June 14, 1966 B. H. BETTCHER 3,255,541

CHANGEABLE SIGN

Original Filed Nov. 25, 1958 3 Sheets-Sheet 1

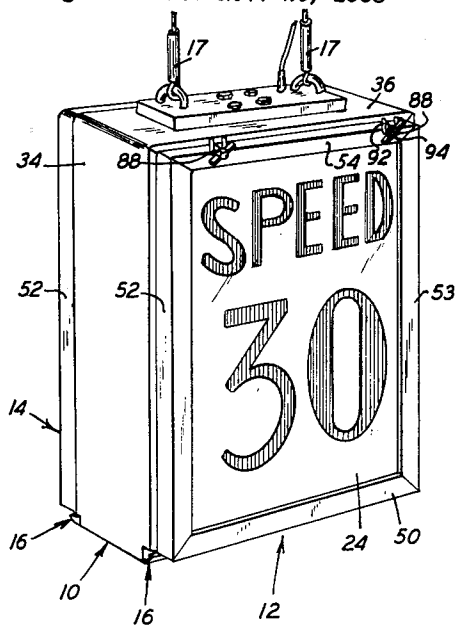


FIG. 1

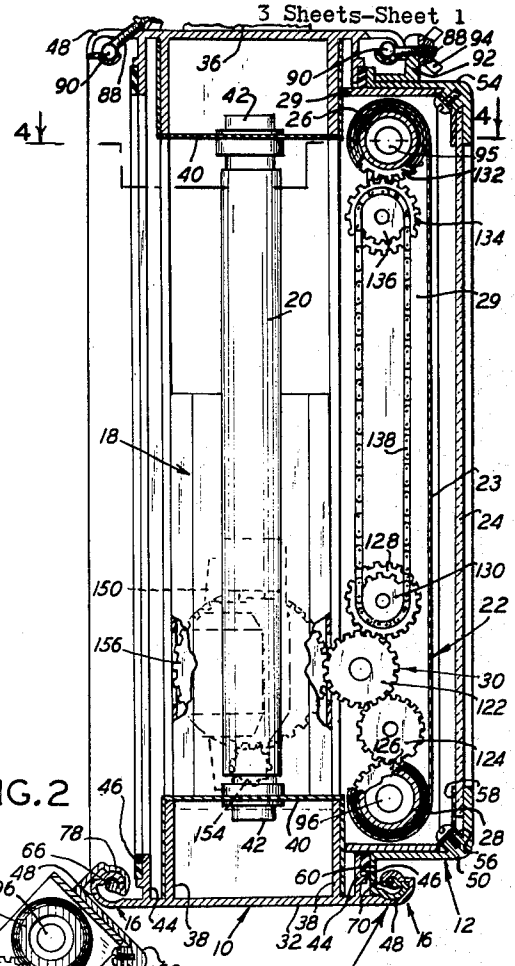
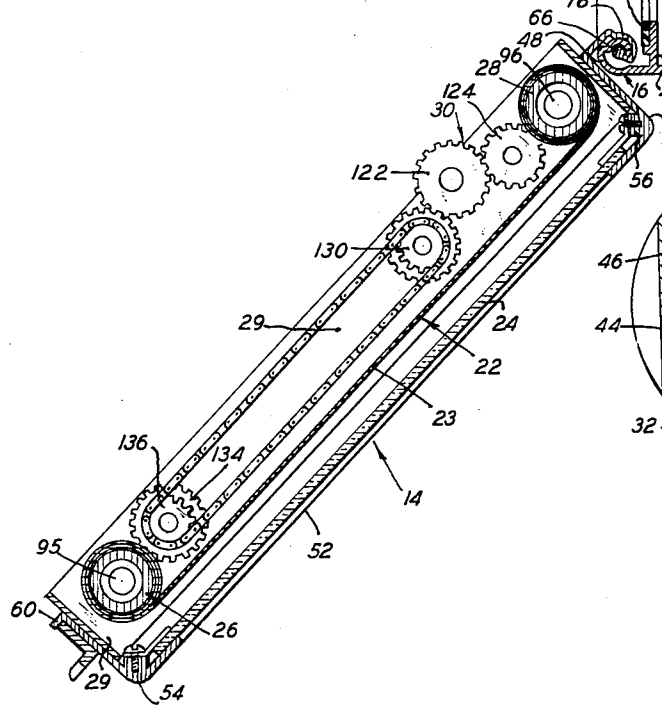


FIG. 2



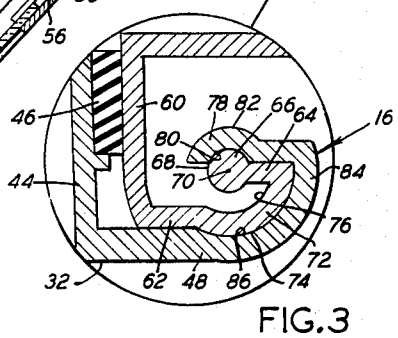


FIG. 3

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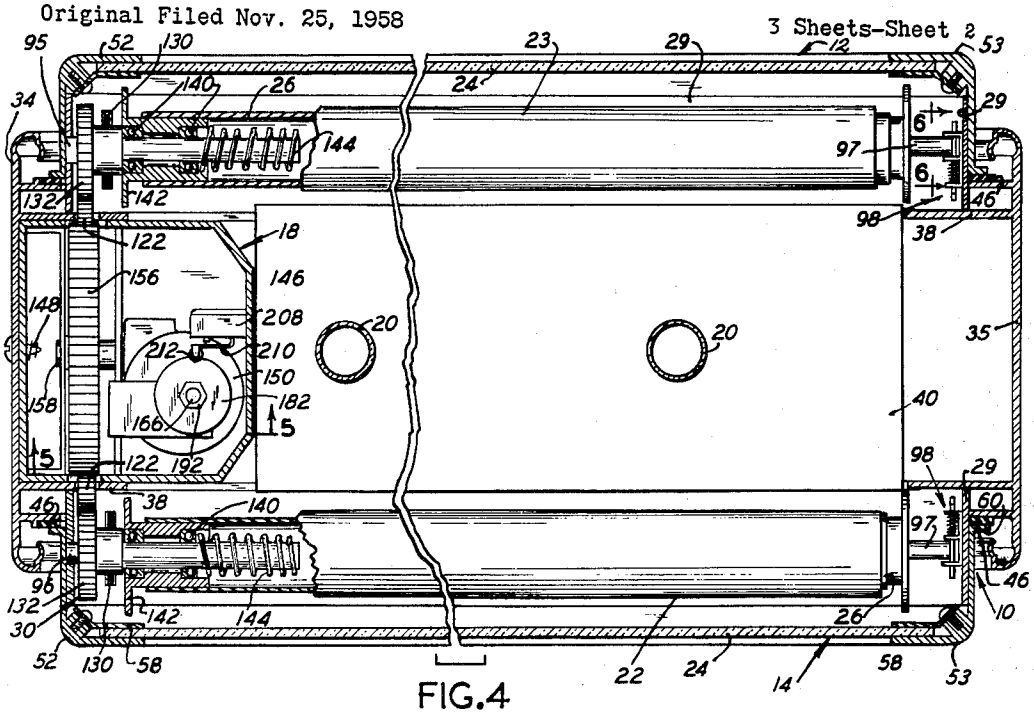


FIG.4

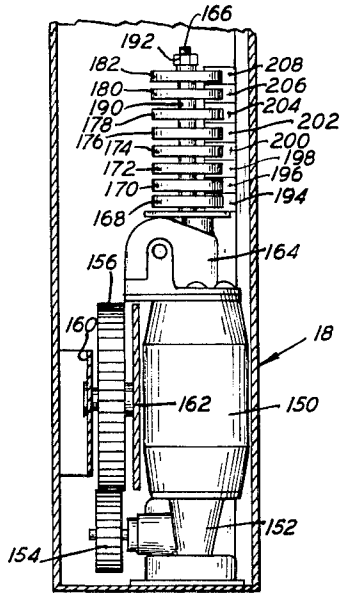


FIG.5

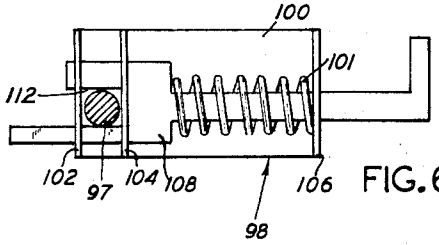


FIG.6

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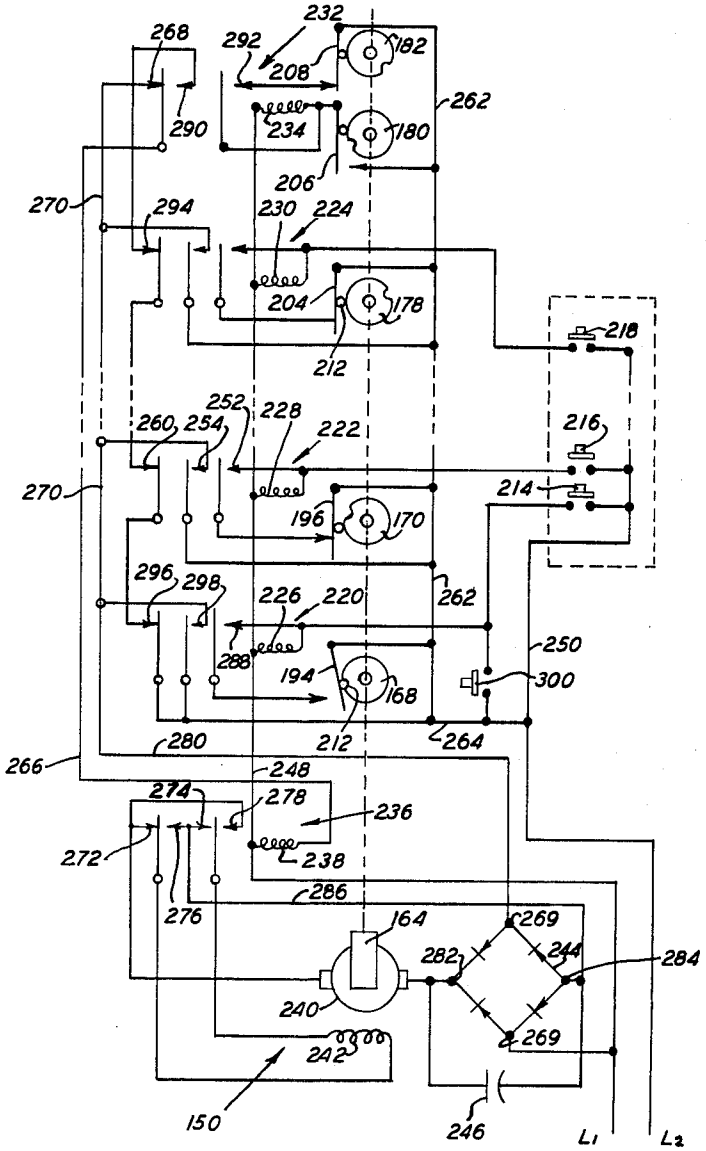


FIG.7

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3,255,541

CHANGEABLE SIGN

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Original application Nov. 25, 1958, Ser. No. 776,371, now Patent No. 3,007,100, dated Oct. 31, 1961. Divided and this application Oct. 30, 1961, Ser. No. 148,602
8 Claims. (Cl. 40—31)

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. This application is a division of my copending application Serial No. 776,371, filed November 25, 1958, now U.S. Patent No. 3,007,100, dated Oct. 31, 1961.

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 mechanism **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 conjnuction 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 position, 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 flange 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 subcasing 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 and 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 is 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 adequate 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**, **173**, **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 **248**, 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 by 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 conductor 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 220, 222 or 224 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 associated 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 changeable illuminated sign comprising a casing having a body portion providing an open side, an openable closure structure for said side having a transparent portion in its exposed face extending over a major portion of said face, a roller sign carried by said closure structure including spaced rollers, a flexible sign element movably carried by said rollers and having a portion extending between said rollers in position to be viewed through said transparent portion, light means carried by and positioned within said body portion for illuminating said sign element, drive mechanism for said rollers, motor means in said body portion of said casing for driving said drive mechanism, cooperative drive connection means in said body portion and said closure structure for connecting said drive mechanism to said motor means when said closure structure is in closed position on said body portion, and means for controlling said motor means to position a selected portion of said sign for viewing through said transparent portion, said drive connection means being disconnected to disconnect said motor means from said drive mechanism when said closure structure is opened.

2. A changeable illuminated sign comprising a casing having a body portion providing an open side, an openable closure structure for said side hinged to said body portion and having a transparent portion in its exposed face extending over a major portion of said face, a roller sign carried by said closure structure including spaced rollers, a flexible sign element movably carried by said rollers and having a portion extending between said rollers in position to be viewed through said transparent portion, light means carried by and positioned within said body portion for illuminating said sign element, drive mechanism for said rollers, motor means in said body portion of said casing for driving said drive mechanism, cooperative drive connection means in said body portion and said closure structure for connecting said drive mechanism to said motor means, and means for controlling said motor means to position a selected portion of said sign for viewing through said transparent portion.

3. A changeable illuminated sign comprising a casing having a body portion providing an open side, an openable closure structure for said side hinged to said body portion and having a transparent portion in its exposed face extending over a major portion of said face, a removable roller sign assembly carried by said closure structure including spaced rollers, a flexible sign element movably carried by said rollers and having a portion extending between said rollers in position to be viewed through said transparent portion, light means carried by and positioned within said body portion for illuminating said sign element, and drive mechanism for said rollers, a removable sign driving and control unit in said body portion of said casing including an electric motor for driving said drive mechanism, cooperative drive connection means in said body portion and said closure structure for connecting said drive mechanism to said motor when said closure structure is in closed position on said body portion, and said unit including means for controlling said motor to position a selected portion of said sign for viewing through said transparent portion, said drive connection means being disconnected to disconnect said motor from said drive mechanism when said closure structure is opened.

4. A changeable illuminated sign comprising a casing having a body portion providing an open side, an openable closure structure for said side hinged to said body portion by hinge members integral with said body portion and closure structure and having a transparent portion in its exposed face extending over a major portion of said face, a removable roller sign assembly carried by said closure structure including spaced rollers, a flexible sign element movably carried by said rollers and having a portion extending between said rollers in position to be viewed through said transparent portion, light means carried by and positioned within said body portion for illuminating said sign element, drive mechanism for said rollers a removable sign driving and control unit in said body portion of said casing including an electric motor for driving said drive mechanism, cooperative drive connection means in said body portion and said closure structure for connecting said drive mechanism to said motor, and said unit including means for controlling said motor to position a selected portion of said sign for viewing through said transparent portion.

5. A changeable illuminated sign comprising a casing having a body portion providing an open side, a closure structure for said side hinged to said body portion by hinge members integral with said body portion and closure structure and having a transparent portion in its exposed face extending over a major portion of said face, a roller sign carried by said closure structure including spaced rollers, a flexible sign element movably carried by said rollers and having a portion extending between said rollers in position to be viewed through said transparent portion, light means carried by and positioned within said body portion for illuminating said sign element, drive mechanism for said rollers, motor means in said body portion of said casing for driving said drive mechanism, cooperative drive connection means in said body portion and said closure structure for connecting said drive mechanism to said motor means when said closure structure is in closed position on said body portion, and means for controlling said motor means to position a selected portion of said sign for viewing through said transparent portion, said hinge members comprising return bent flange portions each having radially spaced arcuate bearing surfaces concentric with a hinge axis, the bearing surfaces on one of said members being positioned to engage the bearing surfaces on the other of said members, said closure structure being removable by sliding one of said hinge members axially of the hinge relative to the other hinge member when said closure structure is opened, said drive connection means being disconnected to disconnect said motor means from said drive mechanism when said closure structure is opened by pivotal motion about said hinge.

6. A changeable illuminated sign comprising a casing having a body portion providing an open side, a closure structure for said side having a transparent portion in its exposed face extending over a major portion of said face, a roller sign carried by said closure structure including spaced rollers, a flexible sign element movably carried by said rollers and having a portion extending between said rollers in position to be viewed through said transparent

portion, light means carried by and positioned within said body portion for illuminating said sign element, drive mechanism for said rollers, motor means in said body portion of said casing for driving said drive mechanism, cooperative drive connection means in said body portion and said closure structure for connecting said drive mechanism to said motor means when said closure structure is in closed position on said body portion, and means for controlling said motor means to position a selected portion of said sign for viewing through said transparent portion, said closure structure being hinged to said body portion for pivotal motion about a hinge axis by hinge members integral with said closure structure and said body portion, said hinge members comprising a first hinge member and a second hinge member, said first hinge member including a radially inner portion having an outer first arcuate surface, a radially outer portion having an outer second arcuate surface, and a portion joining said inner and outer portions, said second hinge member including a radially inner first portion having an inner arcuate surface for bearing engagement with said first surface, a radially outer second portion having an outer arcuate surface for bearing engagement with said second surface, said closure structure being removable by sliding one of said hinge members axially of the hinge relative to the other hinge member when said closure structure is opened, and a portion joining said first and second portions, all of said surfaces being concentric with said axis.

7. A hinge comprising a first hinge member and a second hinge member, said members having pivotal movement with respect to each other about a hinge axis, said first hinge member including a radially inner portion having an outer first arcuate surface, a radially outer portion having an outer second arcuate surface, and a portion joining said inner and outer portions, said second hinge member including a radially inner first portion having an inner arcuate surface for bearing engagement with said first surface, a radially outer second portion having an outer arcuate surface for bearing engagement with said second surface, and a portion joining said first and second portions, all of said surfaces being concentric with said axis.

8. A hinge comprising a first hinge member and a second hinge member, said members having pivotal movement with respect to each other about a hinge axis, said hinge member including a radially inner portion having an outer first arcuate surface, a radially outer portion having an outer second arcuate surface and an inner third arcuate surface, and a radially extending portion joining said inner and outer portions, said first and third arcuate surfaces having portions spaced from each other to define an arcuate space, said second hinge member including a radially inner first portion having an inner arcuate surface for bearing engagement with said first arcuate surface and an outer arcuate surface for bearing engagement with said third arcuate surface, a radially outer second portion having an inner arcuate surface for bearing engagement with said second arcuate surface, and a radially extending portion joining said first and second portions, all of said arcuate surfaces being concentric with said hinge axis, said inner and outer arcuate surfaces of said first portion defining an arcuate portion fitting said arcuate space.

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