United States Patent

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[54] **PROGRAM CONTROL APPARATUS**
11 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **74/568**
[51] **Int. Cl.** **F16h 54/04**
[50] **Field of Search** ..... 74/568, 568 (M), 568 (T); 66/156, 50 (B); 200/38 (B), (B1), (C), (C1)

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ABSTRACT: A program control apparatus includes a drum mounted for rotation and a stack of cam rings removably supported upon the drum surface. The cam rings include outwardly projecting partly cut away flanges formed of easily removable material providing cam surfaces for the control of a program operation through a series of cam follower devices. The drum is mounted only at one end by means of a shaft connected to a wall portion of a support, the support also supporting drive means for rotating the drum and the cam follower devices. The arrangement permits rapid and convenient setup and adjustment of programs through cutting away of portions of the cam ring flanges, through exchange of the cam rings, and through exchange of the entire drum assembly.

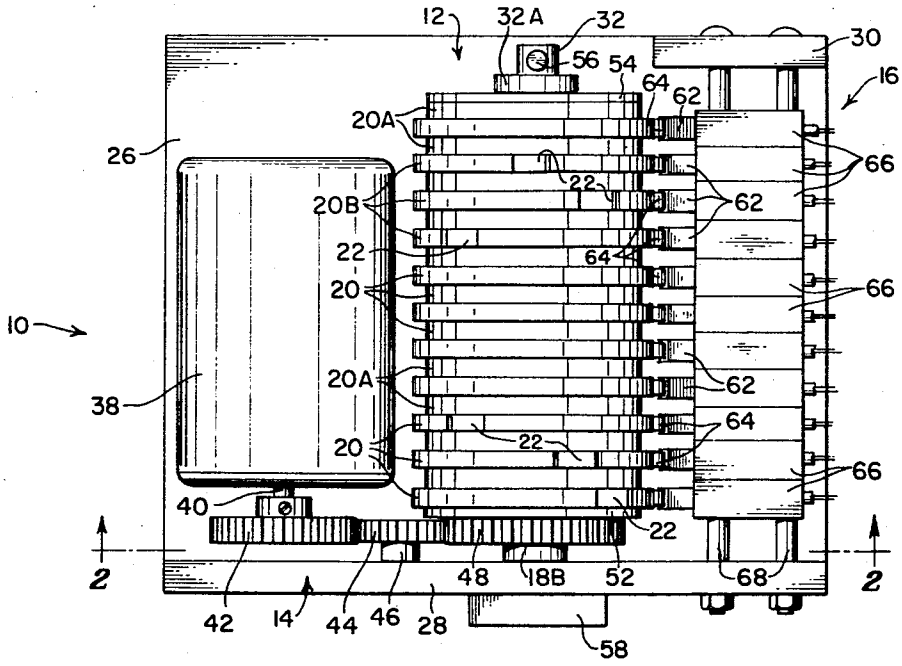


FIG. 1

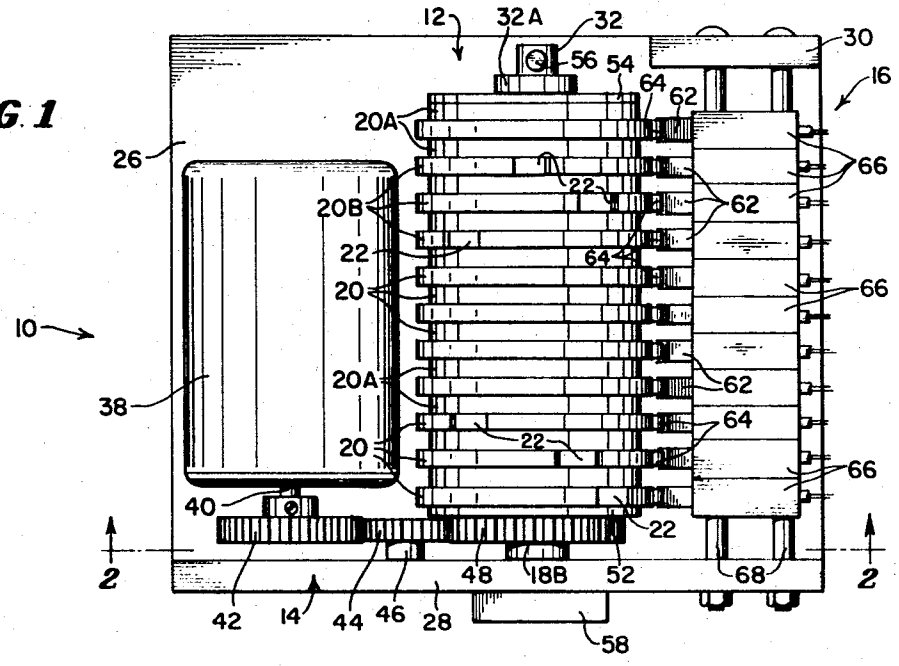


FIG. 2

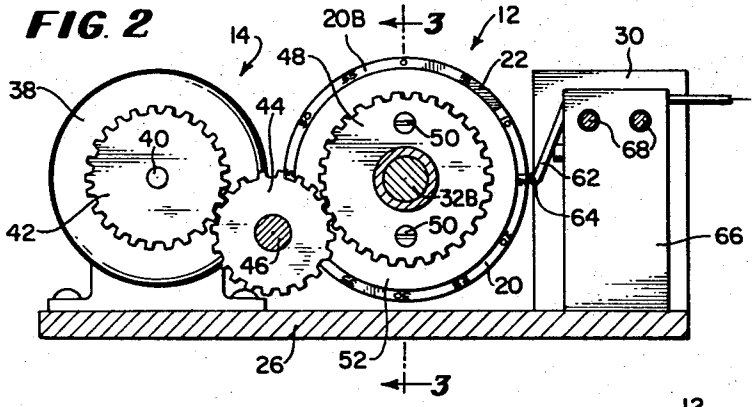


FIG. 5

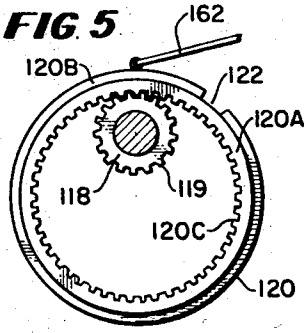


FIG. 3

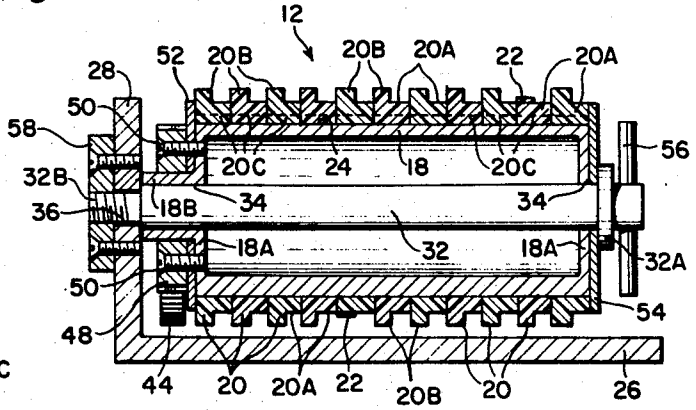
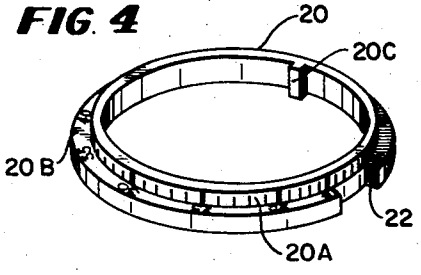


FIG. 4



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PROGRAM CONTROL APPARATUS

The present invention relates to program control apparatus.

Many types of rotary drum programming devices are known. Typically, such devices include a rotating drum having a series of cam surfaces each defining projections or recesses engaged by cam followers to control a series of control devices thereby to carry out a program operation. The present invention relates to improvements in this type of device.

Among the principal objects of this invention are to provide improved program control apparatus; to provide an apparatus which is capable of easily being prepared initially to set up a program; to provide a device in which adjustments of an entire program or portions of the program are easily carried out; and to provide an apparatus which is reliable, compact, and relatively inexpensive.

In brief, the above and other objects and advantages are realized in accordance with the present invention through the provision of a program control apparatus including a drum mounted for rotation together with a series of cam rings removably mounted in stacked relation on the drum. The cam rings each include an outwardly radially extending flange formed of easily cutaway material which is removed in part in accordance with the program to be carried out. The cam rings include base portions of greater axial length to maintain a desired spacing between the flanges when the rings are stacked on the drum. The rings are easily mounted and removed from the drum surface in order to set up, alter, or change the program. In addition, the drum is rotatably mounted on a shaft having only a single end supported on a wall member, the drum being easily removable and replaceable in order to change an entire program. The wall member is associated with a suitable support also carrying a drive means for rotating the drum and a series of cam follower operated devices for carrying out the desired program.

The invention together with its objects and advantages may be best understood from consideration of the following detailed description of the illustrative embodiments shown in the drawing, wherein:

FIG. **1** is a view of a program control apparatus embodying the present invention;

FIG. **2** is a sectional view taken along the line **2–2** of FIG. **1**;

FIG. **3** is a sectional view taken along the line **3–3** of FIG. **2**;

FIG. **4** is a perspective view of one of the cam rings of the apparatus of FIG. **1**; and

FIG. **5** is a sectional view on a reduced scale illustrating an alternative embodiment of the invention.

Having reference now to FIGS. **1—4** of the drawings, there is illustrated a program control apparatus designated as a whole by the reference numeral **10** and constructed in accordance with the principles of the present invention. In the main, the apparatus **10** includes a rotatably mounted programming drum assembly generally designated as **12** together with a drive system generally designated as **14** for rotating the drum assembly **12**. A control assembly designated as a whole as **16** is operated by the drum assembly **12** to carry out a program or a selected sequence of operations.

An important feature of the present invention resides in the construction and arrangement of the drum assembly **12**—this construction making possible simplified setup of the initial program as well as simplifying changes of part of the program or of the entire program. The drum assembly **12** includes a generally cylindrical drum or body **18** (FIG. **3**) over the surface of which are removably supported a stacked arrangement of individual cam rings each designated by the reference numeral **20**. The cam rings are easily prepared so that they present the desired arrangement of cam surfaces for the operation of the control assembly **16**. In addition, the cam rings are easily installed, arranged and replaced on the drum **18**.

Having reference to FIG. **4**, the construction of one of the cam rings **20** is illustrated. The ring includes a generally collar-like base portion **20A** having a substantially uniform inside diameter such that the base portion **20A** may be slidably

received on the drum **18**. The ring **20** further includes a radially outwardly extending flange or rim **20B** formed integrally with the base **20A**. The material of the flange or rim **20B** is such that selected portions of the rim may be removed by a suitable cutting tool or the like to provide recesses of desired extent and location, the recesses being designated as **22** in the figures of the drawing. The ease of preparing the cam rings to set up a desired program is enhanced by the provision of suitable regularly spaced indicia arranged about the periphery of the base portion **20A** of the cam ring. In order to relate the regularly spaced indicia to a parameter of the program to be set up, such as time, the flange or rim **20B** is also provided with indicia, as appears in FIG. **4**.

The cam rings **20** may be supported on the cylindrical surface of the drum **18** in any suitable manner, as by a friction fit or by clamping or the like. In order to prevent rotation of the cam rings relative to the surface of the drum body, a suitable interlocking arrangement is provided. In the illustrated embodiment of the invention in FIGS. **1—4**, this interlocking arrangement takes the form of a radially inwardly extending projection **20C** on each cam ring **20** extending into an axially extending groove **24** (FIG. **3**) in the surface of the drum **18**. As appears best in FIGS. **1** and **3**, when the cam rings **20** are mounted in stacked relationship on the surface of the drum **18**, the base portions **20A** of the rings maintain a desirable uniform spacing between the cam surface defining flanges or rims **20B**.

In order to set up a desired program with the drum assembly **12**, the individual cam rings **20** are prepared by cutting away or removing selected portions of the rims **20B** in accordance with the desired sequence of controlled events to take place. This process if facilitated by the provision of indicia on both the base and flange portions of the cam ring. This cutting away process by which material is removed from the flanges **20B** is easily carried out since the cam rings **20** are formed of a material such as plastic or the like which can readily be removed with a suitable tool. The prepared cam rings are then mounted on the drum **18** in the desired sequence to produce the selected program. In the event it is desired to alter any portion or portions of the completed program, the change is readily accomplished merely by replacing the particular cam ring or rings **20** corresponding to the changes to be made. It is not necessary to change the entire program merely to alter one portion.

An important advantage of the present invention is that the various components of the apparatus **10** are compactly mounted in a convenient and simple arrangement wherein any of the components including the entire drum assembly **12** can easily be removed and replaced. The apparatus is provided with a supporting frame which, in the illustrated arrangement, includes a base **26**, a wall **28**, and a leg **30**, although other arrangements could be used. Conveniently, the drum assembly **12** is rotatably mounted on a shaft **32**, the shaft being supported only at one end on the wall **28**. The opposite end of the shaft is unsupported and therefore easily accessible.

More specifically, the drum or body **18** includes a pair of end walls **18A** (FIG. **3**) defining openings **34** receiving the shaft **32** loosely enough so that the drum **18** is free to rotate about the shaft **32**. The shaft projects through the openings **34** and is releasably attached to an opening **36** in the wall **28**. Thus, when it is desired to change an entire program, this can rapidly and conveniently be accomplished merely be releasing the shaft **32** and replacing the entire drum assembly **12** with a different drum assembly carrying the desired program.

Rotation is imparted to the drum assembly **12** by means of the drive system **14** including a motor **38** supported by the base **26**. The motor includes a rotatable drive shaft **40** carrying a drive pinion **42**. An idler **44** is rotatably mounted on a shaft **46** supported by the wall **28** and serves to transmit rotary motion between the pinion **42** and a driven gear **48** mounted at one end of the drum **18**. The driven gear **48** is received over a hub portion **18B** of the drum **18** and is fixed to the drum in any suitable manner, as with fasteners **50**.

In the arrangement of FIGS. 1—4, the cam rings 20 are clamped in position along the drum surface, although if desired a friction fit mounting or other arrangement could be used. In order to clamp the rings in position, a first clamping plate 52 is sandwiched between the driven gear 48 and the end wall 18A of the drum 18. If desired, the plate 52 could obviously be formed integrally with the drum or with the gear. At the opposite end of the drum 18, an additional clamping plate 54 is held against the opposite wall 18 by an enlarged portion 32A of the shaft 32.

In order to facilitate mounting and removal of the drum assembly 12, the shaft 32 is provided with a handle 56 at its free outermost end. The innermost end of the shaft 32 is provided with a threaded reduced end portion 32B extending through the opening 36 and threaded into a nut member 58 which conveniently may be attached to the wall 28. The spacing between the reduced diameter end portion 32B of the shaft 32 and the enlarged portion 32A of the shaft is such that the drum assembly 12 is permitted freely to rotate on the shaft when driven by the motor 40 and gears 42, 44, and 48. The use of the gear drive arrangement makes it possible easily to remove the motor 40 from the apparatus for replacement or the like.

Referring now more specifically to the construction of the control assembly 16, there are provided a plurality of cam followers comprising pivotally mounted levers 62 having rollers 64 riding upon the cam surfaces defined by the flanges 20B. The cam followers operate suitable control devices which in the illustrated arrangements take the form of miniature push button switches 66. The switches are mounted on a pair of support bars 68 extending between the wall 28 and the leg 30 of the frame. These switches are adapted to be interconnected in known manner with electrically operated equipment to be controlled in a programmed sequence.

Having reference now to FIG. 5 there is illustrated an alternative embodiment of the invention which may be preferred when cam rings of larger diameter are desired to provide cam surfaces of greater length. The construction of the arrangement of FIG. 5 may for the most part be similar to the apparatus 10 shown in FIGS. 1—4 and thus has not been completely illustrated.

When rings of large diameter such as about 6 inches or larger are used, it is difficult to maintain the shape and size of the rings uniform. Thus it may be difficult to mount the rings on a drum having an outside diameter approximately equal to the inside diameter of the rings. Furthermore the accuracy of the program may be impaired since the cam surfaces of different rings may differ somewhat in length.

Such problems are overcome in accordance with the present invention by the provision of a drum 118 the outer circumference of which is provided with regularly spaced elongated gear teeth 119 extending in an axial direction throughout some of all of the length of the drum. Cam rings 120 having inside diameters larger than the drum diameter are removably supported in stacked relation on the drum, and each includes inner gear teeth 120C engageable with the teeth 119. The rings 120 are somewhat loosely supported on the drum 118 so that they hang freely from the drum.

When the drum 118 is rotated, a planetary gear action takes place to cause the rings 120 to rotate about their axes. Cam follower devices including levers 162 for controlling pushbutton switches or the like may be arranged to engage the uppermost portions of the rings 120 to aid in holding the rings 120 on the drum 118. The rings include base portions 120A and flanges 120B which may be identical to the portions 20A and 20B of the cam rings 20. Since each ring has an equal number of inner gear teeth, and since the cam surface at the outside of each ring 120 is aligned rotationally with the inner teeth, the program is accurate regardless of slight variations in the size or shape of the rings.

I claim:

1. A program control apparatus comprising a generally cylindrical drum mounted for rotation about a central longitudinal axis, means defining a plurality of cam surfaces extending in generally circular paths around the circumference of the drum, and a plurality of cam follower means engageable with the cam surfaces for carrying out a program in accordance with the configuration of said cam surfaces, said cam surface defining means including a plurality of individual ring members slidably and removably supported on the surface of the drum, each of said ring members including a radially outwardly projecting flange of initially uniform and initially continuous cross section formed of a material being selectively removable at any desired region to form a recess of any desired length in the flange.

2. The apparatus of claim 1, each said ring member including a base having a smaller outside diameter and a larger axial length than said flange portion, the bases of adjacent ring members abutting one another to provide uniform spacing between the cam surfaces when the ring members are stacked.

3. The apparatus of claim 2, said base and said flange of each ring member being made of plastic material.

4. A program control apparatus comprising a generally cylindrical drum mounted for rotation about a central longitudinal axis, means defining a plurality of cam surfaces extending in generally circular paths around the circumference of the drum, and a plurality of cam follower means engageable with the cam surfaces for carrying out a program in accordance with the configuration of said cam surfaces, said cam surface defining means including a plurality of individual ring members slidably and removably supported on the surface of the drum, each of said ring members including a radially outwardly projecting flange of initially uniform and continuous cross section formed of a material being selectively removable to form a recess in the flange, each said ring member including a base having a smaller outside diameter and a larger axial length than said flange portion, the bases of said ring members providing uniform spacing between the cam surfaces when the ring members are stacked and indicia on the peripheral surface of each said base adjacent said flange to serve as a guide in the removal of the flange material.

5. The apparatus of claim 4, having further indicia on said flange related to said first-mentioned indicia.

6. The apparatus of claim 3, a radially inwardly directed projection on each said ring member, and a groove in the surface of said drum receiving said projections for holding said cam rings against rotation.

7. The apparatus of claim 1, said ring members having an inside diameter slightly greater than the drum diameter and being slidably received thereon.

8. The apparatus of claim 1, said drum having spaced elongated axially extending gear teeth defined on its surface, and said ring members having inside diameters substantially larger than the diameter of the drum, and each ring member having spaced inwardly directed gear teeth engageable with said drum gear teeth.

9. A program control apparatus comprising a support having a wall portion, an opening in said wall portion, a rotatable programming drum having axial opening means defined therethrough and having cam means supported on its surface, a support shaft adapted to extend through said axial opening means rotatably to support said drum, said shaft having an end portion engageable with said opening to provide a single point support for said shaft for mounting said drum in a location projecting from said wall portion, drive means mounted on said support for rotating said drum, and control means mounted on said support and engageable with said cam means for carrying out a program operation, said drive means comprising a driven gear attached to one end of said drum between said drum and said wall portion, a motor mounted on said support means, a drive pinion rotated by said motor, and an idler coupled between said drive pinion and driven gear, said idler being supported on said wall portion.

10. A cam ring adapted to be mounted in stacked relation with similar cam rings on a rotatable cylindrical surface to perform a programming function, said cam ring comprising: a unitary generally annular body including a base and a flange,

the base having an axial length in excess of its radial thickness so as to have a collarlike shape, and said flange having an axial length smaller than the axial length of the base and extending radially outwardly of the base conveniently to be cut away in part to form a peripheral cam surface, said flange initially being continuous and having a uniform cross section readily cut away at any region and for any desired length.

11. A cam ring adapted to be mounted in stacked relation with similar cam rings on a rotatable cylindrical surface to perform a programming function, said cam ring comprising: a unitary generally annular body including a base and a flange, the base having an axial length in excess of its radial thickness so as to have a collarlike shape, and said flange having an axial length smaller than the axial length of the base and extending radially outwardly of the base conveniently to be cut away in part to form a peripheral cam surface, and regularly spaced indicia arranged along said flange and along the periphery of said base to facilitate preparation of said peripheral cam surface.