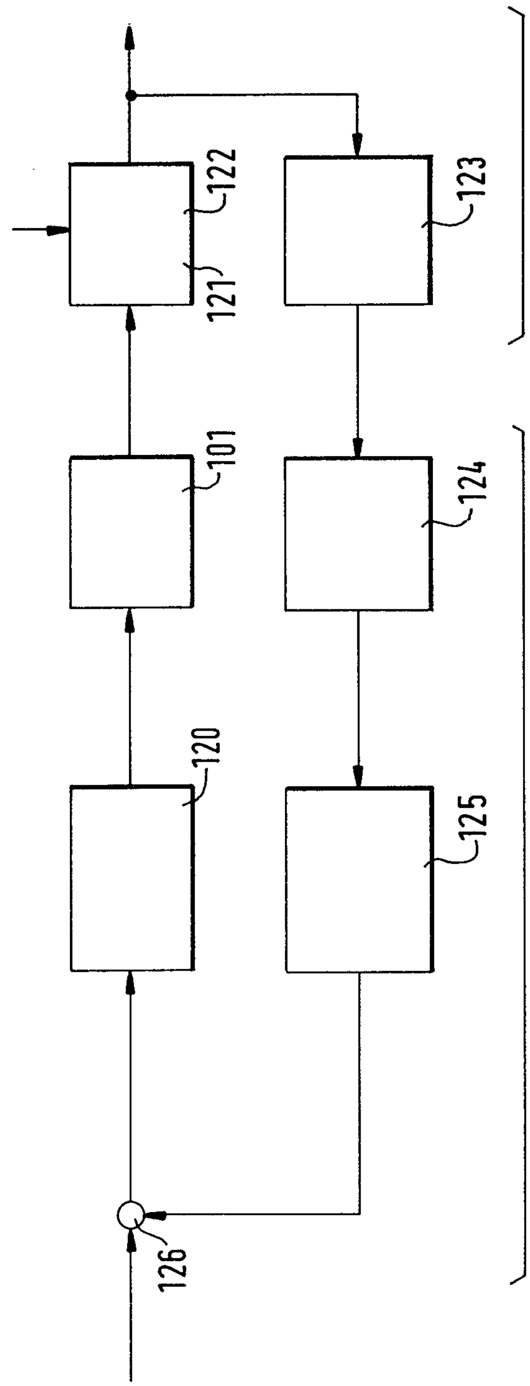

FIG. 9

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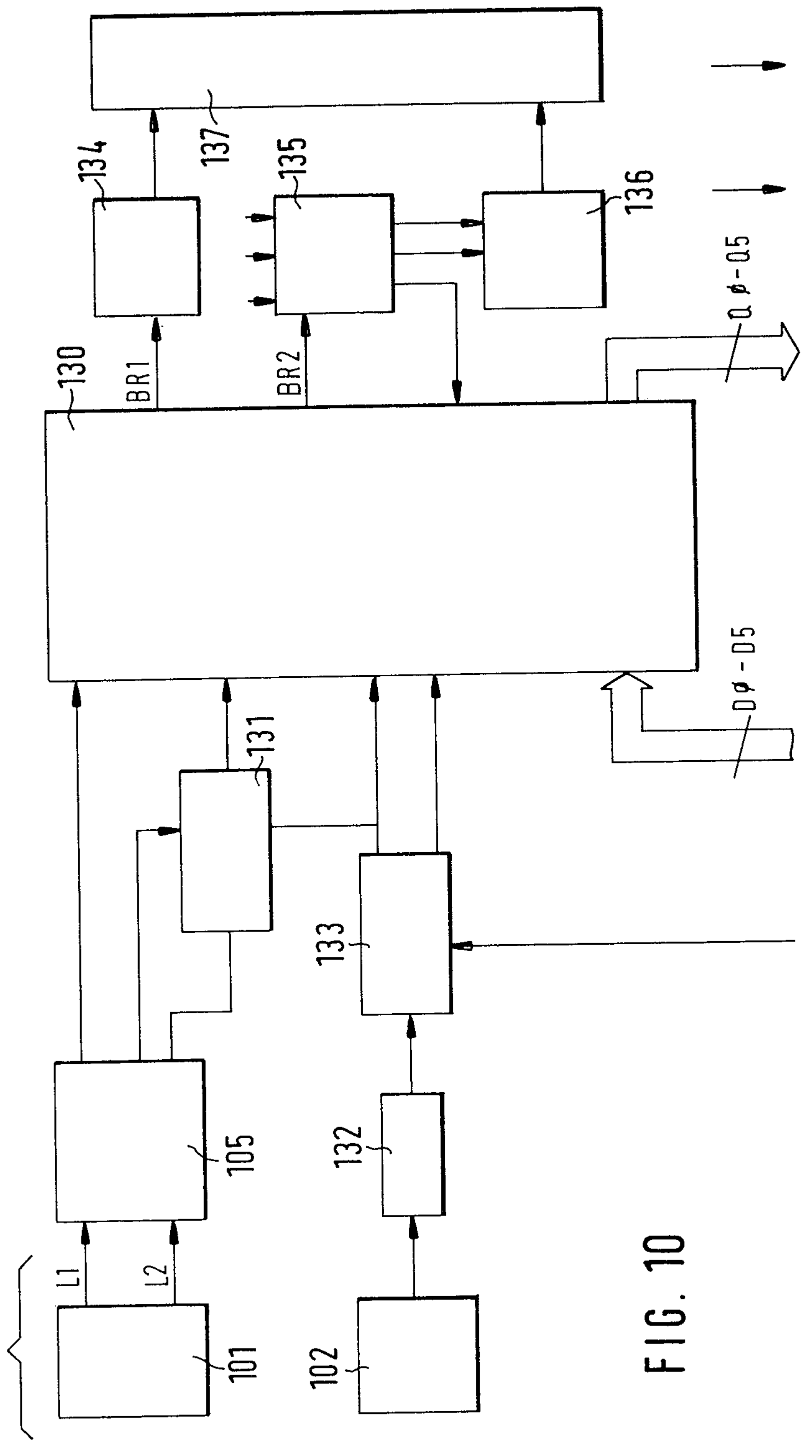


FIG. 10

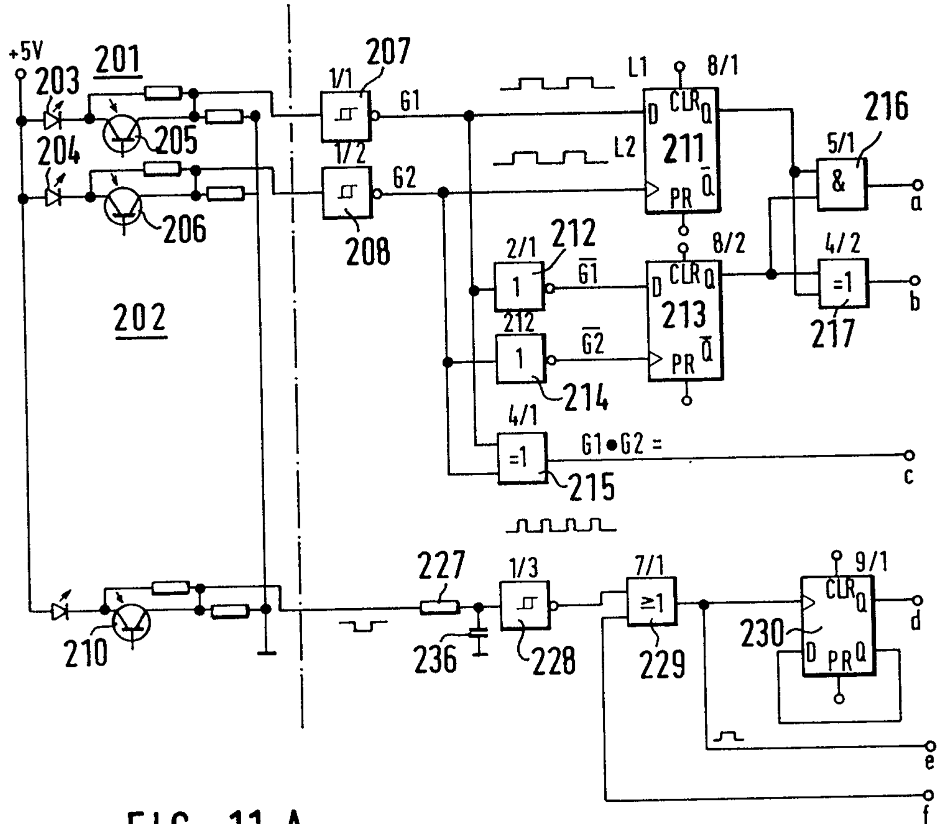


FIG. 11 A

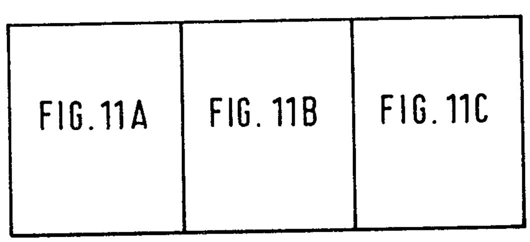
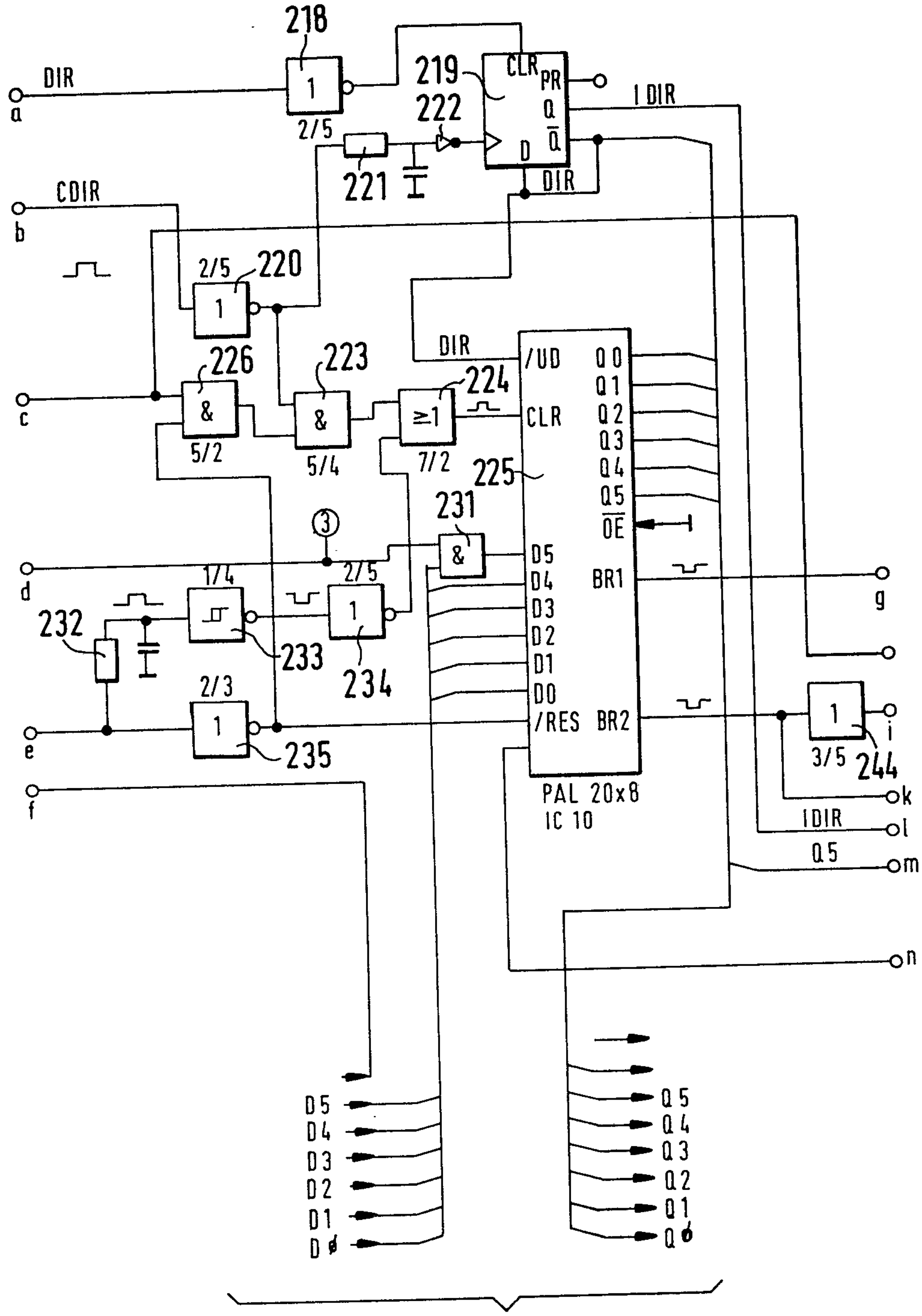
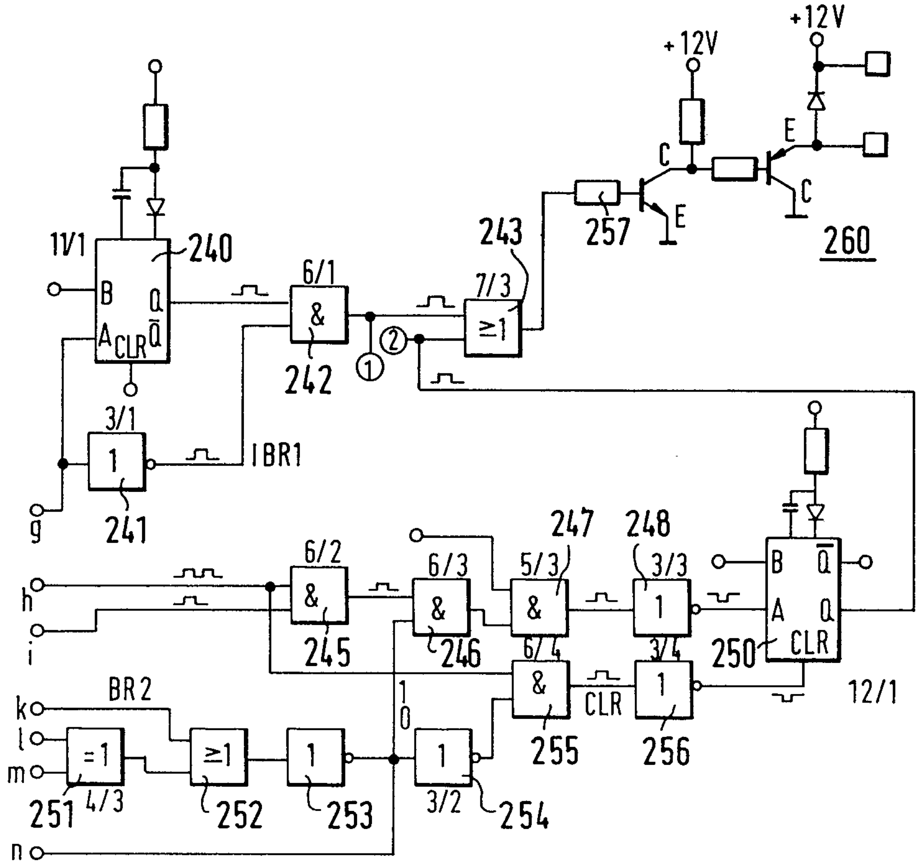


FIG. 11

FIG. 11B


218
219
222
221
CLR
PR
Q
D
DIR
I DIR
a
b
c
d
e
f
g
i
k
l
m
n
CDIR
2/5
220
226
223
224
225
5/2
5/4
7/2
231
233
234
232
235
244
1/4
2/3
3/5
&
≥1
1
/UD
CLR
D5
D4
D3
D2
D1
D0
/RES
Q0
Q1
Q2
Q3
Q4
Q5
OE
BR1
BR2
PAL 20x8
IC 10
IDIR
Q5
3
D5
D4
D3
D2
D1
Dø
Q5
Q4
Q3
Q2
Q1
Qø


+12V
+12V
C
E
C
E
1V1
240
B
Q
A
CLR
6/1
&
242
243
7/3
≥1
257
260
1
2
3/1
1
241
IBR1
g
h
i
6/2
&
245
6/3
&
246
247
5/3
&
248
3/3
1
6/4
&
255
CLR
3/4
1
256
B
A
CLR
250
12/1
k
l
m
n
BR2
=1
251
4/3
≥1
252
1
253
1
0
1
3/2
254

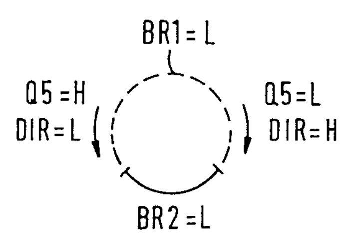

BR1 = L
Q5 = H
DIR = L
Q5 = L
DIR = H
BR2 = L

FIG. 11C

SPECIFICATION

Control means

The present invention relates to a control means.

DE-OS 31 39 577 discloses a device for selecting the operating mode in an apparatus for reproducing information signals which are recorded on a recording medium. This operating mode selection device controls a videotape reproduction apparatus in such a way that it functions either in a first mode (circuit switching mode) or in a second mode (movement mode). For this purpose using a "ball pen mechanism" a control shaft can be fixed by pressure in the axial direction between two axial positions, whereof one permits the unimpeded rotation of the control shaft about a rotation angle of more than 360°, whilst the second position limits the rotation angle to less than 360° symmetrically to an initial angular position.

Several pulse generators control the tape drive mechanism of the videotape reproduction apparatus as a function of the axial position and the angular speed or angular position of the control shaft. In the first operating mode (circuit switching mode) the television scenes recorded on the magnetic tape are reproduced framewise corresponding to the angular speed and rotation direction of the control shaft either forwards or rearwards, whilst in the second operating mode (movement mode) the speed and movement direction of the tape is controlled as a function of the size and direction of the angular utilization of the control shaft and consequently the television scenes recorded on the tape are reproduced with a variable speed in both possible directions. The known device for selecting the operating mode of a videotape reproduction apparatus generally functions satisfactorily, but as a result of the complicated mechanical construction with fixing and braking means, "ball pen mechanism", and a plurality of pulse generators, it requires a large amount of space and is correspondingly heavy and expensive. It is therefore prejudicial to the construction of small, lightweight reproduction equipment.

According to the present invention there is provided a control means with a rotary knob for selecting different operating states by initiating a last column function and for controlling these different operating states by turning the knob, wherein the divergence of the angular position of the knob from a zero position in one operating state supplies a first control quantity and whose angular speed and direction in the other operating state provides a second control quantity, the knob comprising a toroidal coil fixed concentric to the rotation axis of knob and a brake disk in magnetic active connection with the toroidal coil and which is connected in non-rotary manner with the knob with the exception of a predetermined angular deviation.

The inventive control means has the advantage that all the equipment necessary for the function are located within the control knob or button, so that minimum external dimensions, limited fitting depth and weight are obtained. It is a further advantage that through the electrical simulation of mechanical functions, the mechanical construction is significantly simplified.

Embodiments of the invention will now be described with reference to the accompanying drawings, wherein:

Figure 1 is a longitudinal section through a first embodiment of a control knob taken along line III–III in Fig. 3;

Figure 2 is a longitudinal section through the same control knob taken along line II–II in Fig. 3;

Figure 3 is a plan view taken along line I–I in Fig. 1;

Figure 4 is a longitudinal section through a second embodiment of a control knob;

Figure 5 is a longitudinal section through the same control knob at right angles to Fig. 4;

Figure 6 is a plan view taken along line I–I in Fig. 4;

Figure 7 is a block circuit diagram of the control logic circuit of the control knob;

Figure 8 is a block circuit diagram showing the single-chip microcomputer control of the control knob;

Figure 9 is a block circuit dioagram showing the function sequence in one of two possible operating modes for the control knob;

Figure 10 is an extended block circuit diagram for the construction of control logic circuits; and

Figure 11 shows the control logic as a discrete circuit.

In Figs. 1 to 3, the control means comprises a control knob having a hub 1 which is fixed to the free end of a spindle 5 and in the unoperated state is separated by an air gap 26 from a tie plate 2. To the tie plate 2 there is fixed a toroidal coil 7, to which external connection is made by a cable harness 27. Both hub 1 and tie plate 2 are made from a material with a good magnetic permeability. Spindle 5 is rotatably and longitudinally displaceably mounted in two ball bearings 10, 11.

The outer ring of ball bearing 11 is fitted into a bore of a fixing sleeve 4, whilst the outer ring of ball bearing 10 is located in a central bore of the tie plate 2. The outer rings of the two ball bearings 10, 11 are biassed away from one another by a first compression spring 19, whilst a second compression spring 18 is supported by one end on the inner ring of ball bearing 11 and by its other end on a disk 16 attached to spindle 5.

The fixing sleeve 4 is fixed by means of an octagonal nut 13 and a studded washer 14 on the control surface 28 of a video reproduction apparatus, a remote control device, a mixing console or the like. Diametrically opposite one another with respect to the axis of symmetry of the knob, the fixing sleeve 4 has a taphole 29 and a bore 30. Into the taphole 29 there is screwed a threaded stud 8 with a pin, the latter projecting into an oblong hole 32 of the tie plate 2, whose longitudinal extension extends parallel to the rotation axis (Fig. 1a). Inside a resilient plastic sleeve 33, a further threaded stud 31 with a pin is fixed in the bore 30. The pin of threaded stud 31 projects into an oblong hole 34 of the tie plate 2, whose longitudinal direction is parallel to the direction of spindle 5 and therefore to the rotation axis of the control knob.

By means of several screws 20, a rim 3 is fixed to the outer circumference of the hub 1. For ease of handling, the outer circumference of the rim 3 extends down towards the control surface 28, with the exception of a small gap, and engages over a dust protection ring 25. Rim 3 continues inwards and terminates in the tooth system 35 of a pulse generator. The pulse generator has two first forked light barriers 23, 24, which are arranged with a spacing of n+1/2 divisions on a circuit board centrally with respect to axis 5 and are intersected by the teeth of the tooth system 35. A further light barrier arrangement 36 is fitted to the circuit board in angularly displaced manner with respect to the light barrier arrangements 23, 24 and its optical axis is so twisted with respect to the radial direction that upon inserting the tooth system 35 in the light beam the latter is constantly interrupted independently of the rotational position of the tooth system 35.

The operation of the control means will be described in greater detail hereinafter. However, it is merely pointed out beforehand that the described construction can assume three axial positions. In the first axial position corresponding to Figs. 1 and 2, the hub 1 and rim 3 are freely rotatable. As a result the teeth of the tooth system 35 intermittently intersect the optical paths of the forked light barriers 23, 24. On partially pressing down the hub 1 to the second axial position the compression spring 18 is compressed until the air gap 26 between hub 1 and tie plate 2 almost disappears. Through the friction of hub 1 on tie plate 2 the rotation of hub 1 is opposed by increased resistance, so that the tie plate acts as a brake. The elimination of the air gap 26 can also be effected as a consequence of an electrical action on the control knob. By applying a voltage across connections 27 to the coil 7 a magnetic field is produced in the tie plate 2, which acts across the air gap 26 and leads to the air gap 26 being eliminated by attraction of the hub 1 against the plate 2. On further pressing down the hub 1 with the rim 3 fixed thereto, the tie plate 2 is moved counter to the compression spring 19 until the pins of the two threaded studs 8, 31 abut against the top surfaces of recesses 32, 34 in the tie plate. The tooth system 35 of rim 3 is in this third axial position lowered to such an extent that it interrupts the light beam of the forked light barrier 36.

Figs. 4 to 6 show a simpler construction of the control knob 50 comprising a hub 51 and a rim 52, the hub 51 having a hub sleeve 53 which is arranged in slidable and rotatable manner in a bearing sleeve 55 fixed in a pot magnet 54. The position of the control knob 50 with respect to the pot magnet 54 is determined by a shoulder stud 56 in conjunction with a compression spring 57. On the side of the pot magnet, compression spring 57 is supported against a disk 58 and towards the hub side against a disk 59. The shoulder stud 56 is fixed by means of a pressing nut 60 in the hub 51, which is made from a soft, non-magnetic material. Rim 52 can be made from a rubber mixture to improve the grip of the control knob.

Two cylindrical pins 61, 62 are embedded in hub 51 and the free ends thereof connect tie plate 63 in non-rotary but axially displaceable manner with hub 51. The pot magnet 54 contains a toroidal coil 64, which is covered towards the tie plate side by an aluminium disk 65, on which is bonded a brake lining 66. At its upper end, bearing sleeve 55 has a collar 67, which fixes a cup spring 68 positioned above tie plate 63.

The hub 51 also carries a cage 71, which is circumferentially provided with a number of slit-like apertures 72 for the intermittent passage of the light of two forked light barriers 73, 74, which are arranged in spaced manner. This spacing differs by half a division from a complete multiple of the division of apertures 72 in cage 71 in order to obtain a forwards-backwards detection. Below the forked light barriers 73, 74 there is provided a further forked light barrier 75, which with the knob depressed and therefore the cage 71 lowered is continuously interrupted and emits a signal. A recess 76 is formed in tie plate 63 (Fig. 6) and in it is placed a hairpin spring 77 between the tie plate and cup spring 78. Tie plate 63 is connected to cup spring 68 by a rivet 78. Cylindrical pin 61 connected in non-rotary manner to the hub engages between the legs of the hairpin spring 77 and leads to a possibility of control knob 50 turning by at least half a division of the apertures 72 in cage 71 when tie plate 63 is braked by the coil 64.

The control logic according to the block circuit diagram of Fig. 7 is subdivided into three function components. The first function component contains the functional units which are physically incorporated into the control means. They essentially comprise the electrooptical rotation angle scanning 101, the electrooptical last column detection 102 and the electromechanical braking means 103, together with signal conditioning means 104.

The digital logic elements are combined in a second functional component comprising the rotation angle detection 105, the mode switching 106, the timer and the reset logic for braking means 107, together with the actual control logics, comprising the counter mode detection, brake control, interface to external computer and display control 108. The third functional component essentially contains the position indication 109, together with the input interfaces for the operating mode and knob position presetting and the output interfaces for the actual information on the operating mode, knob position and rotation direction.

Fig. 8 is a detail of Fig. 7 in a different manner of representation. It shows in the form of a block circuit diagram the functional components integrated into the control button, namely the electrooptical rotation angle scanning 101, electrooptical last column detection 102, electromechanical braking means 103 and the signal conditioning means 104, together with the control system arranged outside the control knob and which in the present case comprises a single-chip microcomputer 110, e.g. SAB 8749 or SAB 8742, with the position indication 109, which can be in the form of a digital display or a chain of light-emitting semiconductors (LED's). The connections to the control computer of the apparatus are also shown.

The block circuit diagram of Fig. 9 illustrates the circuit arrangement for the fixed coupling of the speed of rotation of the control knob with the magnetic tape speed. Particularly in the case of rapid changes to the control knob rotation speed, e.g. the tensioning motors of a tape unit cannot follow the speed changes due to the mass moment of inertia of the spools fixed thereto. The represented circuit concept opposes a braking couple or torque to the torque exerted by the operator on the control knob and is proportional to the speed difference between the control knob and the magnetic tape. An operation of the control knob corresponding to a realistic acceleration of the tape is not opposed by a braking torque. The regulation of the control knob braking torque can be realized in simple manner through the use of a single-chip microcomputer, to which it is merely necessary to supply information on the tape speed.

A control knob speed results from the torque exerted on the control knob mechanism 120 by the operator. The control signal resulting from the electrooptical rotation angle scanning means 101 in conjunction with the signal conditioning means 104 influences the torque of the tensioning motors 121, 122, which gives a tape speed. By means of the pulse detection of the tape drive shaft 123, it is converted into a speed-dependent signal which, by means of control electronics 124, is related to the control signal of scanning electronics 101 and as a function thereof the knob brake 125 is operated with a changing torque. The difference between the manually acting torque on the control knob and the opposite braking couple of the knob brake 125 gives the resulting torque, which acts on the control knob mechanism.

The construction of the control knob logic is shown in block circuits form in Fig. 10. The meander-like signal sequences displaced with respect to one another by 90° and produced by the electrooptical rotation angle scanner 101 are supplied to the rotation angle detection means 105, which supplies counting pulses therefrom to an input of a circuit 130 acting as a bidirectional counter. From the sequence of the two signals L1/L2 a detection signal for the rotation direction change is obtained and is supplied together with the clock or timing signal obtained therefrom to the counter clock inhibit logic 131.

To the last column pulse generator 102 is connected a debouncing circuit 132, which is followed by an operating mode store, which is also influenced by an external mode switching. The two outputs of the mode store 133, as reset pulses, influence the counter inhibit logic 131 and the reset input of bidirectional counter 130, as well as the operating mode input of said counter. By means of a presetting input of bidirectional counter 130, a counter presetting can be carried out. A "zero position" timer logic 134 and a set/reset logic 135 are connected to bidirectional counter 130. A "stop" timer logic 136 connected to the set/reset logic 135, together with the zero position timer logic 134, influences a switching stage 137 for the brake magnets.

Fig. 11 shows the control knob logic in detail. The two forked light barriers 201, 202 cooperate with the pulse generator connected to the rotary part of the control means. The electrical part of each forked light barrier comprises a light-emitting diode 203, 204 and a phototransistor 205, 206. The output of phototransistor 205 is connected to the input of a Schmitt trigger 207 and the output of phototransistor 206 is connected to the input of a Schmitt trigger 208. Both Schmitt triggers steepen the edge of the light barrier output signals. Light barriers 201, 202 are so arranged with respect to the pulse generator disk or rim not shown in Fig. 8 that the two meander-like signal sequences have a 90° phase difference from one another from the output of Schmitt trigger 207, 208. The direction detection is derived from the phase difference between signal sequence L1 and signal sequence L2. A further forked light barrier is provided within the control means and its light passage is interrupted in the case of the axial operation of the control means. This axial displacement is used for reversing the operating mode of the connected apparatus, e.g. a tape unit.

Signal sequence L1 is supplied from the output of Schmitt trigger 207 to the D-input of a first flip-flop 211 and parallel thereto across an inverting stage 212 to the D-input of a second flip-flop 213. Signal sequence L2 passes from the output of Schmitt trigger 208 to the clock input of D-flip-flop 211 and parallel thereto across a second inverting stage 214 to the clock input of D-flip-flop 213. The outputs of Schmitt triggers 207, 208 are also connected to the two inputs of an OR gate 215 for obtaining a clock signal at the output thereof.

The Q-output of the D-flip-flop 211 is connected in parallel to an input of an AND gate 216 and an OR gate 217, the Q-output of D-flip-flop 213 to the second input of the AND gate 216 and to the second input of the OR gate 217. The output of AND gate 216 is connected across an inverting stage 218 to the reset input of a D-flip-flop 219, the output of the EXCLUSIVE OR gate 217 across a further inverting stage 220, a resistor 221 and the inverting amplifier 222 to the clock input of D-flip-flop 219. The output of inverting stage 220 is also connected to an input of AND gate 223, whose output is connected to an input of OR stage 224. From the output of OR stage 224, a line leads to the clock input of programmable counter 225. The output of the EXCLUSIVE OR gate 215 is connected to an input of AND gate 226, whose output is connected to the second input of AND gate 223. From output $\bar{Q}$ a line leads to the direction input of programmable counter 225 and to the D-input of D-flip-flop 219. A line leads to the Schmitt trigger 228 with connected inverting stage from the output of forked light barrier 210 across resistor 227. There is no need for Schmitt trigger 228, or the two Schmitt triggers 207, 208, if the signal shape from the output of the corresponding light barrier permits this. The output of Schmitt trigger 228 is led to one input of OR gate 229, to whose second input leads a line from an external operating mode reversing means in the connected apparatus. The clock input of a D-flip-flop 230 is connected to the output of OR gate 229. The output $\bar{Q}$ of said flip-flop 230 is linked with the D-input of the same flip-flop, output $\bar{Q}$ leading across an AND gate 231 to input D5 of the programmable counter 225. From the output of OR gate 229 a current path also leads across resistor 232, Schmitt trigger 233 with connected inverting stage and inverting stage 234 to the second input of OR gate 224, whose output is connected to the clock input CLK of the programmable counter 225. A line leads to the input of inverting stage 235 from the output of OR gate 229. The output of inverting stage 235 is firstly connected to the input RES of programmable counter 225 and secondly to the second input of AND stage 226.

From output BR1 of programmable counter 225, a line leads to the input A of multistable flip-flop 240 and across inverting stage 241 to one input of AND gate 242, whose second input is connected to output $\bar{Q}$ of multistable flip-flop 240. The output of AND gate 242 leads to the input of OR gate 243.

Output BR2 of programmable counter 225 leads across inverting stage 244 to an input of AND gate 245, across a further AND gate 246 and a third AND gate 247 to an inverting stage 248 and from thereto input A of multistable flip-flop 250. One input of an EXCLUSIVE OR gate 251 receives signals from the output $\bar{Q}$ of D-flip-flop 219, whilst its other input receives signals from output $\bar{Q}5$ of programmable counter 225. From the output of EXCLUSIVE OR gate 251, a line leads across an OR gate 252, a first inverting stage 253, a second inverting stage 254, and AND gate 255 and a further inverting stage 256 to reset input of multistable flip-flop 250. The output of inverting stage 253 is also linked to the inhibit input of programmable counter 225 and to the second input of AND gate 246, the second input of AND gate 245 is linked with the output of EXCLUSIVE OR gate 215 and also to the second input of AND gate 255. From output $\bar{Q}$ of multistable flip-flop 250, a line leads to the second input of OR gate 243. Across a resistor 257, the output of OR gate 243 acts on switching stage 260 to operate the brake coil 7 (Fig. 1) of the control means.

The pulse sequences L1, L2 supplied by the two forked light barriers 201, 202 are derived from the control means coding and are reciprocally displaced by 90°. As has already been stated, there is no need for Schmitt triggers 207, 208 if the signals from the forked light barriers have a sufficiently steep edge and are present in trouble-free form. The two pulse sequences L1, L2 are supplied in inverted form to D-flip-flop 213 and in non-inverted form to D-flip-flop 211. A check is made in both flip-flops to establish the state of signal L1 when there is a positive edge of signal L2 and output $\bar{Q}$ is set correspondingly. By invention in inverting stages 212, 214 the negative edge of the original signal is investigated in D-flip-flop 213. The logic AND link 216 at the output of the two flip-flops 211, 213 provides at the output a signal representative of the momentary rotation direction of the control means. For example, if the output of AND gate 216 is high in the case of clockwise rotation and low in the case of counterclockwise rotation. The EXCLUSIVE OR gate 216 connected parallel to AND gate 216 to the outputs of D-flip-flops 21, 213 always provides a high pulse if there is a different type of signal at each of the two inputs. This is always the case if the rotation direction of the control means is changed.

The forked light barrier 210 always provide no signal if a different operating mode is to be switched in with the last column function of the control means. This low pulse passes through a debouncing circuit comprising resistor 227 and capacitor 236 and after passing through inverting circuit 228 is supplied to one input of the OR gate 229, whose other input can be occupied with an external operating mode reversing pulse. The particular set mode is stored in flip-flop 230 and can be switched over either by operating the last column function and therefore the light barrier 210 or externally. Flip-flop 230 is set with the CLR input on switching the means to a given operating state. In the represented embodiment, programmable counter 225 is formed by a PAL component of of the PAL 20X8 type and constitutes a 6 bit bidirectional counter with various additional functions. The counter component supplies a binary-coded output signal Q0 to Q5 to the corresponding outputs as a function of the input conditions at inputs D0 to D5. This output signal is increased or decreased with each counter clock at the clock input CLK as a function of the bidirectional input signal UD. Table 1 gives the output conditions as a function of the input conditions for outputs Q0 to Q5, as well as BA1 and BA2. Table 2 contains the function table of component 225.

Counter 225 can be preset to a predetermined value. On activating input RES the preset value D0 to D5 at the counter is fed into the output register Q0 to Q5. In any operating mode, the counter can also be prevented from counting further by applying an inhibit signal SPERR. The count then is retained unchanged. In one control means mode it is desirable to be able to define the zero position by a given count. In the present embodiment the control knob zero position is defined by the count HHHLLL.

In this one of two operating modes brake signal BR1 is always activated when this predetermined count pccurs in order to simulate a zero grid. On the basis of the above defined zero position, the counter can count up or down by turning the control knob to the right or left. In order to simulate a stop for the control knob, the counting range is limited by switching in the brake magnet at the output of switching stage 260. The counting range is limited downwards by the value LLLHHH and upwards by the value HHHLLL. Brake signal BR2 is activated on reaching these counting range limits. Component 225 also offers the possibility of connecting output signals Q0 to Q5 directly to a microprocessor data bus. For this purpose the output connections Q0 to Q5 can be brought into a high-impedance state via connection QE, so that they can be directly interrogated by the microprocessor data bus.

Programmable counter 225 also triggers a signal for activating the brake magnet at output BR1 if the control knob is operated in the "fast rewind" mode and the count is HHHLLL. This count represents the median position, so that as a result on output BA1 is also simulated a signal for simulating the locking position in the control knob median position.

Component 225 also supplies signal BR2 for representing the stops in the "fast search" operating mode. It is triggered at count HHHLLL or LLLHHH in the other direction of movement. When a brake signal appears at output BR2, the inhibit input stops the counter, so that it cannot count further. As a result the clock signal is removed and further counting in the given direction stops.

On activating the RES input of component 225, the input information at inputs D0 to D5 is transferred into outputs Q0 to Q5 and the counter starts to count from there. Thus, the bidirectional counter 225 can be prepositioned to specific values by an external circuit.

Monostable flip-flop 240 is set to a time of approximately one second by the external wiring. Thus, if a pulse edge appears at output A, monostable flip-flop 240 is active for approximately one second. Inverter 241 shortens the time from one second to a brief instant, so that on passing through the zero point the brake is only applied very briefly and therefore zero locking is simulated.

The external wiring gives monostable flip-flop 250 a time constant of 5 seconds, so that the end stop on reaching the end counter position remains for 5 seconds at the most and then the brake is released. On detecting a direction change reversal of the control knob monostable flip-flop 250 must be immediately reset, so that there is no resistance to an opposing movement. The logic comprising gates 251 to 256 decide as a function of the count and the momentary counting direction whether brake signal BR2 is to be maintained or whether the monostable flip-flop 250 is to be reset via the CLR input.

The partly discrete circuit described in Fig. 11 can have greatly reduced space requirements through the use of further PA1 (programmable array logic) components. Through a second, similarly constructed circuit, in conjunction with time-dependent, switched-in resistors, it is conceivable to provide a regulated braking action on the control knob in such a way that an electric wave is maintained between said knob and the tape speed in a forced manner and in particular if the speed of the control knob is modified so abruptly that the relatively slow spools are unable to fllow this speed change. It is also conceivable to obtain gentle braking of the control knob by a type of frequency modulation.

TABLE 1

```
PAL20X8                                                PAL DESIGN SPECIFICATION
6 BIT UP DOWN COUNTER

CLK /RES D5 D4 D3 D2 D1 D0 9 SPERR /UD GND
/OC BR1 15 16 Q5 Q4 Q3 Q2 Q1 Q0 BR2 VCC

/BR1 =  /Q5*  Q4*  Q3*  Q2*  Q1*  Q0* /RES* D5              ;SHUTTLE= D5

/BR2 =   Q5*  Q4*  Q3* /RES* D5                             ;-25> BR2 >25
     +  /Q5* /Q4* /Q3* /RES* D5                             ;SHUTTLE= D5

/Q0 :=   RES* /D0                                           ;RESET
     +  /RES* /Q0                                           ;HOLD
   :+: /RES*  UD* /SPERR                                    ;INCREMENT
     +  /RES* /UD* /SPERR                                   ;DECREMENT

/Q1 :=   RES* /D1                                           ;RESET
     +  /RES* /Q1                                           ;HOLD
   :+: /RES*  UD*  Q0* /SPERR                               ;INCREMENT
     +  /RES* /UD* /Q0* /SPERR                              ;DECREMENT

/Q2 :=   RES* /D2                                           ;RESET
     +  /RES* /Q2                                           ;HOLD
   :+: /RES*  UD*  Q0*  Q1* /SPERR                          ;INCREMENT
     +  /RES* /UD* /Q0* /Q1* /SPERR                         ;DECREMENT

/Q3 :=   RES* /D3                                           ;RESET
     +  /RES* /Q3                                           ;HOLD
   :+: /RES*  UD*  Q0*  Q1*  Q2* /SPERR                     ;INCREMENT
     +  /RES* /UD* /Q0* /Q1* /Q2* /SPERR                    ;DECREMENT

/Q4 :=   RES* /D4                                           ;RESET
     +  /RES* /Q4                                           ;HOLD
   :+: /RES*  UD*  Q0*  Q1*  Q2*  Q3* /SPERR                ;INCREMENT
     +  /RES* /UD* /Q0* /Q1* /Q2* /Q3* /SPERR               ;DECREMENT

/Q5 :=   RES* /D5                                           ;RESET
     +  /RES* /Q5                                           ;HOLD
   :+: /RES*  UD*  Q0*  Q1*  Q2*  Q3*  Q4* /SPERR           ;INCREMENT
     +  /RES* /UD* /Q0* /Q1* /Q2* /Q3* /Q4* /SPERR          ;DECREMENT
```

TABLE 2

FUNCTION TABLE

CLK /RES /UD /OC SPERR D5 D4 D3 D2 D1 D0 Q5 Q4 Q3 Q2 Q1 Q0 BR1 BR2

```
;         S
; /       P
;C R / /  E                            B B
;L E U O  R D D D D D D  Q Q Q Q Q Q   R R
;K S D C  R 5 4 3 2 1 0  5 4 3 2 1 0   1 2
```

CLK	/RES	/UD	/OC	SPERR	D5	D4	D3	D2	D1	D0	Q5	Q4	Q3	Q2	Q1	Q0	BR1	BR2	
C	L	X	L	X	H	L	L	L	L	L	H	L	L	L	L	L	H	H	0 PRESET AT ZEROPOINT
C	H	L	L	L	X	X	X	X	X	X	H	L	L	L	L	H	H	H	+1
C	H	L	L	L	X	X	X	X	X	X	H	L	L	L	H	L	H	H	+2
C	H	L	L	L	X	X	X	X	X	X	H	L	L	L	H	H	H	H	+3
C	H	H	L	L	X	X	X	X	X	X	H	L	L	L	H	L	H	H	+2
C	H	H	L	L	H	X	X	X	X	X	H	L	L	L	L	H	H	H	+1
C	H	H	L	L	H	X	X	X	X	X	H	L	L	L	L	L	H	H	0, BR1
C	H	H	L	L	H	X	X	X	X	X	L	H	H	H	H	H	L	H	-1,
C	H	H	L	L	H	X	X	X	X	X	L	H	H	H	H	L	H	H	-2
C	H	H	L	L	H	X	X	X	X	X	L	H	H	H	L	H	H	H	-3
C	H	L	L	L	H	X	X	X	X	X	L	H	H	H	H	L	H	H	-2
C	H	L	L	L	H	X	X	X	X	X	L	H	H	H	H	H	L	H	-1,
C	H	L	L	L	H	X	X	X	X	X	H	L	L	L	L	L	H	H	0,BR1
C	H	L	L	L	H	X	X	X	X	X	H	L	L	L	L	H	H	H	+1
C	L	X	L	L	H	H	L	H	H	H	H	H	L	H	H	H	H	H	+24 DUMMY PRESET VOR RE. ANSCHL.
C	H	L	L	L	H	X	X	X	X	X	H	H	H	L	L	L	H	L	+25 BR2
C	H	L	L	H	H	X	X	X	X	X	H	H	H	L	L	L	H	L	+25 BR2, COUNTERSTOP
C	H	H	L	L	H	X	X	X	X	X	H	H	L	H	H	H	H	H	+24
C	L	X	L	L	L	L	H	L	L	H	L	L	H	L	L	H	H	H	-23
C	H	H	L	L	H	X	X	X	X	X	L	L	H	L	L	L	H	H	-24 DUMMY PRESET VOR LI. ANSCHL.
C	H	H	L	L	H	X	X	X	X	X	L	L	L	H	H	H	H	L	-25
C	H	H	L	H	H	X	X	X	X	X	L	L	L	H	H	H	H	L	-25 BR2, COUNTERSTOP
C	H	L	L	L	H	X	X	X	X	X	L	L	H	L	L	L	H	H	-24

CLAIMS

1. Control means with a rotary knob for selecting different operating states by initiating a last column function and for controlling these different operating states by turning the knob, wherein the divergence of the angular position of the knob from a zero position in one operating state supplies a first control quantity and whose angular speed and direction in the other operating state provides a second control quantity, the knob comprising a toroidal coil fixed concentric to the rotation axis of knob and a brake disk in magnetic active connection with the toroidal coil and which is connected in non-rotary manner with the knob with the exception of a predetermined angular deviation.

2. Control means according to Claim 1, wherein rotation direction, angular deviation and last column function are scanned and supplied to a processing electronics, which then supplies the actual control instructions to an apparatus to be controlled and simultaneously supplies an indication back to the operator by exciting the toroidal coil.

3. Control means according to Claims 1 or 2, wherein the mechanical stop by fixing the knob takes place by exciting the toroidal coil.

4. Control means according to Claim 3, wherein even when the brake disk is fixed, rotary means can be moved in at least one rotation direction for producing at least one rotation pulse.

5. Control means according to one or more of the preceding claims, wherein each function of the control means can be obtained independently of the momentary position of the knob.

6. Control means according to one or more of the preceding claims, wherein the toroidal coil can be excited in such a way that a variable friction torque can be produced between the value zero and the maximum friction torque.

7. Control means according to Claim 6, wherein independently of the rotation position of the knob, the toroidal coil can be briefly excited in such a way that the friction torque is increased for simulating locking points.

8. Control means according to one or more of the preceding claims, comprising an electronic circuit with a pulse processing means for recording the pulse sequence dependent on the rotation direction and the rotation speed of the knob, for controlling the toroidal coil, for giving control instructions to the apparatus to be controlled and optionally for controlling an optical display.

9. Control means according to Claim 8, comprising a parallel remote control input of the pulse processing means, enabling the operating mode, momentary position and characteristics of the mechanical acknowledgements to be supplied to the knob.

10. Control means according to Claim 8 or 9 comprising a bidirectional counter for counting the rotation position-dependent pulses, for energizing the ring magnets on reaching a predetermined count and for deenergizing the toroidal coil at the start of the downward count after reaching the predetermined count.

11. Control means according to one of the claims 1 to 10, wherein the toroidal coil and pulse generator for rotation direction and last column detection are essentially arranged in one plane parallel to the assembly plane.

12. Control means according to one of the Claims 1 to 10, wherein the toroidal coil, brake disk with return spring, pulse generator and scanner are integral components of the knob housing and this can essentially be fitted above the control surface.

13. Control means according to one of the preceding claims, wherein the axial movement of the brake disk is not influenced by the axial movement of the knob on initiating the last column function.

14. Control means according to one of the preceding claims, wherein on initiating the last column function, scanning of the rotation angle pulses takes place unchanged.

15. Control means according to one of the preceding claims, wherein the predeterminable braking characteristics of the knob are maintained, even on operating the last column function.

Printed for Her Majesty's Stationery Office by Burgess & Son (Abingdon) Ltd, Dd 8991685, 1987.
Published at The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.