

Nov. 7, 1939.

J. R. STRICKLEN ET AL

2,179,166

APPARATUS FOR CONTROLLING INDUSTRIAL PROCESSES

Filed Aug. 15, 1936

Fig. 1

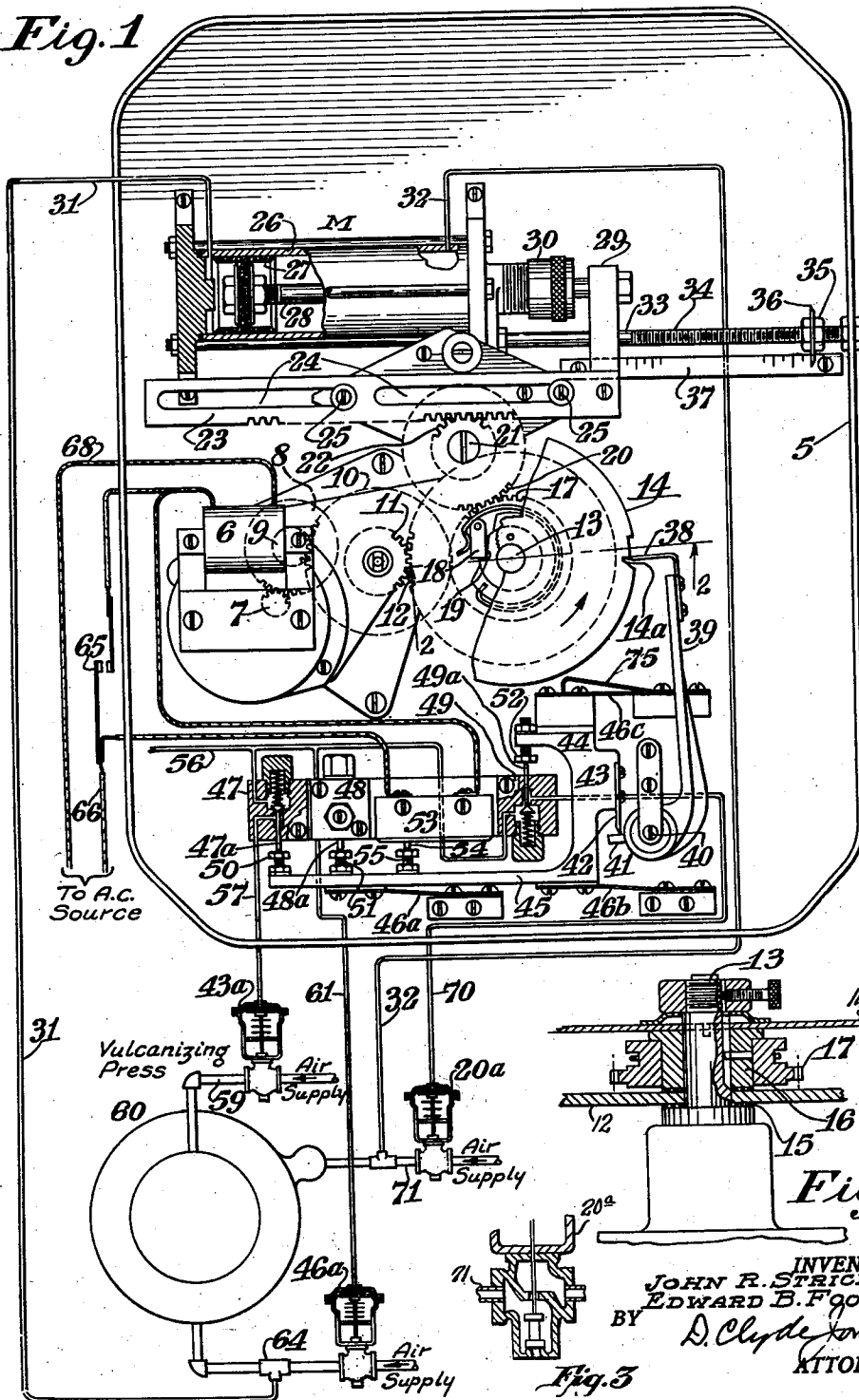
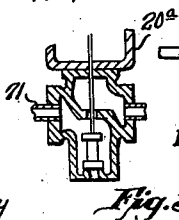
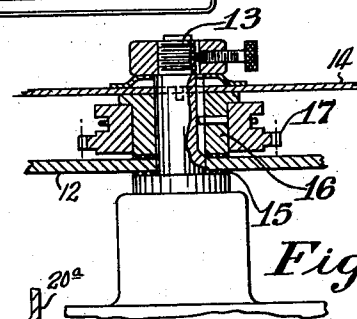


Fig. 2



INVENTOR
JOHN R. STRICKLEN
EDWARD B. FOOTE
BY
D. Clyde Jones
ATTORNEY

UNITED STATES PATENT OFFICE

2,179,166

APPARATUS FOR CONTROLLING INDUSTRIAL PROCESSES

John R. Stricklen, Akron, Ohio, and Edward B. Foote, Rochester, N. Y., assignors to Taylor Instrument Companies, Rochester, N. Y., a corporation of New York

Application August 15, 1936, Serial No. 96,190

6 Claims. (Cl. 161—7)

This invention relates to apparatus for controlling industrial processes.

In various industrial processes it is necessary to measure a time interval or to initiate various operations that take place therein. For example, in the processing of rubber tires or tubes in a vulcanizing press it is the practice to employ suitable timing mechanism for locking the press at the beginning of the operation and for opening the press for the removal of the processed tire at the termination of a predetermined holding period, as is fully disclosed in the patent to Stricklen et al. No. 1,887,251, granted November 8, 1932. Since the holding periods in different processes vary within comparatively wide limits, the timing device must be easily adjustable to lengthen or shorten this period, as desired. In the past, this result has been effected by providing a separate controlling cam for each different holding period or by providing a cam having an adjustable sector whereby various holding periods of different duration may be measured by the use of a composite cam. It has also been proposed to employ a reversible motor in the timing device in conjunction with a complicated control mechanism including a follower acting alternately on two cams which motor, on reversal, resets the device to its initial position at the termination of the holding period. The use of individually-cut cams for each holding period has been a source of annoyance to the user, in that a plurality of cams must be available and whenever the holding period was changed, a different cam corresponding to the desired holding period must be substituted. The adjustable cam is expensive to manufacture and awkward to adjust.

In accordance with the main feature of the present invention a novel arrangement is provided in which a simple clock-actuated cam, having a contour corresponding to the maximum holding period desired, is employed in combination with a motor which quickly rotates the cam to a position to subtract or render ineffective any predetermined portion of the maximum holding interval represented by the contour of the cam.

In the drawing,

Fig. 1 is a front view of the timing device of the present invention together with a diagrammatic showing of a portion of a system in which it is incorporated; Fig. 2 is a cross section taken on the line 2—2 of Fig. 1, and Fig. 3 is a fragmentary sectional showing of the three-way valve suitable for use in the system.

Referring especially to Fig. 1, 5 designates the case of a timing device, the rear wall of which

may be considered as the support for the mechanism contained therein. Within the case there is mounted a synchronous electric motor 6 which operates through a speed reducing train of gears 7, 8, 9, 10, 11 and 12 to rotate the arbor 13. This arbor carries a timing cam which is circular except for the notched portion 14a. A portion of this cam is illustrated as broken away to simplify the disclosure. The notch 14a is made with a double step which permits certain operations controlled by the cam to be effected before others on the conclusion of the cycle. For example, in a vulcanizer it may be desirable to deflate a tube or the like before the press is actually opened. A double step in the notch 14a enables the controlling valves 47, 48 and the switch 53 to operate out of step. It should be mentioned at this point that the gear 12 drives the arbor 13 through the following friction clutch arrangement. The gear 12 is mounted to rotate on the arbor 13 but one of its surfaces engages the fiber covered face of the collar 15, which is attached to the arbor and its other surface is frictionally engaged by the fiber-covered face of a second collar 16 also secured to the arbor. By this construction the gear 12 frictionally drives the arbor, but when the arbor 13 is driven by other means to be described, the gear 12 maintains its normal speed of rotation independently thereof.

The collar 16 has rotatably mounted thereon a gear 17 which carries a pawl 18 adapted to engage the single tooth or notch 19 in the collar 16. Thus when the gear 17 is rotated in a counterclockwise direction, the pawl 18 engages the notch 19 to rotate the arbor and timing cam 14 thereon. However, when the gear 17 is rotated in a clockwise direction the pawl 18 does not engage the notch and therefore the cam 14 is not rotated thereby at this time. A gear 20 rotatively mounted on the stud shaft 21 on the rear wall of the case, meshes with the gear 17, while the gear 20 carries a pinion 22 which is adapted to engage the teeth on a rack bar 23. This bar is provided with longitudinally extending slots 24 to receive supporting guide screws 25 which cooperate with the slots to limit the rack bar 23 to a lengthwise motion. A pneumatic motor M mounted on the frame, drives this rack bar. This motor includes a cylinder 26 having provided therein a piston 27. The piston is carried at one end of a piston rod 28, the other end of which is connected by a bracket 29 to one end of the rack bar. It will be understood that the piston rod extends through a suitable stuffing box 30 in one end of the cylinder to prevent the pressure

fluid from escaping at this point. This piston is moved to the right or to the left by pressure fluid respectively supplied through the conduits 31 and 32. A rod 33 having a suitably threaded portion 34 is secured to the case in parallel relation to the rack bar 23, which threaded portion carries an adjustable stop in the form of a nut 35 provided with a disc-like index 36 positioned to engage and limit the motion of the bracket 29 when it is moved toward the right. This index cooperates with a scale 37 which is suitably graduated in units of time to assist the operator in adjusting the nut to limit the rotation of the timing cam 14 by the pneumatic motor, to a predetermined interval. It will be appreciated that if the adjusting nut 35 and index 36 are moved toward the right the holding period is shortened, while if they are moved toward the left the period is lengthened.

The periphery of the cam 14 is engaged by a finger 38 mounted on a follower arm 39 of a bell crank lever which is pivotally mounted at 40. This lever is also provided with a short arm 41 which engages a plate 42 carried on a frame 43 having a short upper member 44 and a long lower member 45. This frame is normally maintained in a given position by the leaf springs 46a, 46b and 46c which are of the same length so that all points of the frame have straight line motion in a vertical direction, thereby constituting a convenient type of parallel motion support for the frame. On the rear wall of the case there are mounted relay valve blocks 47, 48 and 49 which control the application of compressed air or other pressure fluid to various devices. The valve blocks 47 and 48 have their valve stems 47a and 48a extending downwardly to engage the adjustable tappets 50 and 51 which are carried on the long member 45 of the frame, while the valve block 49 has its valve stem 49a extending upwardly to engage the short member 44 of the frame. There is also mounted in line with the valve blocks an electrical switch 53 which has its actuating button 54 positioned to be engaged by the adjustable tappet 55 on the long member 45 of the frame. This switch may be made of the type disclosed in the patent to Leupold No. 1,780,758, is designed to maintain its contacts normally open except when the button 54 is depressed.

A pressure fluid supply conduit 56 supplies pressure fluid such as compressed air, to the inlet of the relay valves 47, 48 and 49. The valve 47 discharges into the conduit 57 communicating with the motor top of the three-way diaphragm valve 43a in the pressure fluid supply conduit 59 leading to a machine 60 to be controlled, which portion is actuated at the beginning of the cycle of the machine. The outlet of the valve 48 discharges into conduit 61 communicating with the motor top of the three-way diaphragm valve 46a which likewise controls the flow of pressure fluid through the conduit 63 to another portion of the machine, also operated at the beginning of the mentioned cycle. At the conclusion of the timing cycle, the relay valve 49 discharges into the conduit 70 communicating with the motor top of the diaphragm valve 20a. This diaphragm valve permits the flow of compressed air through the conduit 71 to another portion of the machine. It will be noted that the conduit 32 communicates with the conduit 71.

While the device of the present invention is applicable to the control of various machines and processes, it is particularly adapted to governing

the timed sequence of the operations of a vulcanizing press, such as is disclosed in the mentioned Stricklen and Fraine patent. The diaphragm valves 43a and 46a may correspond to the diaphragm valves 43 and 46 of that patent in which the valve 43 effects the registration of the two halves of the mold and operates the breech lock of the press, while the diaphragm valve 46 serves to inflate the tube to be vulcanized. The diaphragm valve 20a of this disclosure may correspond to the diaphragm valve 20 of the patent which serves to release the breech lock and to open the press at the conclusion of the holding period at the end of the cycle of operation of the press.

When it is desired to operate the device, the push button 65 is depressed and is held in this depressed position to complete a circuit from one side of the alternating current source, conductor 66, push button contact 65, conductor 67 and thence to the motor 6, conductor 68 to the other side of the alternating current source. The motor 6 then rotates and in so doing drives the train of gears 7, 8, 9, 10, 11 and gear 12, which frictionally rotates the arbor 13 and the cam 14 carried thereby, in a counterclockwise direction. As the finger 38 engages the rise portion of the cam 14, it swings the follower arm outward and in so doing elevates the short arm 41. This arm elevates the frame 43 and the long member 45 thereof engages the button 54 of the switch 53 causing it to close its contacts. When this takes place, the operator may release the push button switch 65 and the motor will continue to rotate as long as the switch 53 is held closed by the long member. Also when the long member of the frame is elevated, it raises the valve stems 47a and 48a to open the valves 47 and 48. Pressure fluid is then supplied through the conduit 56 and these valves respectively, to the conduit 57 leading to the top of valve 43a and conduit 61 communicating with the top of the valve 46a. In response to the application of pressure fluid to the top of the valve 43a, this valve opens, and pressure fluid is supplied to the machine 60 through the supply conduit 59. Also when the valve 48a is opened, pressure fluid is supplied through the conduit 64 to another portion of the machine 60, and pressure fluid is also supplied from conduit 64 through conduit 31 to the left end of the motor M.

The application of this pressure fluid through conduit 31, forces the piston 27 and its piston rod 28 toward the right carrying with it the rack bar 23. This movement of the piston and the rack bar continues until the arm 29 engages the stop 36 on the adjusting nut 35. As the rack bar 23 moves toward the right, it engages the pinion 22 which rotates the gear 20 attached thereto. This gear, in turn, drives the gear 17 so that pawl 18, carried on the gear 17, engages the notch 19 in the collar 16 secured to the arbor 13 and drives the arbor and the timing cam 14 carried thereby a sufficient distance to rapidly subtract a predetermined time interval from the maximum interval, as measured by the circular timing cam thereby leaving the desired holding period. It will be understood that while the rack bar 23 is operating through the mentioned gears to drive the arbor, the fiber faces on the collars 15 and 16 slide on the face of the gear 12. In other words, the cam is operated at this time independently of the electrical motor 6. However, when the pneumatic motor ceases to operate, the electric motor 6 operating through the

mentioned train of gears resumes the rotation of the timing cam to measure the timing interval which is terminated when the finger 38 on the follower arm 39 drops into the notch 14a in the cam 14.

When the finger 38 on the follower arm 39 thus drops into the notch 14a, the frame 43 is permitted to lower itself under the action of gravity and spring 75. This lowering of the large member of the frame permits valves 47 and 48 to close and switch 53 to open, thereby interrupting the circuit of motor 6. However, the short member of this frame depresses the valve stem 49a to open the valve 49. Compressed air is then permitted to pass from the supply conduit 56, valve 49, conduit 70 to the motor top of the diaphragm valve 20a. This diaphragm valve then opens and compressed air is supplied through the conduit 71 to the machine 60. When compressed air is supplied to the conduit 71, it also passes through the conduit 32 to the right-hand end of the pneumatic motor M. This compressed air then moves the piston to the position illustrated in Fig. 1. As the piston is restored to its normal position, it also moves the bracket 29 and the rack bar 25 toward the left into the position shown. The rack bar 25 during this movement drives the pinion 22 and through gear 20 rotates the gear 17 in a clockwise direction. The pawl 18 carried on this gear does not engage the notch 19 at this time so that the timing cam is not rotated thereby. While this is taking place, the fiber-covered face slides on the surface of gear 22 without effecting any counterclockwise movement thereof.

We claim:

1. In apparatus of the character described, the combination with a timing cam and mechanism to be controlled thereby in accordance with a desired timing cycle, means for driving the cam through a given timing cycle at a given rate, means including a reversible motor for independently driving said cam in one direction at a faster rate through a portion of the timing cycle whereby the duration of the cycle can be reduced to a predetermined interval, said mechanism including means controlling the actuation of said motor in one direction for driving said cam and the actuation of said motor in the reverse direction to a normal position.

2. In apparatus of the character described, the combination with a timing cam and mechanism to be controlled thereby in accordance with a desired timing cycle, means for driving the cam through a given timing cycle at a given rate, means including a reversible motor for independently driving said cam in one direction at a faster rate through a portion of the timing cycle whereby the duration of the cycle can be reduced to a predetermined interval, said mechanism including means controlling the actuation of said motor in one direction for driving said cam and other means for actuating said motor in the reverse direction to a normal position.

3. In apparatus of the character described, the

combination with a timing cam and mechanism including valves to be controlled thereby in accordance with a desired timing interval, means for driving the cam through a given timing cycle at a given rate, means including a reversible motor for independently driving said cam in one direction at a faster rate through a portion of the cycle whereby the duration of the timing cycle can be reduced to a predetermined interval, one of said valves controlling the actuation of said motor in one direction for driving said cam and said other valve controlling the actuation of said motor in the reverse direction independently of said cam.

4. In apparatus of the character described, the combination with a timing cam and mechanism to be controlled thereby in accordance with a desired cycle, said mechanism including valves, means including a motor and a friction clutch for driving the cam through its timing cycle at a given rate, a reciprocating motor including a cylinder and a piston operating therein, adjustable means for limiting the movement of said piston in one direction, means including a one-way driving connection operated from said piston for rotating said cam at a faster speed, means including one of said valves for introducing pressure fluid into one end of said cylinder for operating the piston in one direction, and means including another of said valves for introducing pressure fluid into the other end of said motor for operating the piston in the opposite direction.

5. In apparatus of the character described, the combination with a timing cam and mechanism to be controlled thereby in accordance with a desired cycle, said mechanism including valves, means including a motor and a friction clutch for driving the cam through its timing cycle at a given rate, a reciprocating motor including a cylinder and a piston operating therein, a rack bar operated by said piston, adjustable means for limiting the movement of the rack bar in one direction, means including gears operated from said rack bar and a one-way driving connection for rotating said cam at a faster speed, means including one of said valves for introducing pressure fluid into one end of said cylinder for operating the piston in one direction, and means including another of said valves for introducing pressure fluid into the other end of said motor for moving the piston in the opposite direction.

6. In apparatus of the character described, the combination with a cam and mechanism to be controlled thereby in accordance with a desired timing cycle, means for driving the cam through its timing cycle at a given rate, movable means for driving said cam at a faster rate through a portion of its cycle whereby the duration of the timing cycle can be reduced to a predetermined interval, and means including a stationary stop in the path of travel of said movable means for terminating the movement thereof.

JOHN R. STRICKLEN.
EDWARD B. FOOTE.