

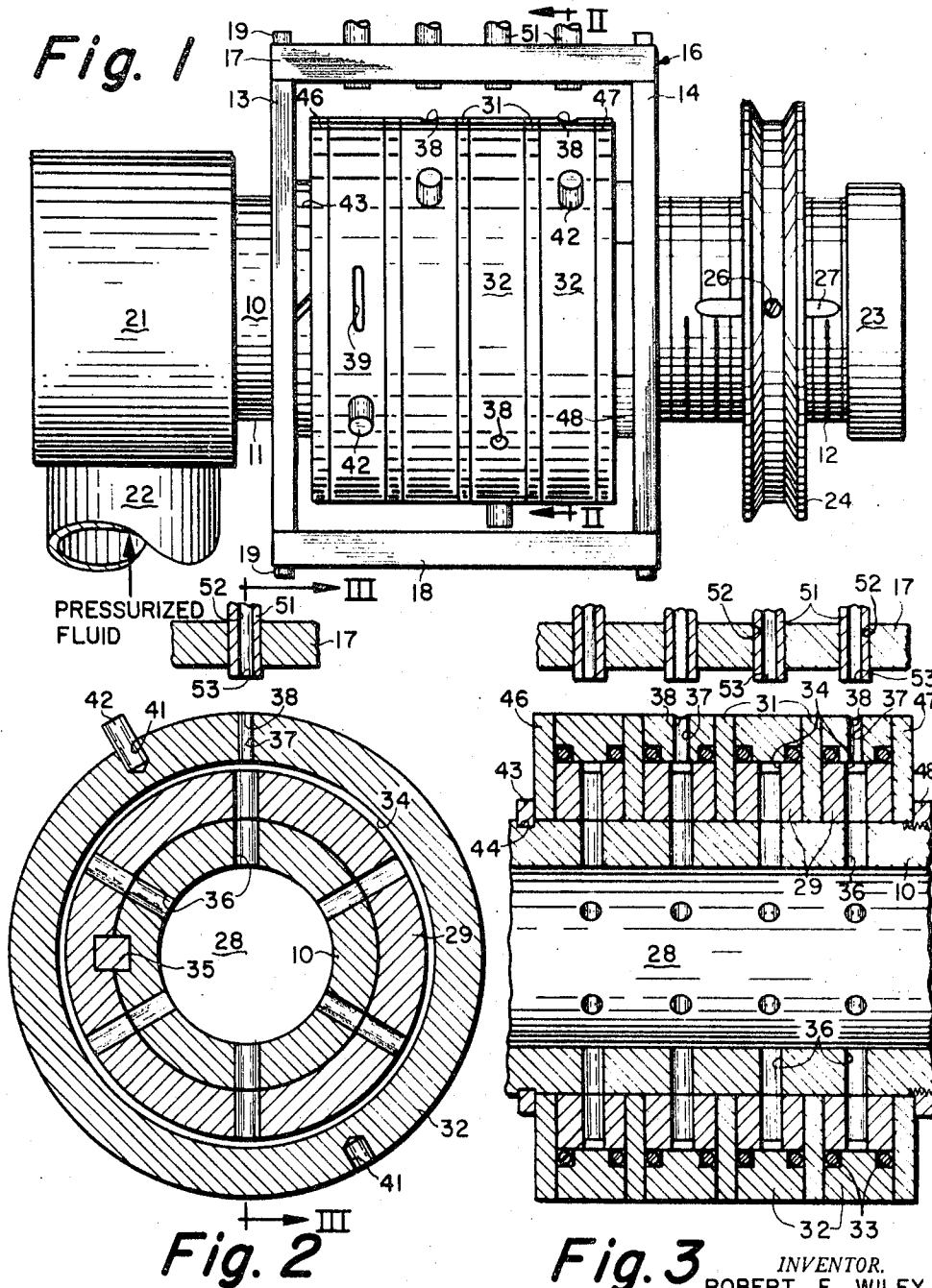
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TIMING APPARATUS

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TIMING APPARATUS

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ABSTRACT OF THE DISCLOSURE

An adjustable timing apparatus for actuation of fluid amplifiers in accordance with a desired program therefor. A hollow rotatable shaft having a plurality of rings thereabout and normally rotatable therewith, the rings and shaft embodying fluid passages leading from said hollow to orifices in the outer periphery of the rings to supply pressurized fluid supplied to said hollow to input tubes of fluid amplifiers, such rings being rotatively adjustable about said shaft to vary the sequence of receipt of the pressurized fluid by the input tubes.

Background of the invention

The invention relates to the field of fluid amplifiers or similar pressurized-fluid actuated apparatus. It is well known, for example, to actuate a plurality of fluid amplifiers or similar devices in a predetermined sequence controlled by a perforated tape, card or disk passing between the input tubes of said amplifiers or fluid devices, and pressurized fluid output tubes disposed opposite said tubes and slightly spaced therefrom. The sequence of operation of said amplifiers or devices depends on the relative locations of the perforations in said tape, card or disk, as is well known in the art. In order to vary or adjust the sequence of operation of said amplifiers or devices, new perforated tapes, cards or disks are substituted for those previously employed. Such new perforated items have their perforations at locations thereon which differ from those on the previously employed perforated items, thereby varying the sequence in which jets of pressurized fluid are permitted to flow between said pressurized-fluid output tubes and said input tubes of the fluid amplifiers or similar devices.

It is believed obvious that, if a fluid-actuated device is actuated at an incorrect point in time in a period of a sequence of actuations of a plurality of such devices controlled by a perforated tape, card or disk, in order to correct for such incorrect operation, it is expedient to substitute a new tape, card or disk for the incorrectly perforated one rather than to change the locations of the input tube of the incorrectly actuated device and the associated output tube. Furthermore, if only small adjustments in the time sequence of said actuations are desired, it is similarly expedient to substitute new tapes, cards or disks for the incorrectly perforated ones. It is readily apparent, therefore, that it would be desirable to provide, where possible, adjustable timing apparatus for controlling the sequence of operation of fluid amplifiers or similar devices, such timing apparatus being minutely adjustable for minute corrections in said sequence of operations, and selectively adjustable over a wider range for varying said sequence of operations. Accordingly, the present invention relates to timing apparatus for controlling repetitive sequences of operations of fluid ampli-

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fiers or similar fluid-actuated devices, such apparatus being readily adjustable for either minutely regulating or for completely changing said sequences of operations.

Summary of the invention

In carrying out the invention there is provided a cylindrical shaft embodying a fluid chamber supplied with pressurized fluid and having annularly disposed thereabout a plurality of spaced-apart annular members normally frictionally engaged for rotation with said shaft but manually rotatively movable about said shaft, such shaft and each such member embodying fluid passages leading from said chamber through the outer periphery of the respectively associated member regardless of the rotational position of such member on the shaft. The input tubes of fluid amplifiers or other pressurized-fluid actuated devices can be disposed, for actuation thereof, in the path of rotational movement of jets of fluid issuing from said fluid passages during rotation of said shaft and rings.

Brief description of the drawings

FIG. 1 of the drawings comprises a side elevational view of the preferred form of apparatus embodying the invention,

FIG. 2 is a cross-sectional view of the apparatus taken on line II—II of FIG. 1, and

FIG. 3 is a cross-sectional view of a portion of the apparatus of FIG. 1 taken on line III—III of FIG. 2.

Similar reference characters refer to similar parts in each of the figures of the drawings.

Description of the preferred embodiment

Referring first to FIG. 1, there is shown a longitudinal hollow, cylindrical shaft 10 whose left and right hand ends 11 and 12, respectively (viewing FIG. 1), extend through suitable rotary bearings (not shown) provided in vertical end sections 13 and 14, respectively, of a support frame 16. Such end sections are secured to top and bottom sections 17 and 18, respectively, of frame 16 by bolts such as 19 extending through said top and bottom sections and screwed into cooperating threaded holes provided in the top and bottom edges of end sections 13 and 14. There is provided on end 11 of shaft 10 a substantially fluid-tight rotary union 21 having a first end of a first end of a pressurized-fluid conduit 22 connecting therewith. The other end of conduit 22 is connected to a source of constant-pressure pressurized fluid, such source not being shown in the drawings for purposes of simplification thereof. Rotary unions such as 21 are well known.

End 12 of shaft 10 is threaded and is provided with a fluid-tight cap 23 which is screwed onto the threads on such end 12 of the shaft. A pulley 24 is also screwed onto end 12 of shaft 10 and is then secured to such shaft for rotary movement therewith by a set screw 26 which extends diametrically through the center of the perimeter of pulley 24 and is screwed tightly against a flat area 27 on end 12 of shaft 10.

Referring to FIGS. 2 and 3 of the drawings the previously mentioned hollow in shaft 10 provides a fluid chamber 28 to which is supplied, through conduit 22 and rotary union 21, constant-pressure pressurized fluid from the previously mentioned source thereof. A plurality of rings such as 29 extend snugly around the outer perimeter of shaft 10 and are spaced from each other by annular spacers or washers, such as 31, such spacers having a larger diameter than the rings such as 29. The rings such

as 29 and the spacers such as 31 are keyed against rotary movement on shaft 10 by a key 35 (FIG. 2) extending through keyways provided in the inner periphery of rings 29 and spacers 31, and along a keyway provided in the outer periphery of shaft 10 and extending longitudinally along such shaft.

There is provided between the facing surfaces of the outer portions of the spacers, such as 31, members, such as 32, which annularly snugly but rotatably surround the outer peripheries of the rings such as 29 and, thus, also surround shaft 10. The members, such as 32, are slightly smaller in thickness than are the rings, such as 29, and, therefore, such members are not held by said facing surfaces of the spacers, such as 31, against rotary movement about said rings. However, there is provided adjacent the circumferential edges of the inner wall of each member, such as 32, annular gaskets, such as 33, which surround the outer peripheries of the rings, such as 29, adjacent the edges of such outer peripheries. The gaskets, such as 33, are disposed in recesses provided in said circumferential edges of the inner wall of each member, such as 32, and are compressed against said edges by the spacer rings such as 31. This will be further discussed hereinafter. The gaskets, such as 33, provide fluid-tight seals between rings 29 and members 31 which, as hereinafter also further discussed, prevent the escape of pressurized fluid from between such rings and members. Said gaskets also frictionally engage each respective member, such as 32, and, thus, normally provide for rotational movement of said members with the rings, such as 29, and, thereby, with shaft 10.

An annular fluid passage, such as 34, is provided contiguous to or in said inner wall of each of the members, such as 32, such fluid passage extending annularly around said inner wall where such wall contacts the outer periphery of the respectively associated ring such as 29. Such fluid passages, each, therefore, extend annularly about the inner wall of each respective said member between such member and said shaft. As will be readily apparent from a brief glance at FIG. 3 of the drawings, the annular passages, such as 34, can be provided entirely in the outer peripheries of the rings, such as 29, as in the preferred embodiment of the invention illustrated or, alternatively, such passages can be embodied entirely in the inner walls of the members, such as 32. As a further alternative, said passages can be embodied partially in both said members and said rings as will be readily apparent to those skilled in the art.

Extending from fluid chamber 28 to each annular passage, such as 34, there is provided at least one passage, such as 36, to convey to each such annular passage, pressurized fluid supplied to said fluid chamber. From each said annular passage, such as 34, there is provided at least one passage, such as 37, for conveying to at least one orifice, such as 38, provided in the outer wall of the respectively associated member 32, pressurized fluid conveyed to the respective annular passage. However, in practicing the invention it is deemed expedient to provide for each said annular passage more than one passage, such as 36, as shown in FIGS. 2 and 3 of the drawings. While the orifices, such as 38, provided in the outer walls of members, such as 32, are shown as being circular, if required for operation of the fluid amplifiers or other similar fluid-activated devices with which the invention is employed, orifices in the form of slots, such as orifice 39 shown in FIG. 1 of the drawings, can be provided. It will be understood that, under such conditions, the passage, such as 37, leading to such a slotted orifice is correspondingly increased in dimensions in order to provide a sufficient volume of pressurized fluid through said slotted orifice for actuation of the fluid amplifier whose input tube is disposed in the rotational path of movement of such orifice during rotation of the apparatus.

Holes such as 41 (FIG. 2) are provided in the outer periphery of each of the members, such as 32, and extend

partially through each such member. A pin or dowel such as 42 can be wedged in each such hole for rotational movement of each respective member about said shaft. In accomplishing such movement of one of said members, the pin, such as 42, on such member is manually gripped and rotational force is then applied to the respective member through said pin to overcome the force frictionally engaging such member for rotation with shaft 10, as previously mentioned. When the force of said frictional engagement is overcome, additional rotational force may be applied to said member to rotate such member about said shaft to the degree desired. Alternatively, pins such as 42 need not be provided but a removable pin or dowel can be inserted in one of the holes, such as 41, in each member 32 when it is desired to rotate the respective member about shaft 10.

There is also shown in the drawings a split ring 43 which is forced over the end of shaft 10 and around the outer periphery thereof, and is then moved along said shaft until it snaps into a cooperating annular channel 44 (FIG. 3) provided in said outer periphery. A spacer 46, similar to the spacers, such as 31, previously discussed, is provided on shaft 10 and bears against said ring. Following the positioning of said rings, spacers, gaskets and the members, such as 32, on shaft 10, another spacer 47, identical to spacer 46, is disposed on said shaft and a relatively large hex nut 48 is then screwed over the threads on the right hand end of such shaft and is tightened against spacer 47. The faces of the spacers, such as 31, are thereby forced tightly against the faces of the rings, such as 29, and the gaskets or O-rings, such as 33, are compressed to assure fluid-tight seals about the edges of the inner walls of the members, such as 32, while frictionally engaging such members for rotational movement with shaft 10 as previously mentioned.

In employing the apparatus of the invention, the input tubes such as tubes 51, of the fluid amplifiers or similar fluid operated devices to be actuated by the apparatus in accordance with a selected repetitive program for such devices, are secured, in any convenient manner, in holes such as 52 extending through said top section 17 of support frame 16, the orifices, such as 53, in the ends of the input tubes, such as 51, being disposed in the rotational paths of travel of jets of fluid issuing from the orifices, such as 38, in the outer walls of the members, such as 32, during rotation of said members with shaft 10. Constant-pressure pressurized fluid is supplied through conduit 22 to rotary union 21 and flows through such union to fluid chamber 28 and thence through the passages, such as 36, to and around the annular passages, such as 34. From said annular passages, the pressurized fluid flows through the passages such as 37, and jets of such fluid continuously issue from the orifices, such as 38, in the outer walls of the members such as 32. A drive belt may be disposed around pulley 24 and around a pulley on the output shaft of a suitable source of rotary power having a variable speed control. Such belt, source of power and speed control are not shown in the drawings since they do not form a part of the present invention. However, such items are well known.

Following the connections to the apparatus of the invention as discussed above, said power source is energized and controlled to a speed such as to cause rotation of shaft 10 and its associated members in accordance with the time cycles of said selected repetitive program for actuation of said fluid devices, such shaft being rotated through 360° of rotation for each cycle of said repetitive program. The members, such as 32, are disposed on said shaft so that the respective orifices, such as 38, in the outer walls thereof pass opposite the respectively associated orifices, such as 53, in the input tubes, such as 51, in the time sequence desired for actuation of said fluid devices during each cycle of rotation of shaft 10. However, as previously pointed out, if adjustments or changes in the periods of time between sequential actuation of two or

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more of said fluid devices is found necessary or desirable, each member, such as 32, can be independently or individually rotated about shaft 10, in the manner previously discussed, to adjust or vary said periods of time in the sequence of actuation of the fluid devices.

It is pointed out that the orifices, such as 53, in said input tubes of said fluid devices are shown spaced from the outer walls of the members, such as 32, at a relatively great distance. This is to allow the pins, such as 42, to clear said input tubes during rotation of the apparatus. However, as previously mentioned, if removable pins or dowels are employed in the holes, such as 41, for adjustment of the members, such as 32, about shaft 10, the ends of the input tubes, such as 51, can be disposed in close proximity to the outer walls of said members. Alternatively, if the ends of said input tubes are mounted in top section 17 of support frame 16 so that they extend further therethrough and closer to the orifices, such as 38, in the members, such as 32, pins such as 42 could be mounted off-center of the center line of each said member and thereby made to clear said ends of the input tubes.

If, for example, the apparatus is to be used for actuation of one or more fluid amplifiers of the type which are normally biased to a first condition and are actuated to a second condition only so long as jets of fluid are supplied to the input tubes of such amplifiers, the amplifiers reverting to their first condition upon termination of said jets to said input tubes, a slotted orifice or orifices such as 39 (FIG. 1) may be used to supply the jets of fluid to the amplifiers. The length of such slots control, of course, the periods of time that said amplifiers are actuated to their second condition.

For purposes of simplification of the drawings, the timing apparatus embodying the invention is shown as comprising only four members, such as 32, for actuation of a maximum of four fluid devices. However, it is readily apparent that the apparatus can incorporate a lesser number of members such as 32, or a greater number of such members for actuation of a greater maximum number of fluid devices.

The timing apparatus of the present invention can also be conveniently employed in a method for manufacturing timing drums of a more economical but non-adjustable type. For example, if it is desired to manufacture such a timing drum for actuation of two or more fluid amplifiers, in accordance with a desired program therefor, a timing apparatus such as that heretofore discussed is provided and the input tube of each of said amplifiers to be actuated in accordance with said program is disposed selectively positioned in the rotational paths of travel of one of the orifices provided in the outer peripheries of the rings surrounding the shaft of said timing apparatus. Pressurized fluid is then supplied to the fluid chamber in said shaft and the shaft rotated at a speed selected in accordance with said program. Said rings are then selectively rotated about said shaft to adjust such rings to sequentially supply jets of fluid issuing from said orifices to said input tubes in precise accordance with said program. A hollow cylindrical and rotatable drum substantially corresponding in diameter to the outer periphery of said rings of the timing apparatus and in length to the length of said shaft of the such apparatus is provided, such drum also being rotatable in a manner identical to said timing apparatus. Following the above mentioned adjustment of the rings of the timing apparatus, there is duplicated in the outer periphery of said drum a set of orifices precisely positionally corresponding to said orifices in said rings, such orifices connecting with the hollow portion of the drum. The drum can then be substituted for said timing apparatus for actuation of said fluid amplifiers in a manner corresponding to such actuation of the amplifiers by said timing apparatus and the timing apparatus can then be similarly reemployed for precise establishment of another program for another set of two or more fluid amplifiers.

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Although there is herein shown and described only a preferred embodiment of the invention including minor modifications thereof, it will be understood that additional changes or modifications may be made in the invention within the purview of the appended claims without departing from the spirit and scope thereof.

What is claimed is:

1. A timing apparatus for providing selective programming of one or more fluid amplifiers, such apparatus comprising, in combination,

(A) a cylindrical shaft mounted for rotation about its longitudinal axis and embodying a fluid chamber,

(B) a plurality of spaced-apart members annularly and rotatably surrounding said shaft,

(C) means associated with each said member and including at least one fluid passage extending between said fluid chamber and an orifice in the outer wall of the respectively associated member for conveying fluid to said orifice regardless of the rotational position of such member about said shaft,

(D) means including annular gaskets adjacent the circumferential edges of the inner wall of each said member to provide fluid-tight seals for said fluid passages and for frictionally engaging each respective member for rotational movement of such member with said shaft,

(E) means for supplying constant pressure pressurized fluid to said chamber, and

(F) means for individually overcoming the force frictionally engaging each of said members for rotational movement with said shaft and selectively rotating each such member about said shaft at any desired time to vary the distances between said orifices in the outer walls of such members, whereby each input tube of said fluid amplifiers can be disposed in one of the circular paths of travel of said orifices for periodic receipt therefrom of jets of fluid when pressurized fluid is supplied to said chamber and said shaft and said associated members are rotated, and the time intervals between periodic receipt of one of said jets by the associated one of said input tubes can be selectively varied, relatively to such receipt by others of such tubes, by rotational adjustment of said members about said shaft.

2. Apparatus in accordance with claim 1 and in which said gaskets comprise O-rings.

3. A timing apparatus for providing selective programming of one or more fluid amplifiers, such apparatus comprising in combination,

(A) a cylindrical shaft mounted for rotation and embodying a fluid chamber,

(B) a plurality of members spaced apart along the length of said shaft, each such member rotatably and annularly surrounding such shaft,

(C) an annular fluid passage extending annularly about the inner wall of each respective said member and between such member and said shaft,

(D) means including annular gaskets compressed against the circumferential edges of the inner walls of said members to provide fluid-tight seals for each respective one of said annular fluid passages and for frictionally engaging each respective one of said members for rotational movement with said shaft,

(E) at least one fluid passage extending between each of said annular passages and said fluid chamber,

(F) at least one fluid passage extending from each of said annular passages and through an orifice in the outer wall of each respective said member with which each such annular passage is associated,

(G) means for supplying and continuously maintaining pressurized fluid in said chamber at a constant pressure, and

(H) means for independently overcoming the force frictionally engaging each of said members for rotation with said shaft and rotating each such mem-

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ber about said shaft to rotationally adjust the position about such shaft of at least said one orifice in each such rotated member relatively to the position about such shaft of at least one of said orifices in the other such members, whereby the input tubes of said fluid amplifiers can be disposed in the rotational paths of travel of said orifices for periodic receipt therefrom of jets of fluid when pressurized fluid is supplied to said chamber and said shaft is rotated, and the relative time intervals between the receipt of said jets by said input tubes can be selectively adjusted by said rotational adjustment of said members about said shaft.

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4. Apparatus in accordance with claim 3 and in which said gaskets are O-rings.

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