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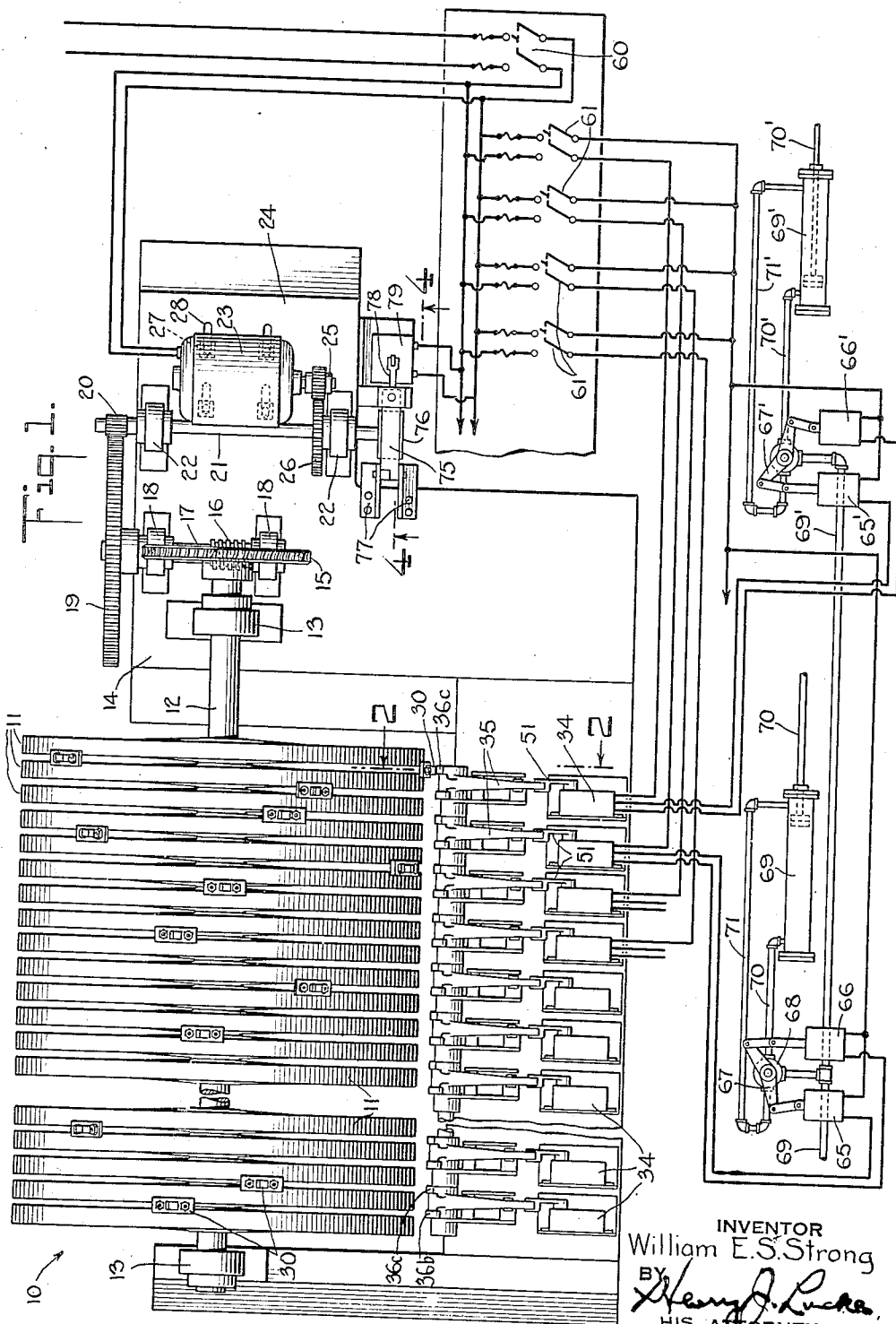
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TIMING MECHANISM

Filed Jan. 28, 1937

2 Sheets-Sheet 1



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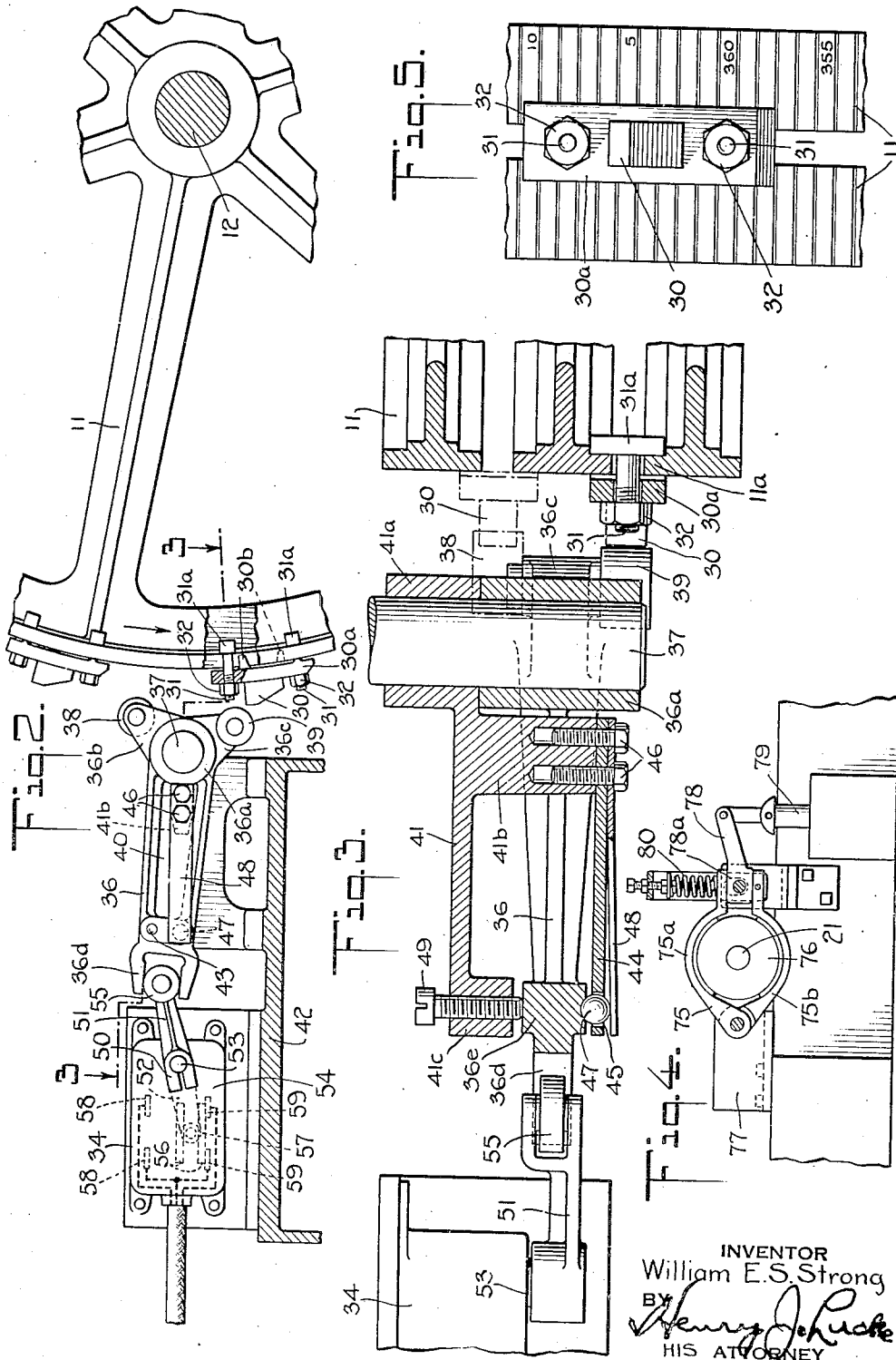
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TIMING MECHANISM

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8 Claims. (Cl. 161—1)

This invention relates to automatic timing mechanism, and is particularly adapted for automatically controlling a series of machine operations in timed sequence.

5 In the production of many types of articles, manufacturing is accomplished by subjecting the raw material to a number of independent steps carried out sequentially. Usually the respective steps involve machine operations, the time duration of which varies considerably relative to the other steps of the series depending upon the nature of the operation. It is a convenient and economical procedure to carry the article from manufacturing step to manufacturing step, and to control the duration of each step in accordance with the nature thereof, all automatically.

10 The present invention provides apparatus for accomplishing such automatic control by the use of simple mechanism functioning cooperatively.

15 It is applicable to any type of manufacturing operation not accomplished manually.

20 The apparatus is readily adjustable to include additional manufacturing steps as they become necessary, and for varying, within extremely wide limits, the time duration of each operation and the number of independent applications of that operation within the time period allotted therefor relative to the other operations of the series.

25 In general, the apparatus includes an endless-path actuator driven, preferably, at a constant speed which may be varied as desired to suit the specific application of the apparatus. Adjustably mounted on the actuator is at least one set of at least two actuating means, such as trip-fingers, the actuating means of the set being spaced apart from one another and being adjustable with respect to the spacing. Disposed adjacent the path of travel of the set of actuating means is a control device adapted for actuation in one manner by one of the component actuating means of the set, and for actuation reverse to the first mentioned manner of actuation, by the next succeeding actuating means of the set, and continually in like manner. The time interval between respective actuations will depend upon the number of actuating means provided and upon the relative spacing thereof on the actuator.

30 The control device is conveniently a double throw electrical switch having trip mechanism disposed for cooperation with the actuating trip-fingers, the mechanism being so arranged that the switch will be thrown to a contact position

by one of the trip-fingers of the set and thrown to a different contact position by the next succeeding trip-finger of the set and continually in like manner as the actuator executes its endless-path of travel. The switch may electrically control any suitable mechanism for starting or stopping the particular operation concerned. The duration of each operating period and the repetition of the operation with the same or a different time duration will be determined by the number of trip-fingers provided in the set and the relative spacing thereof.

35 When a series of operations such as manufacturing steps is to be controlled, the number of sets of actuating means corresponding to the number of operations are mounted in side by side relation upon the actuator and a corresponding number of control devices are disposed in respective correlative relation therewith, each set of actuating means serving, through its respective control device, to determine the time extent of, the repetition of, and the sequential timing of its respective operation relative to the other operations of the series.

40 In the drawings which illustrate only one embodiment of the present invention:

45 Fig. 1 is a plan view of apparatus pursuant to the invention wired for electrically controlling the initiations and haltings of a series of compressed air motivated manufacturing or other types of operations;

Fig. 2 represents a vertical section taken on the line 2—2, Fig. 1;

Fig. 3 represents a horizontal section taken on the line 3—3, Fig. 2;

Fig. 4 represents a vertical section taken on the line 4—4, Fig. 1;

Fig. 5 represents a view of a fragment of the circumferential surface of the actuator, together with actuating means, of Fig. 1.

Referring to the drawings:

The apparatus illustrated in Fig. 1 employs a rotary actuator, indicated generally at 10, for actuating a series of control devices in timed relative sequence.

50 The rotary actuator 10 comprises a series of flat-rimmed wheels 11, rigidly mounted for synchronized collective rotation on the horizontal shaft 12, the latter being journaled in bearings 13, 13, rigidly positioned on the supporting structure 14.

The shaft 12 is preferably rotated at a uniform speed by any suitable means. In the present case, an electric motor is utilized together with speed reducing mechanism as follows: Gear

15 is rigidly mounted at one end of the shaft 12 and meshes with a worm gear 16, rigidly mounted on a shaft 17, which latter is journaled in the bearings 18, 18. The shaft 17 has rigidly mounted thereon at one of its ends the gear 19 for rotation by the pinion 20, the latter being rigidly mounted on the shaft 21. The shaft 21 is journaled in the bearings 22, 22. A constant speed electric motor 23 is adjustably mounted on a base support 24, and has a drive pinion 25 rigidly mounted on its extending rotor shaft. The drive pinion 25 meshes with a gear 26 rigidly mounted on the shaft 21.

Through the above described series of gears and pinions, the speed of the motor 23 is reduced to the low speed at which it is desired to rotate the actuator 10. The speed ratio may be increased or decreased by the replacement of the pinion 25 and the gear 26 with a pinion and gear, respectively, of suitable differing diameters. For accomplishing the change, the motor 23 may be slid back and forth on its support 24 by loosening the bolts 27, operative within the slots 28 for securing the motor to its support.

The circumferential rims 11a of the component wheels 11 of the actuator 10 are preferably graduated in degrees, see Fig. 5, there being 360 degrees comprehending the complete circumference.

Disposed at an appropriate location on and between the circumferential rims of mutually adjacent wheels are actuating means. These advantageously take the form of trip-fingers 30 extending from respective base plates 30a.

Each of the base plates 30a is adjustably secured in place by means of bolts 31, 31. The bolts extend through the base plate adjacent its ends, the bolt heads, indicated at 31a, having extended transverse dimensions for clamping engagement with the under surface of portions of the mutually adjacent circumferential treads 11a. Each of the base plates 30a, further, may have four projections 30b spaced apart on the under surface thereof and fitting in the space between adjacent treads, the projections functioning collectively as a guide formation for preventing lateral play. By loosening the nuts 32, 32 of the bolts 31, 31, the base plate and superimposed trip-finger may be slid around the circumferential periphery of the actuator 10 for securement at any desired location thereon.

Disposed adjacent the paths of travel of the actuating means are control devices for coordination with and actuation by respective actuating means. The control devices may comprise double-throw electric switches, as indicated generally at 34, coupled with trip-mechanism indicated generally at 35. The double-throw switch No. CR 9440—A1A (lever type) manufactured by the General Electric Company has been found to be especially suitable for the purpose.

The trip-mechanism, see Figs. 2 and 3, may comprise a lever 36 pivotally mounted near one end, through the medium of the bearing 36a, on a horizontally extending shaft 37; the fulcrum of the lever is thus established at the location of pivot, forming a lever of the first order.

Extending from opposite lateral portions of the bearing 36a to form the short or work arm of the lever 36, see particularly Fig. 3, are arm-members 36b and 36c, the two extending at an obtuse angle with respect to each other transversely of the axis of the shaft 37. The arm-members 36b and 36c may be provided at their free extremities with

rollers 38 and 39, respectively, for cooperation with the actuating trip-fingers 30.

The long arm of the lever 36 is provided with a wide slot 40 throughout the greater part of its length, and has its free extremity 36d bifurcated in the form of a U-shaped slot adapted to receive an extending element (hereinafter described) of the switch 34.

Associated with the lever 36 is a bracket element 41 rigidly mounted on, and preferably made integral with, a supporting structure 42. The bracket element 41 has an extending bearing member 41a in which the shaft 37 is journaled, and a projection 41b extending through the slot 40 adjacent the fulcrum 36a. The projection 41b is much less in thickness than the width of the slot 40 for allowing considerable movement of the long arm of the lever 36 with respect to its fulcrum.

The lever 36 is oscillated up and down about its fulcrum at predetermined time intervals through the action of trip-fingers 30 cooperating with arm-members 36d and 36c as hereinafter more fully described.

For locking the lever 36 at the extreme upper and lower limits of its throw during the predetermined time interval without preventing actuation from one limit position to the other limit position, the following mechanism is conveniently employed. The long arm of the lever 36 is provided at one lateral surface of its solid portion 36c, occurring between the slot 40 and the bifurcated end 36d, with recesses 43, 43 mutually spaced apart transversely of the length of the lever. A carrier element 44, having a circular perforation 45 adjacent one end is rigidly secured at its other end to the free terminus of the projection 41b, as by means of the screws 46, 46. Carried within the perforation 45 is a ball 47 adapted to ride freely along the surface of the solid portion 36c between the recesses 43, 43, and to fit into said recesses as illustrated. A spring clip 48 coextensive with the carrier element 44 and secured thereto by the stated screws 46, 46, serves to retain the ball 47 in a free rolling status with respect to its carrier 44. At each limit position of the lever 36, the ball 47 fits into one of the recesses 43, 43, and maintains the lever rigidly in position. The tension of the spring clip 48 may be controlled by the set screw 49, carried by an extension 41c of the bracket element 41.

The switches 34 are mounted on the supporting structure 42 for actuation by the lever 36. As illustrated, each of the switches 34, see Fig. 2, comprises a trip-lever 50 having oppositely extending individual arms 51 and 52, rigidly mounted on the shaft 53. The shaft 53 is journaled within a casing 54 and extends outwardly therefrom. The arm 51 is rigidly secured to the outwardly extending portion of the shaft 53 and is arranged to engage the U-shaped end 36d of lever 36 of the trip-mechanism 35. A roller 55 may be provided at the extremity of arm 51 for rolling engagement within the U-shaped end 36d. The arm 52 is rigidly secured to the shaft 53 within the casing 54 and carries at its extremity, as diagrammatically illustrated by dotted lines, the oppositely positioned contact plates 56 and 57 for alternate make and break with the sets of positive and negative terminals 58, 58 and with the sets of positive and negative terminals 59, 59, respectively.

The respective sets 58, 58 and 59, 59 of positive and negative terminals are connected to a source of electric current by any suitable wiring system,

such as the system conventionally illustrated in Fig. 1.

As the trip-lever 50 oscillates by reason of its connection with the trip-mechanism 35, the contact plates 56 and 57 make and break electrical connection, alternately, with the sets 58, 58 and 59, 59, respectively, of positive and negative terminals, for initiating and halting any operation not manually carried out. In the present embodiment, two of the switches are illustrated as controlling compressed-air motivated mechanical operations.

The illustrated wiring system is a conventional type. A main switch 60 may be provided for connecting it with a main electrical power line. Sub-switches, as indicated at 61, may be provided for disconnecting any particular switch 34 from the system, therewith eliminating the operation it controls from the series of operations controlled by the series of switches.

The compressed-air motivated mechanism, as illustrated, may comprise solenoids 65 and 66 operative, respectively, on links connected to respective ends of a bell crank 67 for opening and closing an air valve, indicated generally at 68. The air valve functions to allow compressed-air, supplied from any suitable source through the pipe 69, to pass alternately through piping 70 and 71, respectively, to opposite ends of an air-cylinder 72 for reciprocating a piston 73. The piston may accomplish any suitable operation.

The trip-mechanisms 35, respectively cooperating with the switches 34 comprise a preferred form of the control devices of this invention. In the illustrated embodiment designed to control a series of operations for a predetermined time period in predetermined relative sequence, the trip-mechanisms 35 are disposed in side by side spaced relationship on the shaft 37, and are disposed with their respective component arm-members 36b and 36c in the paths of rotation of respective sets of trip-fingers 30.

For attaining actuation of the switch 34 to one contact position, and thereafter, following a predetermined time interval, reverse actuation to a different contact position, each of the trip-mechanisms 35 is placed with one of its arm-members 36b and 36c in the path of rotation of a single or group of trip-fingers 30 disposed between two mutually adjacent wheels 11, and with the other of the arm-members 36b and 36c in the path of rotation of the single or group of trip-fingers 30 disposed between the mutually adjacent wheels 11 next succeeding the first mentioned wheels 11, all as clearly illustrated in Fig. 1. The stated groups may comprise two or more trip-fingers aligned circumferentially of the mutually adjacent wheels. The mutually adjacent singles or groups of trip-fingers as stated, form a set of actuating means operative on a single trip-mechanism in effecting actuation and reverse actuation thereof.

In adjusting the time interval between successive actuations of respective control devices, and the number of actuations of, and the sequential order of actuations of each control device relative to the other control devices of the series, trip-fingers 30 which cooperate with one of the arm-members 36b and 36c, are properly spaced relative to trip-fingers 30 which cooperate with the other arm-member, and the spacing of those related trip-fingers of each set are properly set relative to the related trip-fingers of the other sets. Proper spacing is aided by the

graduations on the tread surfaces of the wheels 11.

The so related trip-fingers 30 of any one set will, on traveling through their paths of rotation alternately trip their respective arm-members. For this purpose, the trip-fingers are beveled in the direction of rotation for engaging, and providing a riding surface for the respective rollers 38 and 39 carried by the arm-member extremities.

To recapitulate: a plurality of trip-fingers may be provided for any group component of a set of actuating means, the trip-fingers of each group being aligned circumferentially on the actuator for adjustment in a path coincident with the path of travel of the actuator. The relative spacing of related trip-fingers of the respective groups of each set provide for the durations of the various predetermined time intervals of the operations which they control, and, also, for the frequency of repetition of successive predetermined time intervals in the application of a single operation. The number of individual sets of groups of trip-fingers and correlated trip-mechanism will determine the number of distinct operations controlled by the apparatus. The setting of trip-fingers of any individual set relative to the setting of other individual sets of the series determine in what sequential relation the series of operations will be carried out. Thus, it is clear that any number of operations may be timed in any desired manner by properly adjusting the various trip-fingers on the actuator relative to the other trip-fingers thereon.

For obtaining instantaneous halting of the actuator 10 when the main switch 60 is thrown out of circuit with the electric power line, a brake, operative on the drive mechanism for the actuator, is provided.

The brake conveniently comprises a clutch 75 encircling a pulley 76 which is rigidly mounted on an extending end of shaft 21. The clutch 75 may comprise semi-encircling arms 75a and 75b, mutually pivoted to supporting structure 77, and provided with coordinating jaws at a location opposite the location of pivot. A link 78, having an actuating head 78a received between the stated jaws of the clutch-arms, has its free end pivotally connected to a solenoid, indicated generally at 79.

Normally, i. e., when the solenoid is not energized, the clutch-arms 75a and 75b are held in braking contact with the pulley 76 by reason of the compressive action of the spring 30 on the jaw end of clutch-arm 75a. The solenoid may be connected in circuit with the main switch 60 in the manner clearly illustrated in Fig. 1.

By closing the main switch 60 to connect the wiring circuit of the apparatus with the electric power line, the motor 27 and the solenoid 79 will be energized simultaneously, thus effecting rotation of the shaft 21 and release of the braking action of clutch 75 thereon, simultaneously. Assuming the switches 61 to be closed, thus connecting the switches 34 with the main circuit, actuation of the trip-mechanism 35 will cause energizing of the solenoids 65 and 66, in the control of the mechanical operation effected by the piston 70.

Whereas this invention has been described and illustrated with respect to only one embodiment thereof, it should be distinctly understood that various changes may be made from time to time as the art progresses without departing from the

spirit of the invention as defined in the following claims.

I claim:

1. Automatic timing apparatus comprising a rotary cylindrical actuator; a plurality of trip elements each removably and adjustably mounted for unlimited adjustment around a fixed circumferential path of a series of mutually parallel circumferential paths defined at the circumferential surface of said cylindrical actuator; and a series of independent control devices each comprising a trip mechanism which has a trippable member arranged to extend into the path traced by travel of the trip element or elements mounted in one of the circumferential paths of said series, and which has a second trippable member extending into the path traced by travel of the trip element or elements mounted in a circumferential path of the said series which is next adjacent the said one circumferential path, said control devices being adapted to regulate respective machine operations.

2. Automatic timing apparatus comprising a series of mutually independent coextensive wheels rigidly mounted in side by side relation on a common shaft for simultaneous rotation, the rims of adjacent wheels being spaced apart laterally from each other; a plurality of trip elements removably and adjustably mounted between the rims of adjacent wheels for unlimited adjustment around the circumferences thereof; and a series of independent control devices each comprising a trip mechanism which has a trippable member arranged to extend into the path traced by travel of the trip element or elements mounted between the rim of one wheel and the rim of the wheel next adjacent one side thereof, and which has a second trippable member extending into the path of travel of the trip element or elements mounted between the rim of said one wheel and the rim of the wheel next adjacent the other side thereof, said control devices being adapted to regulate respective machine operations.

3. Apparatus as recited in claim 1 wherein the trip mechanisms each comprise a lever pivoted at one end adjacent the circumferential path of said actuator and have trippable members extending rigidly outwardly from the said pivoted end thereof into the path of travel of said trip elements, said trippable members lying on opposite sides of a plane passed through said lever perpendicular to the pivotal axis thereof, said lever having its other end bifurcated wherein a switch, having a switch arm, is provided, said switch arm having a free terminus articulatively received between the bifurcations of the said other end of the lever; and wherein means are provided for temporarily locking the said arm at the open and closed positions of said switch arm.

4. Apparatus as recited in claim 2 wherein the trip mechanisms each comprise a lever pivoted at one end adjacent the circumferential path of said actuator and have trippable members extending rigidly outwardly from the said pivoted end thereof into the path of travel of said trip elements, said trippable members lying on opposite sides of a plane passed through said arm perpendicular to the pivotal axis thereof, said lever having its other end bifurcated wherein a switch, having a switch arm, is provided, said switch arm having a free terminus articulatively received between the bifurcations of the said other end of the lever; and wherein means are

provided for temporarily locking the said arm at the open and closed positions of said switch arm.

5. Automatic timing apparatus, comprising supporting means extending and adapted to move about a fixed endless circuit; a plurality, more than two, of respectively independently adjustable trip elements securely mounted on the peripheral surface of said supporting means for unlimited independent adjustment therearound and relative thereto in a pair of substantially continuous parallel paths defined upon and about said supporting means, and for travel therewith about said endless circuit, each of said trip elements comprehending only a small fraction of the periphery of the supporting means, said fraction being measured along the periphery; a control device arranged for actuation in intermittent reciprocative strokes, said control device being disposed adjacent said supporting means and having a pair of cooperative trippable members arranged for alternate extension, respectively, into corresponding paths of said pair of paths and for alternate actuation by the trip elements disposed in said pair of paths; and means for motivating said supporting means about said endless circuit according to predetermined timing.

6. Automatic timing apparatus as recited in claim 5 wherein there are a plurality of groups of a plurality, more than two, each of trip elements disposed in a pair of substantially continuous parallel paths, said groups being mounted on the stated supporting means in side-by-side relation; and wherein there are a plurality of the stated control devices, each cooperatively associated with a respective one of said groups of trip elements and having a pair of cooperative trippable members arranged for alternate extension, respectively, into corresponding paths of said pair of paths and for alternate actuation by the trip elements disposed in said pair of paths; and means for motivating said supporting means about said endless circuit according to predetermined timing.

7. Automatic timing apparatus, comprising supporting means extending and adapted to move about a fixed endless circuit; a plurality of trip elements mounted on said supporting means for unlimited independent adjustment therearound in a pair of substantially parallel paths and for travel therewith about said endless circuit; a control device disposed adjacent said supporting means and arranged for intermittent actuation by said trip elements, said control device comprising trippable mechanism including a lever pivoted adjacent one of its ends, short arm means for said lever comprising two oppositely directed arms lying on opposite sides of a plane passed through said lever perpendicular to the pivotal axis thereof, said arm members being adapted for alternate extension into respective lines of travel of said trip elements; a long arm for said lever slotted intermediately, a bracket rigidly mounted and extending within said slot, said slot being configured to allow freedom of movement of said long arm of the lever about said bracket, means carried by said bracket and means provided by said long arm of the lever for cooperatively locking said lever at the termination of its respective reciprocative strokes, said means being subject to displacement by normal actuation of said lever; and switch means articulatively engaging the free end of said long arm of the lever for actuation thereby.

8. Automatic timing apparatus, comprising supporting means extending and adapted to move about a fixed endless circuit; a plurality of trip elements mounted on said supporting means for unlimited independent adjustment therearound in a pair of substantially parallel paths and for travel therewith about said endless circuit; a control device disposed adjacent said supporting means and arranged for intermittent actuation by said trip elements, said control device comprising trippable mechanism including a lever pivoted adjacent one of its ends, short arm means for said lever comprising two oppositely directed arms lying on opposite sides of a plane passed through said lever perpendicular to the pivotal axis thereof, said arm members being adapted for alternate extension into respective lines of travel of said trip elements; a long arm for said lever; means for locking said lever at the termination of its respective reciprocative strokes, said means comprising a rigidly mounted bracket, a carrier plate rigidly secured to said bracket and extending adjacent the free end of said arm of the lever substantially parallel to the length thereof, said carrier element having a perforation formed therein at a location adjacent said free end; a ball freely carried within said perforation; a spring clip urging said ball against the lateral surface of said long arm of the lever; and two shallow recesses formed in said lateral surface, said recesses being disposed relative to each other, to said lateral surface, and to said ball in such manner as to respectively engage said ball at terminations of the respective reciprocative strokes of said lever.

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