Oct. 31, 1961 B. H. BETTCHER 3,007,100

MOTOR BRAKING CIRCUIT

Filed Nov. 25, 1958 3 Sheets-Sheet 1

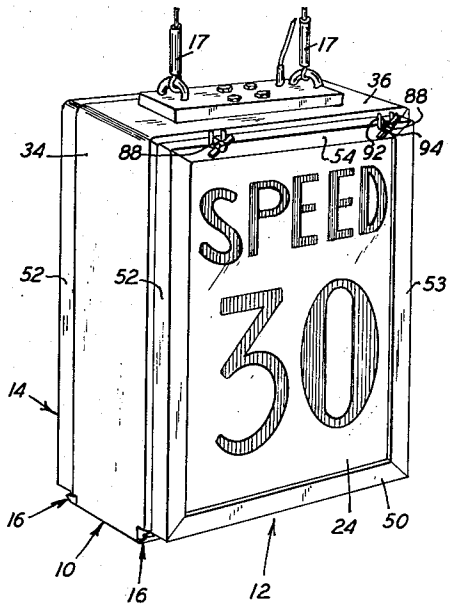


FIG.1

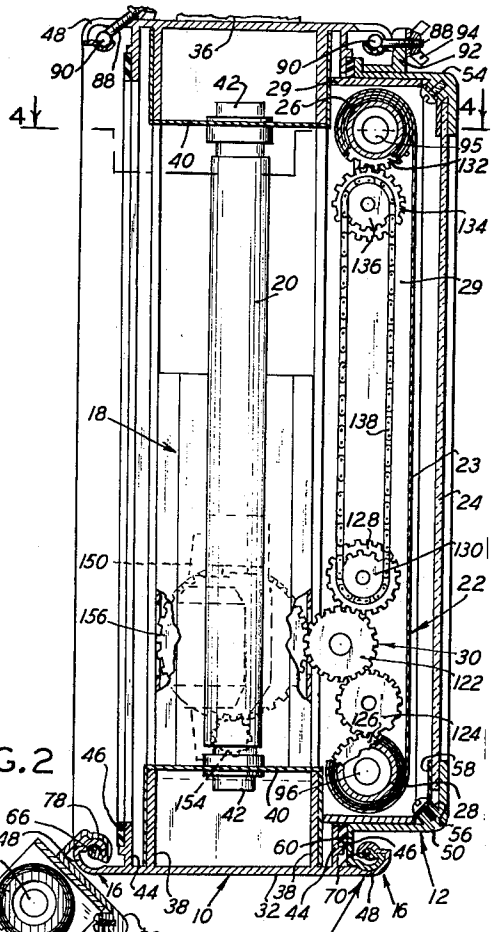
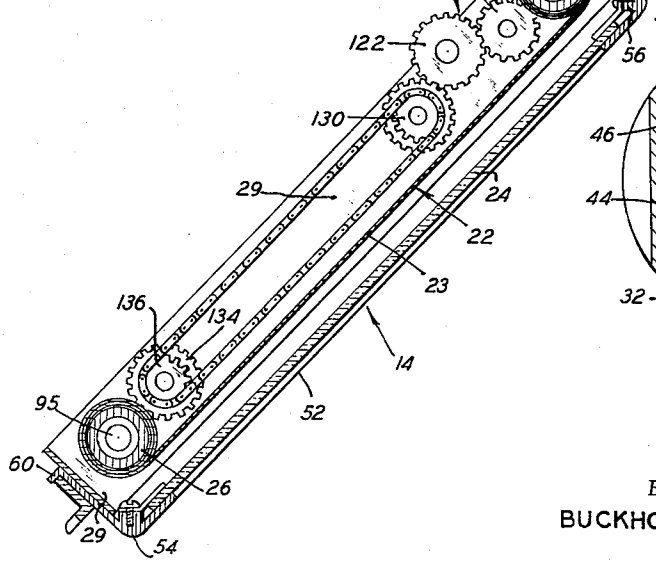


FIG.2



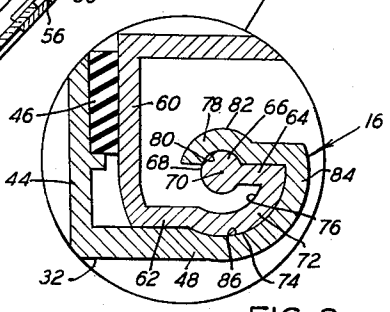


FIG.3

INVENTOR.
BRUCE H. BETTCHER
BY
BUCKHORN, CHEATHAM & BLORE
ATTORNEYS

Oct. 31, 1961 B. H. BETTCHER 3,007,100

MOTOR BRAKING CIRCUIT

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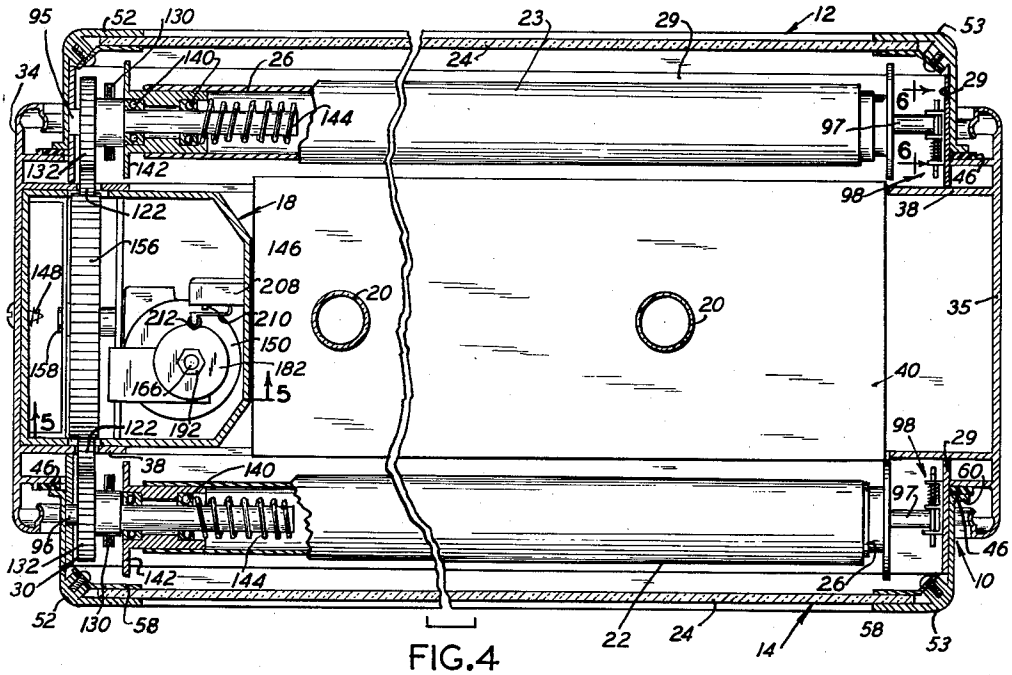

FIG.4

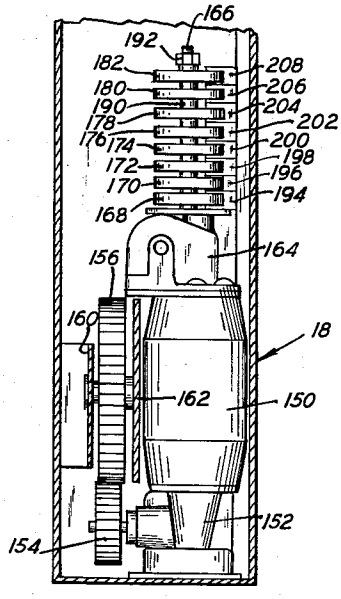

FIG.5

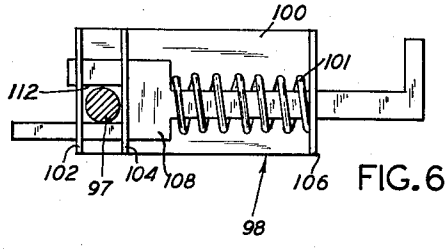

FIG.6

INVENTOR.
BRUCE H. BETTCHER
BY
BUCKHORN, CHEATHAM & BLORE
ATTORNEYS

Oct. 31, 1961 B. H. BETTCHER 3,007,100

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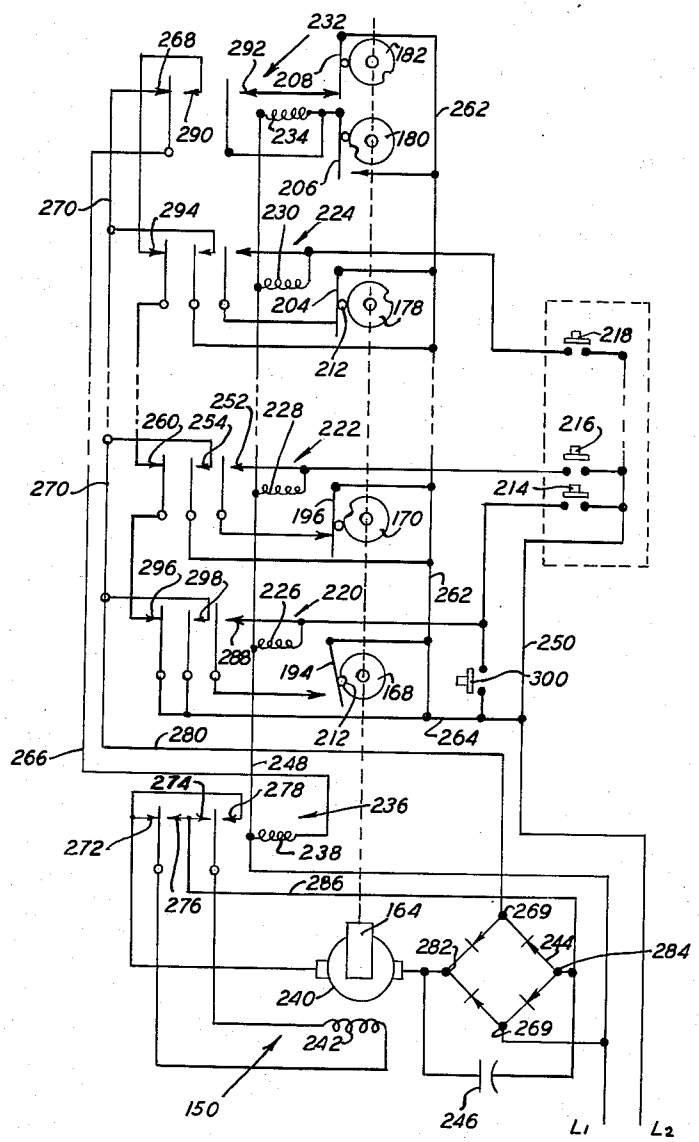

FIG.7

INVENTOR.
BRUCE H. BETTCHER
BY
BUCKHORN, CHEATHAM & BLORE
ATTORNEYS

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3,007,100
MOTOR BRAKING CIRCUIT

Bruce H. Bettcher, Portland, Oreg., assignor to The Pam Company, Portland, Oreg., a corporation of Oregon

Filed Nov. 25, 1958, Ser. No. 776,371
6 Claims. (Cl. 318—373)

This invention relates to a changeable sign and more particularly to an improved type of roller sign including an improved drive mechanism and motor control circuit for enabling selected changing of the sign by remote control and also including an improved casing structure for such sign providing a sign containing openable closure structure and an improved hinge for such closure structure.

The sign of the present invention includes a casing body made up of side and end members suitably secured together and containing a removable driving and control unit including a motor and associated sign driving and control mechanism as well as lamps for illuminating the sign. Such casing body has attached thereto at least one openable closure structure which contains a removable sign assembly including a pair of rollers and a flexible sign element carried by such rollers with a drive mechanism for rotating the rollers, such drive mechanism being automatically disconnected from the driving and control unit contained in the casing body when the closure structure is opened and being reconnected when the closure structure is closed. The driving and control unit in the casing body is arranged so that a roller sign assembly may be provided on two sides of the casing in each of two closure structures hinged to the sign casing along one edge thereof. Opening either closure structure provides access to the interior of the casing to enable the driving and control unit to be removed therefrom and also enables the roller sign assembly to be removed from such closure structure for replacement or repair.

The sign of the present invention also includes an improved hinge for securing each of the closure structures to the casing body, such hinge being preferably provided by a hinge member integral with one element of the casing body and another hinge member integral with one element of such closure structure. Such elements and the elements making up the sides and ends of the casing body and also making up the sides and ends of the closure structures are readily formed by metal extrusion operations. In a preferred embodiment of the sign, the hinges are located in a protected position below the closure structures and such hinges enable each closure structure to be opened and closed. Such hinges also enable each closure structure to be removed or installed on the casing body by a movement longitudinally of the axis of the hinge for such closure structure. Thus each hinge has two members only, which elements can slide relatively axially of each other when its closure structure of the sign is open to connect or disconnect such members.

The sign of the present invention also includes an improved motor control circuit which enables the roller signs to be driven to any one of a plurality of predetermined positions and rapidly and accurately stopped at such positions by remote control. The motor employed has an armature winding and a field winding and the stopping operation is produced by disconnecting the motor from its source of power and, at the same time or immediately thereafter, reversing one of the windings of the motor and discharging a charged capacitor through such motor. In the specific embodiment shown, the motor control device provides for changing the direction of rotation of the motor at each end of the travel of the sign so that the sign can approach each of such predetermined positions from either direction. The stopping circuit,

however, performs its stopping operation including reversing the connections to one of the motor windings and discharging a charged capacitor through the motor, irrespective of the direction of travel of the sign when approaching the selected predetermined position. Upon again actuating the remote control to select another predetermined position of the sign, the sign is driven in the same direction it approached the previously selected predetermined position until it reaches the next selected predetermined position or the end of its travel. In the latter case, the motor is reversed and the sign is driven in the opposite direction until it reaches the selected position.

It is therefore an object of the present invention to provide an improved changeable sign in which a casing is provided for an easily removable sign driving and control unit and such casing has an openable closure structure containing a roller sign assembly driven from such unit.

Another object of the invention is to provide a changeable sign in which a sign casing body and a closure structure therefor are formed of extruded metal elements and in which certain of such elements provide an improved hinge for such closure structure made up of parts which are integral with such elements.

Another object of the invention is to provide an improved hinge having hinge members pivotally movable with respect to each other about a hinge axis and made up of hinge members integral with elements of the sign casing body and a closure structure therefor.

Another object of the invention is to provide an improved hinge for a closure structure of a casing of a changeable sign in which hinge members are formed integral with parts of the casing body and a closure structure therefor and the closure member may be installed on the casing by a sliding motion axially of the hinge when the closure structure is open.

Another object of the invention is to provide an improved hinge in which a pair of hinge members are pivotally movable relative to each other about a hinge axis and in which such hinge members have radially spaced bearing portions and the hinge can be assembled and disassembled by a motion of the hinge members relative to each other axially of such hinge.

Another object of the invention is to provide a changeable sign in which a flexible roller sign element is remotely controlled to stop at any selected one of a plurality of predetermined positions and the flexible sign element is accurately and rapidly stopped in the selected position.

A further object of the invention is to provide a motor control circuit for a roller sign in which an electric motor having armature and field windings is rapidly stopped at a selected predetermined position by disconnecting such motor from its source of power, reversing one winding of the motor, and discharging a charged capacitor through the motor.

A still further object of the invention is to provide an improved motor control circuit in which an electric motor having field and armature windings is rapidly stopped by disconnecting such motor from its source of power and, at the same time or immediately thereafter, reversing one of such windings and discharging a charged capacitor through such motor.

Other objects and advantages of the invention will appear in the following detailed description of a preferred embodiment shown in the attached drawings of which:

FIG. 1 is a perspective view showing the exterior of a sign in accordance with the present invention;

FIG. 2 is a vertical section on an enlarged scale taken approximately through the center of the sign of FIG. 1 looking toward the side of such sign containing the sign driving and control unit and one of the two roller sign

containing closure structures being shown in open position;

FIG. 3 is a further enlarged fragmentary view showing the hinge of the present invention in a vertical section perpendicular to the axis of the hinge;

FIG. 4 is a horizontal section through the upper portion of the sign on an enlarged scale with respect to FIG. 2 looking downward and taken approximately on the line 4—4 of FIG. 2 with both closure structures of the sign in closed position;

FIG. 5 is a fragmentary vertical section taken approximately on the line 5—5 of FIG. 4 and showing the sign driving and control unit;

FIG. 6 is a fragmentary vertical section on a further enlarged scale showing one of the roller retaining structures for the rollers of the roller sign; and

FIG. 7 is a schematic diagram of the motor control and stopping circuit of the present invention.

Referring more particularly to FIGS. 1 to 4 of the drawings, the sign disclosed therein includes a casing made up of a casing body 10 and two closure structures 12 and 14 in the form of doors hinged at their bottom edges by hinges 16 to the bottom edges of opposite faces of the casing body 10. The sign may be suitably suspended by cables 17. The casing body 10 contains a sign driving and control unit 18 which is removable and replaceable as a unit and also a plurality of light sources, shown as fluorescent lamps 20, suitably held therein. Each closure structure 12 and 14 contains a roller sign assembly 22 including a flexible sign element 23 viewable through a transparent member 24 forming part of a closure structure 12 or 14, the flexible sign elements 23 being positioned to be illuminated by the lamps 20. The flexible sign elements are each carried by upper and lower rollers 26 and 28, respectively. The rollers 26 and 28 of each assembly 22 are suitably journaled in a subframe 29 for such sign assembly. The rollers are driven from a motor forming part of the sign driving and control unit 18 through roller drive mechanisms 30 as described in more detail below.

The casing body 10 is constructed of a bottom element 32, side elements 34 and 35 and a top element 36. All of such elements may be extruded metal elements having the cross section of the bottom element 32 shown in FIG. 2 or of the side element 35 shown in FIG. 4. Such elements may be of general channel formation having spaced flanges 38 forming reinforcing members. The various elements 32, 34, 35 and 36 are mitered so as to fit together at the corners of the casing body and have their mitered ends secured together, for example by welding. The flanges 38 extend inwardly to provide a rectangular inner chamber for receiving supports 40 for sockets 42 for the lamps 20 and also for receiving at one side, the sign driving and control unit 18. The elements of the casing body also have gasket supporting flanges 44 extending inwardly and parallel to and positioned exteriorly of the flanges 38, the flanges 44 being lesser width than the flanges 38. The flanges 44 are provided with gaskets 46 of rectangular ring form for sealing the closure structures 12 and 14 to the casing body 10. The edges of the various casing elements 32, 34, 35 and 36 terminate in return bent flanges 48 which, as described below, are formed to provide one member of a hinge for each of the closure structures 12 and 14 at the lower portion of the casing. Such flanges 48 are also employed at the top of the housing as part of a fastening structure for holding the closure structures in closed position.

Each of the closure structures 12 and 14 are made up of a bottom element 50, two side elements 52 and 53 and a top element 54. Such elements may also be of extruded metal and as originally formed, they all may have the cross section of the bottom element 50 shown in FIG. 2. Thus such elements have a right angle body portion and are mitered and have their mitered ends joined at the corners of the closure structures, for example by welding. The various elements of the closure structures have an internal ridge 56 extending inwardly at an angle of substantially 45 degrees to both portions of the angular body portion from the corner joining such portions. The ridge 56 is employed as an attaching means for retaining elements 58 which hold a transparent member 24 in position in an opening in each closure structure surrounded by the elements 50, 52, 53 and 54.

The other edge of the body portions of each side element 52 and 53 and of each top element 54 of the closure structures terminates in an outwardly extending right angular flange 60 which abuts a gasket 46 when the closure structures 12 and 14 are in closed position. The similar flange 60 of the bottom element 50 only of each closure structure in turn terminates in another outwardly extending substantially right angular flange 62 (FIG. 3) which has a return bent portion 64 also forming part of the hinge 16 at the bottom of the closure structures 12 and 14. The side elements 52 and 53 and the top elements 54 of the closure structures thus have the same cross section as the bottom element 50 except that the flange 60 is severed longitudinally at about its midpoint so as to eliminate a portion of such flange as well as the flange 62 and its return bent portion 64. The side elements 52 and 53 and top element 54 may thereby be produced by severing the flange 60 of an element having the same cross section as the bottom elements 50 of the closure structures 12 and 14, or may, of course, be formed in a separate extrusion operation which does not form the flange 62. In each case the flange 60 of the bottom element also engages the gasket 46 to seal the closure structures 12 or 14 to the casing 10.

The details of the hinge 16 are shown most clearly in FIG. 3. In such figure, the flange 62 and its return bent portion 64 provides a first hinge member and such first hinge member has a radially inner portion 66 which has an outer first arcuate surface 68. Such surface 68 is concentric with the axes 70 of the hinge. The first hinge member 62 also has a radially outer portion 72 which has an outer second arcuate surface 74 and an inner third arcuate surface 76 which is spaced from the surface 68 to provide an arcuate space between such surfaces. The flange 48 on the edge of the bottom member 32 of the casing 10 provides a second hinge member. Such second hinge member has a radially inner portion 78 which has an inner arcuate surface 80 in bearing contact with the surface 68 on the radially inner portion 66 of the first hinge member. Such inner portion of the second hinge member also has an outer arcuate surface 82 which makes bearing engagement with the inner arcuate surface 76 of the first hinge member when the hinge is partially open. The surfaces 80 and 82 of the radially inner portion 78 of the second hinge member are spaced radially so that the radially inner portion 78 of the second hinge member 48 is arcuate and fits within the arcuate space provided between surfaces 68 and 76 on the first hinge member when the hinge is partially opened. The second hinge member also has a radially outer portion 84 which is provided with an inner arcuate surface 86 which makes bearing contact with the outer arcuate surface 74 on the first hinge member when the hinge approaches the closed position shown in FIG. 3. All of the various arcuate surfaces on the two hinge members 62 and 48 are concentric with the axis 70 of the hinge.

The hinge structure 16 provides for a full 180 degree opening motion of a closure structure 12 or 14 from a closed position with respect to the casing body 10. In the closed position of the closure structure 12 shown in FIG. 3, the cooperating arcuate surfaces 68 and 80 in conjunction with the cooperating arcuate surfaces 74 and 86 provide for pivoting the two hinge members about the axis 70 for somewhat more than 90 degrees while maintaining such surfaces coaxial. Before the arcuate surface 74 moves away from arcuate surface 86 as the closure structure 12 pivots toward the fully open posi-

tion, the arcuate surface 76 engages arcuate surface 82 so that the arcuate space between the surfaces 68 and 76 of the first hinge member closes over the radially inner portion 78 of the second hinge member. Such condition is illustrated by the position of hinge 16 between the closure structure 14 and the casing body 10 shown in FIG. 2. The engagement of the surface 76 with the surface 82 in conjunction with the continued engagement between the surfaces 68 and 80 still maintain the hinge members in position for pivotal motion about the axis 70.

The closure structures 12 and 14 are held in closed position by clamp bolts 88 positioned in slots in the flanges 48 of the top element 36 of the body casing 10. The bolts 88 have heads 90 in the form of a cross member positioned in the return bend of the flange 48. The clamp bolts 88 extend exteriorly of the casing 10 through U-shaped members 92 secured to the top element 54 of each closure structure 12 and 14. Wing nuts 94 on the bolts 88 clamp the closure structures 12 and 14 against the gaskets 46 on the casing 10.

As stated above, each closure structure 12 and 14 contains a roller sign assembly 22 including a subframe 29. Such subframe is in the form of a rectangular ring which slides into position in each closure structure and which supports the various elements of the sign assembly so that such sign assembly may be installed or removed from a closure structure as a unit.

The upper rollers 26 at their driven ends of the sign assembly are provided with shafts 95 journaled in bearing apertures in the subframe 29. The lower rollers 28 are also provided with shafts 96 (FIG. 2) at their driven ends and it will be understood that such shafts will also be journaled in the subframe 29. At their other ends, the rollers 26 and 28 have shafts 97 rotatively and releasably supported in bearing structures 98, one of which is shown in FIG. 6, as including a bearing support member 100 having a plurality of spaced flanges 102, 104 and 106, all extending inwardly of the closure structure at substantially right angles to the general plane of the bearing support member. Flanges 102, 104 and 106 are suitably apertured to receive a forked bearing member 108 which is spring pressed toward the left in FIG. 6 to the position shown by a compression spring 101 between the flange 106 and the forked portion of the member 108. The forked portion of such member 108 has a slot 110 therein and the shaft 97 of the rollers 26 is received in the slot 110 between the flanges 102 and 104. The bearing support members 100 for the shaft 97 of each roller 26 or 28 is suitably secured to the subframe 29 of the sign assembly. It will be apparent that the slot 110 and the flanges 102 and 104 of each bearing structure provides a bearing for a shaft 97 and that movement of the forked member 108 to the right in FIG. 6 will release such shaft by movement parallel to the flanges 102 and 104 so that the shaft 97 of a roller 26 or 28 may be moved out of engagement with a bearing structure 98 after the sign assembly 22 has been removed from its closure structure 12 or 14. The shaft 95 or 96 at the other end of such roller may then be withdrawn from its bearing aperture in the subframe 29. The rollers 26 and 28 carrying a flexible sign element 23 may thereby be installed or removed from a sign assembly 22.

The drive mechanism 30 for each roller of a sign assembly 22 includes a driven gear 122 (FIG. 2) meshing with a lower idler gear 124 which in turn meshes with a gear 126 on the shaft 96 of the roller 28. The driven gear 122 also meshes with a lower chain drive gear 128 which has a sprocket 130 secured thereto. The upper roller 26 has a gear 132 on its shaft 95 which meshes with an upper chain drive gear 134 having a sprocket 136 secured thereto. An endless flexible drive chain 138 extends between the sprockets 130 and 136, such that the upper roller is also driven from the driven gear 122. All of the gears 122, 124, 128 and 134 are suitably journaled on stub shafts carried by a side member of the subframe 29. It will be apparent that rotation of driven gear 122 in one direction will drive the flexible sign element 23 in one direction and rotation of the driven gear 122 in the other direction will drive the flexible sign element in the opposite direction.

It will also be apparent that the two rollers 26 and 28 of each sign assembly will have rotative movements which vary relative to each other as the flexible element 23 of the sign assembly 22 is transferred from one roll to the other. In order to provide for such operation, the shaft 95 of each upper roller 26 is journaled in the end of the roller 26 by means of a pair of antifriction bearings 140 carried by a flange member 142 having a sleeve portion secured in the tubular end of the roller 26. The shaft 95 is connected to the roller 26 by a coil spring 144 which is given an initial twist so as to maintain the flexible element 23 of the sign assembly in tension between the rollers 26 and 28. It will be apparent that the spring 144 will permit limited relative rotation between roller 26 and its corresponding roller 28 as the flexible member 23 of the sign assembly is transferred from one roller to the other. The position of each flexible sign element is, however, definitely set at all times by the position of its roller 28, which position is in turn set by the position of the driven gear 122.

The sign driving and control unit 18 includes a subcasing 146 which may be removed or placed in position in the casing body 10 by a motion longitudinally of the side element 34 of the casing and then a motion transverse of such side element toward the interior of the casing. Such unit is held in position by a single fastening element, such as a screw 148, and is braced in such position by the flanges 38 on such side element 34 and on the bottom element 32. The unit 18 contains an electric motor 150 mounted with its shaft vertical and has at its lower end a speed reducing unit 152 which drives a spur gear 154 meshing with a main drive gear 156 journaled upon a shaft 158 mounted in cross members 160 and 162 secured to the casing 146. The main drive gear 156 is of the correct diameter and is positioned so that the driven gears 122 of the sign assemblies mesh therewith, as shown most clearly in FIG. 2, when the closure structures carrying such sign assemblies are closed. Slots are provided in the flanges 38 of the side elements 34 and in the sub casing 18 for entrance of such gears 122. It will be apparent that rotation of the main drive gear 156 will rotate the driven gears 122 to drive the flexible sign elements 23.

Another speed reducer 164 is mounted on the upper end of the motor 150 and serves to drive a shaft 166 upon which are mounted a plurality of control cams 168, 170, 172, 174, 176, 178, 180 and 182 (FIG. 5) mounted between suitable spacer washers 190. The various cams being held in adjusted position by a nut 192 screw-threaded on the end of the shaft 166. Each of the control cams just mentioned has associated therewith a switch 194, 196, 198, 200, 202, 204, 206 or 208, respectively. Each switch has an actuating arm 210 (FIG. 4) for actuating the switch when a roller 212 carried by such arm drops into a notch in the associated cam or when the roller is cammed out of such notch. The cams 168 to 182, inclusive, and switches 194 to 208, inclusive, form part of a remote control circuit for stopping the flexible sign element at any desired point determined by the position of the cams on the shaft 166.

The control circuit for the sign in shown in FIG. 7 and in order to simplify the circuit only, the switches 194, 196, 204, 206 and 208 and their associated cams are shown. Such control circuit can also contain the switches 198, 200 and 202 of FIG. 5 and the associated cams and circuits, but such switches and their associated cams and circuits are entirely similar to the switches 196 and 204 and their associated cams and circuits. It will be apparent that such switches 198, 200 and 202 and their associated cams and circuits can be inserted in the dotted

portion of the diagram between the switches 196 and 204 and their associated cams and circuits. That is to say, a circuit of FIG. 7 is adaquate for three predetermined positions of the flexible sign element but any number of additional positioning determining switches and their associated cams and circuits can be inserted between the switches 196 and 204.

The switches 194, 196 and 204 are position determining control switches for the flexible sign element 23 while the switches 206 and 208 are limit and motor reversing control switches. Each position determining control switch 194, 196 and 204 has a remote control push button 214, 216 or 218, respectively, associated therewith. Each switch 194, 196 and 204 also has a relay 220, 222 or 224, respectively, associated therewith, such relays having an actuating coil 226, 228 and 230, respectively. The switches 206 and 208 have a motor reversing control relay 232 associated therewith for reversing the rotation of the motor 150 when the flexible sign element 23 reaches either end of its travel so that the flexible sign element reverses and continues to travel in the opposite direction until a predetermined position selected by one of the push buttons 214 is reached. The circuit also contains a motor winding reversing relay 236 having an actuating coil 238, the relay 236 acting in conjunction with the relay 232 to reverse the motor and also forming part of a stopping circuit for rapidly stopping the motor 150 when the flexible sign element reaches a selected predetermined position. The motor 150 is a direct current motor having an armature 240 and a field 242 and the control circuit contains a direct current source in the form of a bridge rectifier circuit 244. The circuit also contains a motor stopping capacitor 246 connected across the direct current terminals of the rectifier circuit and thus functions as a filter element as well as forming part of a motor stopping circuit described below. The entire motor circuit and motor control circuit is supplied from a single phase alternating current source indicated by the lines L_1 and L_2.

The circuit of FIG. 7 is shown in the condition in which the sign is in a predetermined position selected by push button 214 and the circuit is conditioned so that the motor 150 will rotate the cams in a given direction in such figure, a clockwise direction being assumed. The switch 194 is open by reason of its roller 212 having dropped into a notch in its associated control cam 168. In the condition of the circuit shown, all relays are deenergized and the D.C. source 244 is disconnected from the line L_2. Assume that the push button 216 is then depressed. A circuit is thereby made from the lines L_1 through conductor 248 and relay actuating coil 228, push button 216 and conductor 250 to the line L_2. This causes relay 222 to be actuated to close normally open contacts 252 and 254 and open normally closed contacts 260 of such relay 222. Closing contacts 252 completes a relay holding circuit in parallel with push button 216 from one side of such push button through such contacts 252, closed switch 196 and conductors 262, 264 and 250 back to the other side of push button 216. This maintains relay 222 actuated until switch 196 is opened.

Closing of contacts 254 of relay 222 completes a circuit through the actuating coil 238 of relay 236 to actuate such relay. This circuit may be traced from line L_1 through relay actuating coil 238, conductor 266, normally closed contacts 268 of relay 232, conductor 270, closed normally open contacts 254 of relay 222 and conductors 262 and 264 to line L_2. Relay 236 is thereby actuated to open normally closed contacts 272 and 274 thereof, and close normally open contacts 276 and 278 thereof. At the same time a circuit through the alternating current terminals 269 of the rectifier circuit 244 is completed from the alternating current line and such circuit may be traced from the line L_1 through the terminals 269 of the rectifier circuit 244, closed normally open contacts 254 of relay 222 and conductors 262 and 264 to the line L_2. The rectifier circuit 244 is thus energized and a D.C. potential appears between the terminals 282 and 284 thereof. The motor 150 is thereby supplied with direct current power and the motor circuit may be traced from the terminal 282 of the rectifier circuit through the armature 240, closed normally open contacts 278 of relay 236, field coil 242, closed normally open contacts 276 of relay 236 and conductor 286 to terminal 284 of the rectifier circuit 244. Under these conditions, the motor 150 starts and runs to drive the flexible sign elements 22 through the speed reducer 152 of FIG. 5 and the gearing previously described and also to drive the cams 168, 170, 178, 180 and 182 of FIGS. 5 and 7, through the speed reducer 164 in timed relation with the sign. It is assumed that the cams just referred to will be rotated in a clockwise direction in FIG. 7.

As soon as the cam 168 begins to turn, the switch 194 associated therewith is closed but has no effect at all upon the circuit as contacts 288 of relay 220 are open and are in series with the switch 194. Rotation of the cams in a clockwise direction continues until the motor reversing switch 206 associated with cam 180 is closed by the roller of the switch 206 dropping into the notch in the cam 180. This completes a circuit through the actuating coil 234 of the relay 232. Such circuit may be traced from the line L_1 through the conductor 243, relay coil 234, switch 206, and conductors 262 and 264 to line L_2. Relay 232 is thus actuated to open normally closed contacts 268 and close normally open contacts 290 thereof, and also close normally open contacts 292. Closing normally open contacts 292 completes a holding circuit through the relay coil 234 in parallel with the switch 206 and such circuit may be traced from one side of the switch 206 through closed normally open contacts 292, closed switch 208 and conductors 262 back to the other side of the switch 206. This holds the relay 232 actuated until the switch 208 is opened.

Opening of normally closed contacts 268 of relay 232 deenergizes the actuating coil 238 of the relay 236, which coil was energized as described above when push button 216 was depressed. Such contacts 268 were in series in the energizing circuit of relay coil 238 as previously traced. Closing of normally open contacts 290 of relay 232 has no present effect on the circuit, since normally closed contacts 260 of relay 222 are in series with such contacts 290 of relay 232 and relay 222 has been actuated to open contacts 260. Actuation of relay 236, however, reverses the connections of field coil 242 of the motor 150 to reverse the motor. The motor thereby reverses to drive the various control cams and the flexible sign element 23 of FIG. 2 in the reverse direction. The various cams now rotate counterclockwise in FIG. 7 and switch 206 associated with control cam 180 is again opened as its roller drops into the notch in the cam 168. The relay 232 is, however, maintained in actuated condition by reason of the previously traced holding circuit through contacts 292 thereof and switch 208 associated with cam 182. The motor continues to run to turn the various cams in a counterclockwise direction as switch 194 associated with the cam 168 is first closed and then opened. This actuation of switch 194 has no effect on the circuit, since the normally open contacts 288 of relay 220 are in series with switch 94 and the relay coil 226 of relay 222 is not energized. Continued rotation of the cams in a counterclockwise direction causes switch 196 to be opened by cam 170 to deenergize the actuating coil 228 of relay 222, since the switch 196 is in series therewith. The normally open contacts 254 of relay 222 are thereby opened and such contacts in series in the energizing circuit for rectifier circuit 244 previously traced. The rectifier circuit no longer furnishes power to the motor.

Capacitor 246 is connected across the terminals 282 and 284 of the rectifier circuit 244 so as to be charged while the motor 150 is running. When the rectifier circuit 244 is deenergized, the motor continues to rotate and, in

fact, is supplied with electric power from the capacitor **246** so that its back voltage is maintained in opposition to the voltage supplied by the capacitor **246**. That is to say, the capacitor **246** starts to discharge through the motor while the motor continues to run in the same direction but the time during which this condition can exist is sufficiently short that the capacitor retains most of its charge.

The deenergization of the actuating coil **228** of relay **222** also causes normally closed contacts **260** of relay **222** to cause energization of actuating coil **238** of relay **236** which was deenergized when relay **232** was actuated by depressing push button **216**. That is to say, closing of contacts **260** completes a circuit through relay coil **238** which may be traced from line L_1 through coil **238**, conductor **266**, closed normally open contacts **290** of relay **232**, normally closed contacts **294** of relay **224**, normally closed contacts **260** of relay **222**, normally closed contacts **296** of relay **220** and conductors **264** to line L_2. Energization of relay coil **236** again actuates relay **238** to again reverse connections of the field winding **242** of the motor **150**. This reverses the field in the motor **150** so that the generator or back voltage developed in the motor is reversed and is in the same direction as the voltage across the capacitor **246** and the capacitor rapidly discharges through the motor **150**. An armature torque is produced in a direction opposite from that which caused the motor rotation and by providing a capacitor **246** of the correct size, the motor can be brought almost instantly to a stop. When the motor comes to a stop, static friction effects become predominant and the motor accurately stops even though the capacitor has sufficient energy stored therein to continue to produce a small amount of reverse torque after the motor has actually stopped. The size of the capacitor is therefore not at all critical as long as it is sufficiently great to bring the motor to a rapid stop.

If either push buttons **214** or **218** are now depressed, the motor will be started and will run in a direction rotating the cams counterclockwise, which was the direction the motor was running before it was stopped as just described. That is to say, depression of any push button will open the circuit through relay coil **238** which was energized to rapidly stop the motor, as described above, since each relay **220**, **222** and **224** associated with a remote control push button has normally closed contacts in series in the energizing circuit for such coil **238** when the relay **232** is actuated to condition the motor for driving the cams in a counterclockwise direction. If it were push buttons **218** which were depressed, the motor would continue to drive the cams in a counterclockwise direction until the switch **204** is opened by its roller dropping into the notch in its cam **178**, at which time another rapid stopping of the motor will take place in the manner described above. If it were the push buttons **214** which were depressed, the motor will continue to rotate the cam counterclockwise in FIG. 7 until the switch **208** is opened by its cam **182**. This breaks the holding circuit previously described which has been retaining the actuating coil **234** of relay **232** energized thus causing opening of closed normally open contacts **290** of relay **232** and closing the open normally closed contacts **268**. Opening contacts **290** has no effect, since normally closed contacts **296** of relay **220** in series therewith have been opened by actuation of such relay by depressing push button **214**. Closing of normally open contacts **268** of relay **232**, however, completes a circuit through relay coil **238** of relay **236** to reverse the motor by reversing its field. Such circuit through coil **238** may be traced from line L_1 through coil **238**, conductor **266**, contacts **268** of relay **232**, conductor **270**, closed normally open contacts **298** of relay **220** and conductor **264** to line L_2. The motor then drives the cams clockwise until switch **194** is opened by its cam **168**.

Opening of switch causes a quick stopping operation of the motor **150** in a manner similar to that above described. The resulting deenergization of relay coil **226** of relay **220** opens contacts **298** of such relay to disconnect the energizing circuit through rectifier circuit **244** and at the same time deenergizes relay coil **238** of relay **236** to reverse the connections of the motor field and thereby discharge the capacitor **246** through the motor to produce a stopping torque. The circuit is now back in the condition assumed at the start of the description of such circuit so that the motor will drive the control cams clockwise irrespective of which remote control push button is depressed. All relays are deenergized and in case of a power failure, the specific circuit shown will be left conditioned for clockwise rotation of the cams.

The remote control push buttons may be positioned at a distance from the sign and for adjustment purposes the control unit in the sign is preferably provided with a push button **300** which is shown as being connected in parallel with the push button **214**. Depressing this push button brings the cams of the driving and control unit to a definite position. The flexible sign elements **23** of the sign assemblies **22** may each be moved to a corresponding position when its closure structure **12** and **14** is open and upon closing of such closure member, the flexible sign elements **23** will be driven to predetermined positions set by the cams **168**, **170** and **178** under control of the remote control push buttons.

The operation of the sign of the present invention and its various components should be clear from the above description thereof but will be briefly reviewed. The two closure structures **12** and **14** can be opened or closed by pivotal action for a full 180 degrees about the axes **70** of the hinges **16** and are held in closed position by clamp bolts **88** holding such closure structures against the gaskets **46**. When open, the closure structures **12** and **14** and their contained roller sign assemblies **22** can be removed from the sign casing body **10** by a sliding motion axially of the hinges **16**. The sign assemblies **22** can each be installed or removed as a unit from the closure structures by a sliding motion perpendicular to the plane of the transparent members **24**.

When either closure structure is closed, the driven gear **122** of its sign assembly **22** meshes with the main drive gear **156** of the driving and control unit **18** positioned in the casing body **10** so that the roller **28** of each sign assembly **22** can be driven through the gears **124** and **126** and the roller **26** driven through the gear **128**, chain **138** and gears **132** and **134** from the gear **156**. The gear **156** forms part of the driving and control unit **18** which can be installed in the casing by a sliding motion parallel to the interior flanges **38** of the casing structures. The gear **156** is driven from the motor **150** through a speed reducer **152** under control of a remote control circuit including push buttons **214**, **216** and **218** (FIG. 7) and the cams **168** to **182** also driven through a speed reducer **164** (FIG. 5) from the motor **150**.

The push buttons **214**, **216** and **218** of FIG. 7 in conjunction with the cams **168** to **182** and the switches associated therewith each actuate the control circuit of such figure to cause the flexible sign element **23** (FIG. 2) to be moved by the motor to a selected predetermined position. Depressing any of such push buttons actuates a relay and establishes a hold circuit for such relay to cause the rectifier circuit **284** to be energized to supply electric power to the motor **150**. This causes the motor to run in the same direction it ran in a previous sign moving operation until the sign reaches the predetermined position corresponding to such push button, the motor being reversed at the end of travel of the flexible sign elements under control of the cams **180** and **182**, if required, for the flexible sign element to reach such position.

When the flexible sign element does reach such position, the cam operated switch **168**, **196**, or **204**, which corresponds to the push button depressed, is opened by the roller **212** thereof dropping into a notch in its as-

sociated cam. This results in deenergizing the rectifier circuit 244 and simultaneously causes the relay 236 to reverse the connections to the motor field 242 to cause the capacitor, which has been charged by being connected across the direct current terminals 282 and 284 of the rectifier circuit, to discharge through the motor windings to produce a stopping torque in the motor.

Depressing another remote control push button or the setting push button 300 will cause the motor to again run in the direction in which it ran in the previous sign moving operation. Depressing the push button 300 brings the flexible sign element to a given predetermined position enabling the flexible sign elements 23 of the sign assemblies 22 in the closure structures 12 and 14 to be properly positioned so as to be synchronized with the cams 168 to 182. The positions of the cams may be individually adjusted to correlate them with the positions of the indicia on the flexible sign element.

While I have disclosed the preferred embodiment of my invention, it is understood that the details may be varied and that the scope of the invention is to be determined by the following claims.

I claim:

1. A motor control for causing a motor to drive a roller sign and stop said sign rapidly and accurately at any one of a plurality of predetermined positions, said control comprising a direct current motor having an armature winding and a field winding, a plurality of control switches each corresponding to one of said positions, a plurality of cams driven by said motor and each corresponding to one of said positions, a plurality of cam controlled switches each controlled by one of said cams, means controlled by any selected one of said control switches to connect said motor to a source of direct current power to energize said windings and cause said motor to run and drive said sign and said cams, stopping means controlled by the cam controlled switch corresponding to said selected control switch for bringing said motor to a stop when said sign reaches a selected position corresponding to said one control switch, said stopping means including, a capacitor, means to charge said capacitor, means to disconnect said motor from said source and immediately thereafter to reverse one of said windings and discharge said capacitor through said motor to rapidly stop said motor.

2. A motor control comprising a motor having an armature winding and a field winding, means for connecting said motor to a source of electric power to energize said windings and cause said motor to run, and means to rapidly bring said motor to a stop including, a capacitor, means to charge said capacitor, means to disconnect said motor from said source and immediately thereafter to reverse one of said windings and discharge said capacitor through said motor to rapidly stop said motor.

3. A motor control comprising a direct current motor having an armature winding and a field winding, means for connecting said motor to a source of direct current power to energize said windings and cause said motor to run, and means to rapidly bring said motor to a stop including, a capacitor, means to charge said capacitor, means to disconnect said motor from said source and immediately thereafter to reverse one of said windings and discharge said capacitor through said motor to rapidly stop said motor.

4. A driving and control mechanism for driving a driven element and stopping said element rapidly and accurately at any one of a plurality of predetermined positions, said control comprising an electric motor having an armature winding and a field winding, a plurality of control switches each corresponding to one of said positions, a plurality of cams driven by said motor and each corresponding to one of said positions, a plurality of cam controlled switches each controlled by one of said cams, means controlled by any selected one of said control switches to connect said motor to a source of electric power to energize said circuits and causing said motor to run and drive said element and said cams, stopping means controlled by the cam controlled switch corresponding to said selected control switch for bringing said motor to a stop when said element reaches a selected position corresponding to said one control switch, said stopping means including, a capacitor, means to charge said capacitor, means to disconnect said motor from said source and immediately thereafter to reverse one of said windings and discharge said capacitor through said motor to rapidly stop said motor.

5. A driving and control mechanism for driving a driven element alternately in opposite directions of travel and stopping said element rapidly and accurately at any one of a plurality of predetermined positions, said control comprising an electric motor having an armature winding and a field winding, a plurality of control switches each corresponding to one of said positions, a plurality of cams driven by said motor and each corresponding to one of said positions, a plurality of cam controlled switches each controlled by one of said cams, means controlled by any selected one of said control switches to connect said motor to a source of electric power to energize said circuits and cause said motor to run and drive said element and said cams, said motor control having means at the ends of travel of said element for reversing one of said windings to reverse said motor and thereby reverse the direction of travel of said element, stopping means controlled by the cam controlled switch corresponding to said selected control switch for bringing said motor to a stop when said element approaches from either direction of its travel and reaches a selected position corresponding to said one control switch, said stopping means including, a capacitor, means to charge said capacitor, means to disconnect said motor from said source and immediately thereafter to reverse one of said windings and discharge said capacitor through said motor to rapidly stop said motor.

6. A driving and control circuit for driving a roller sign comprising an electric motor having an armature winding and a field winding, means for connecting said motor to a source of electric power to energize said windings and cause said motor to run, and means to rapidly bring said motor to a stop to accurately position said sign including, a capacitor, means to charge said capacitor, means to disconnect said motor from said source and immediately thereafter to reverse one of said windings and discharge said capacitor through said motor to rapidly stop said motor.

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