June 11, 1963 V. L. COLT ETAL 3,093,168

POWER OPERATED DEVICE

Filed Feb. 16, 1960 4 Sheets-Sheet 1

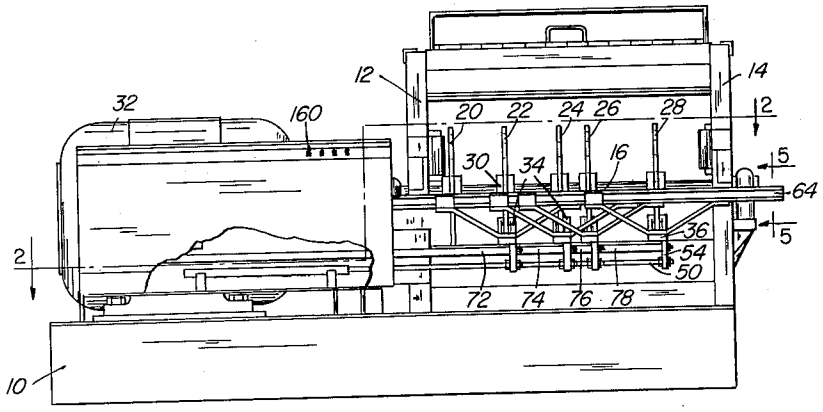


Fig. 1

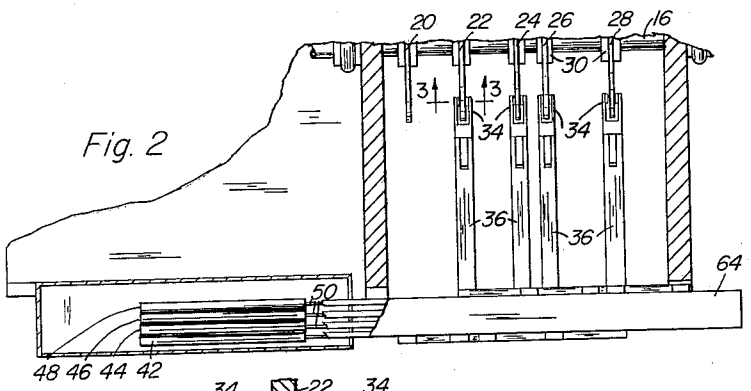


Fig. 2

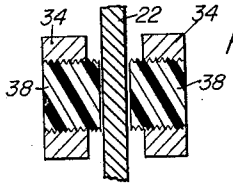


Fig. 3

Fig. 4

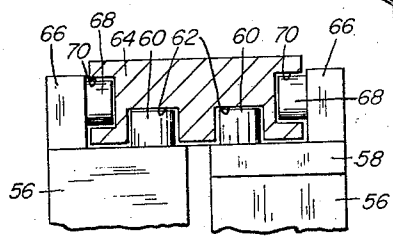


Fig. 5

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POWER OPERATED DEVICE

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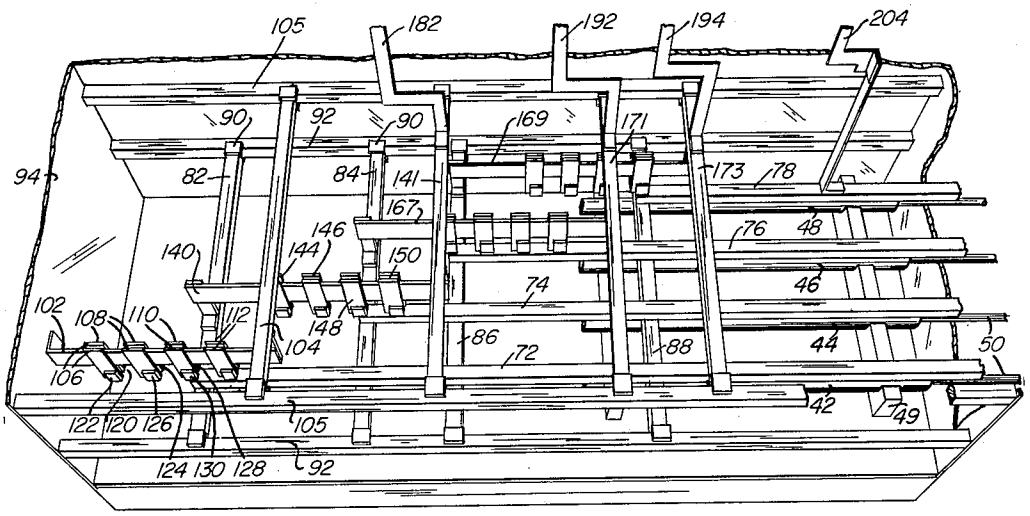


Fig. 6

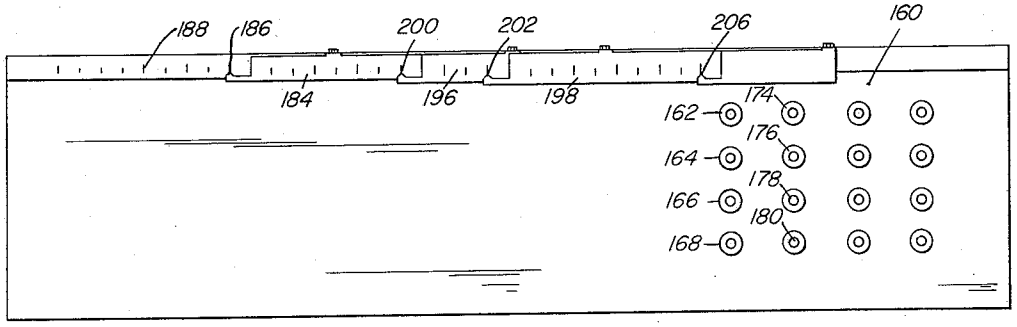


Fig. 7

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POWER OPERATED DEVICE

Filed Feb. 16, 1960 4 Sheets-Sheet 3

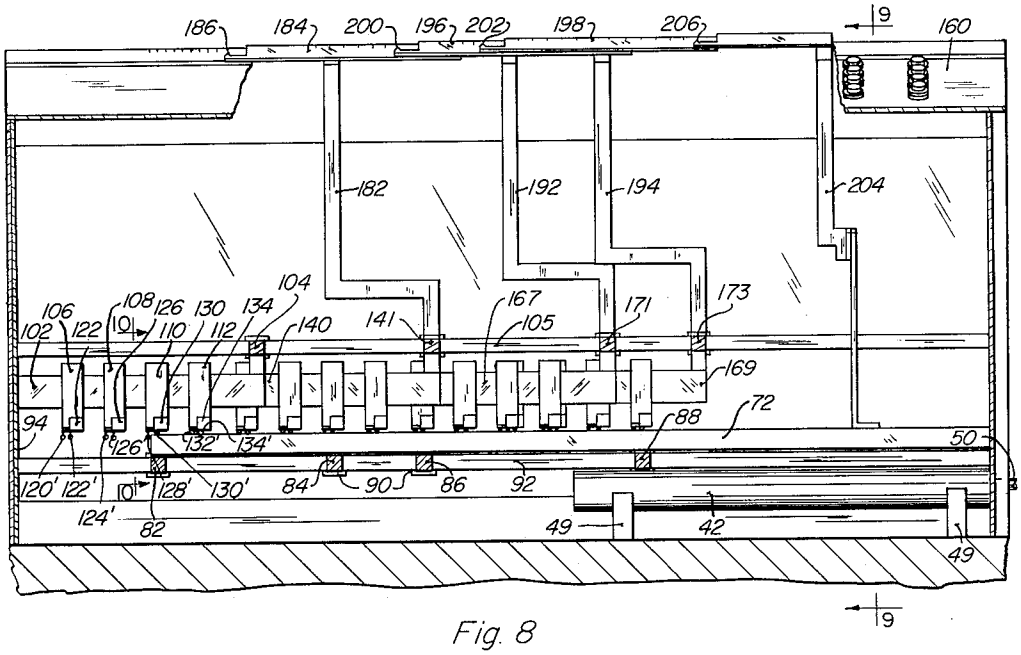


Fig. 8

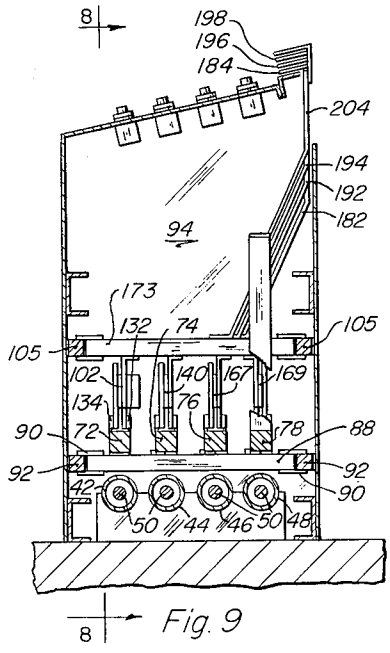


Fig. 9

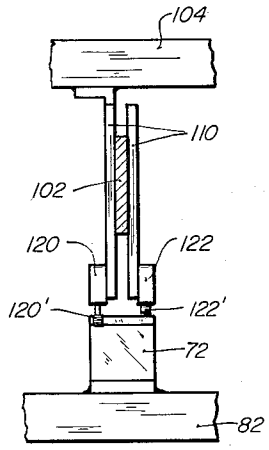


Fig. 10

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POWER OPERATED DEVICE

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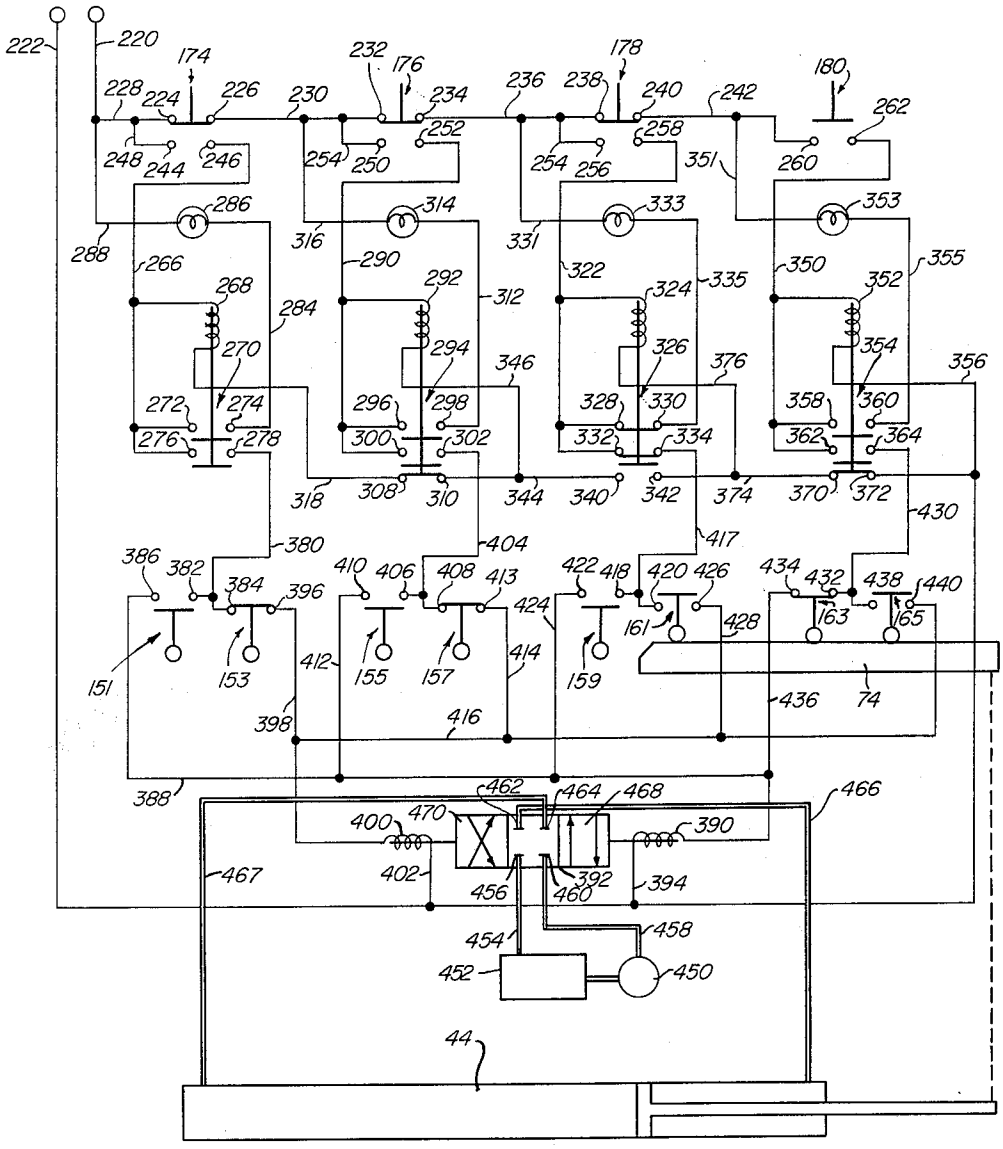


Fig. 11

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United States Patent Office 3,093,168 Patented June 11, 1963

3,093,168

POWER OPERATED DEVICE

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Filed Feb. 16, 1960, Ser. No. 9,083
12 Claims. (Cl. 143—37)

The present invention relates to a power operated device and more particularly to a control mechanism for a power operated device having a plurality of individually shiftable load elements.

It is a principal object of the present invention to provide a power operated device having a plurality of load elements mounted in a longitudinally extending series with means for selectively shifting certain of said load elements and at the same time maintaining a predetermined relationship between at least certain of the load elements upon such shifting.

Another object of the invention is to provide a power operated device including a plurality of load elements and an individual motor for moving each of such load elements and in which a new and novel control system is provided enabling manual adjustment of the position of any one of such load elements while automatically maintaining the same relative positioning between the shifted element and at least certain of the other load elements.

A more particular object of the invention is to provide a new and improved saw mill edger.

A further object is to provide a new and improved arrangement for positioning the adjustable saws of a saw mill edger.

Another object is to provide a new and improved control system for a saw mill edger.

Still other objects and advantages of the invention will become more apparent hereinafter.

In accordance with the illustrated embodiment of the invention, a saw mill edger is provided with a plurality of circular saws shiftably mounted upon an arbor with a plurality of hydraulic motors, each including a cylinder and a piston connected one to each of the saws for shifting the same. An operator control means is provided to enable shifting of any one of the saws to a predetermined position relative to an adjacent saw. Sensor means are provided for each saw to enable the movement of an adjacent saw to be detected and which sensor means is operable to effect certain maintenance of spacing between the saws.

For a more detailed description of the invention, reference is made to the accompanying drawings, wherein:

FIG. 1 is a front elevation partly broken away of a saw mill edger incorporating the invention;

FIG. 2 is a fragmentary sectional view taken substantially along line 2—2 of FIG. 1 showing certain details of the invention;

FIG. 3 is an enlarged sectional view taken substantially along line 3—3 of FIG. 2;

FIG. 4 is an enlarged, fragmentary perspective view showing certain details of the arrangement for shifting the saws of the edger;

FIG. 5 is an enlarged, fragmentary sectional view taken substantially along line 5—5 of FIG. 1;

FIG. 6 is a fragmentary, semi-schematic, perspective view of certain of the control mechanisms of the invention;

FIG. 7 is a view of an operator's control panel and saw positioning indicators;

FIG. 8 is an elevation of a portion of the control arrangement and motor means of the invention taken substantially along line 8—8 of FIG. 9;

FIG. 9 is a sectional view taken substantially along line 9—9 of FIG. 8;

FIG. 10 is an enlarged sectional view taken substantially along line 10—10 of FIG. 8 showing a detail of the control mechanism; and

FIG. 11 is a circuit diagram of a control circuit utilized in the present invention.

The present invention is illustrated as adapted to an edger for trimming and slitting slabs in a saw mill. The illustrated edger includes a frame having a base 10 upon which are mounted a pair of side plates 12, 14 rotatably supporting in suitable journals a saw arbor 16 upon which are mounted a plurality of saws including a base saw 20 and shiftable saws 22, 24, 26 and 28. As indicated, the arbor 16 is fluted and the saws are each provided with a cooperatively fluted hub 30 so that the saws will be driven as the arbor rotates. A motor 32 is provided for driving the arbor 16 and for providing power to suitable feed rolls to carry the slabs through the edger and past the saws. Since the feed rolls form no part of the present invention and are well known in the art (see, for example, the patent to L. J. Peter, No. 2,507,644), they are not shown in the present drawings.

The saw 20 is fixed in position upon the arbor 16 by any suitable means, but each of the saws 22, 24, 26 and 28 is movable longitudinally of the arbor and each is straddled by a saw shifting member comprising a pair of arms 34 extending forwardly from a shifting bar 36. The arms 34 are spaced to provide a slot slightly wider than the saw blade and are provided with hard wood or fiber inserts 38 which preferably are threadedly mounted in the arms 34 and adjusted so as lightly to brush the opposite smooth surfaces of the saw. As will be evident, lateral shifting of a shifting bar 36 will result in shifting of the corresponding saw along the arbor 16.

For the purposes of illustrating the invention, the saws 22, 24, 26 and 28 represent a plurality of load elements mounted in a longitudinally extending series and which are shiftable relative to predetermined positions relative to each other and to a fixed element positioned at one end of the series, the fixed element in this case comprising the fixed or base saw 20.

To effect shifting of the saws 22, 24, 26 and 28, the edger is provided with a plurality of motor means including a first member fixedly secured to the frame of the edger and a second member movable relative to the frame. The illustrated motor means comprise a plurality of cylinders 42, 44, 46 and 48 fixedly secured to the base by frame members 49 (FIGURE 4), each of which cylinders is provided with a reciprocable piston having a piston rod 50 extending from an end of the corresponding cylinder. The rods of the cylinders 42, 44, 46 and 48 are connected to shift the saws 22, 24, 26 and 28, respectively. The end of each of the piston rods 50 is bolted or otherwise suitably secured to a depending bracket 54 on the end of one of the shifting bars 36. Each of the shifting bars 36 is slidably supported on the frame of the machine by a pair of oppositely projecting arms 56, each of which has a horizontally extending portion 58 having a guide bushing 60 projecting upwardly therefrom and which fits within one of a pair of longitudinally extending grooves 62 (FIGURE 5) formed within a guide member 64. Extending upwardly from one side of the portion 58 of each arm is a flange 66, the flanges of a pair of arms being arranged to embrace opposite sides of the guide member 64 as best shown in FIG. 5. Each flange 66 has a guide element 68 projecting therefrom and which engages in a cooperative groove 70 formed in the corresponding side surface of the guide member 64.

As will be evident, selective admission of fluid to the opposite ends of the cylinders 42, 44, 46 and 48 will cause the pistons thereof to move and to shift the saws 22, 24, 26 and 28 along the arbor 16. A suitable hydraulic circuit for operating the cylinders is shown schematically

in FIG. 11 and will be described in detail hereinafter.

In accordance with the present invention, control means are provided for the motors or cylinders **42**, **44**, **46** and **48**, which control means include operator controlled switch means which are operable to actuate a selected one of the cylinders to move a selected one of the shiftable saws a predetermined distance along the arbor. A sensor means is also provided for each saw and which is operable to detect shifting movement of the saw next adjacent thereto on the side toward the base saw. Such sensor means is operable upon actuation to shift its corresponding saw a distance equal to and in the direction of the movement of the detected saw. In other words, with reference to FIG. 2, means are provided so that when saw **22** is shifted in either direction along the arbor, the saws **24**, **26**, **28** will be shifted in like direction and the same distance so as to maintain identical spacing between the saws **22**, **24**, **26**, **28**. On the other hand, if an operator shifts saw **24**, saws **26** and **28** will likewise shift, and if an operator shifts the saw **26**, only the saw **28** will be automatically shifted therewith. These features of the control means and others will now be described in detail.

With particular reference to FIGS. 4, 6 and 9, extending parallel to each of the cylinders **42**, **44**, **46**, **48** and immediately above each is a switch actuating bar indicated at **72**, **74**, **76** and **78**, respectively. As more particularly shown in FIG. 4, the bar **72** is secured to the bracket **54** to which the piston rod of the cylinder **42** is connected so that any movement of the piston of the cylinder **42** will be imparted to the bar **72**. The bars **74**, **76** and **78** are connected in similar fashion to the bracket **54** to which the piston rod of the corresponding cylinder is connected. The opposite ends of the switching bars **72**, **74**, **76**, **78** are supported upon transversely extending supporting elements **82**, **84**, **86**, **88**, respectively, provided at their opposite ends with bifurcated guides **90** which straddle longitudinally extending support rods **92**.

Secured at one end to an end plate **94** is a switch supporting member **102** which is positioned immediately above the path of the switching bar **72**. The opposite end of the member **102** is connected to a bar **104** (FIGURE 6) having bifurcated guides at its opposite ends straddling opposite support rods **105**. Fixedly secured to the opposite side surfaces of the member **102** are a plurality of pairs of switch mounting plates, there being four pairs shown **106**, **108**, **110**, **112**. Mounted upon each of these plates is an electrical switch having an actuator element depending below the plate in position to be engaged and raised by the switching bar **72** as it moves beneath the switch to actuate the same. The plates **106** carry a normally open switch **120** and a normally closed switch **122** and which have actuator elements indicated (FIGURES 8 and 10) at **120'** and **122'**, respectively. The plates **108** support a normally open switch **124** and a normally closed switch **126** having actuators **124'** and **126'**, respectively. The plates **110** support a pair of switches **128**, **130**, normally open and closed, respectively, and which have actuator elements **128'** and **130'**, respectively. The plates **112** support a pair of switches **132**, **134** which are normally open and normally closed, respectively, and have actuator elements **132'**, **134'**, respectively. The switches of each pair are arranged so that the actuator element of the normally closed switch of such pair is contacted first as the switching bar moves to the left as shown in FIG. 8 and the actuator element of the normally open switch of such pair is contacted immediately thereafter. Such movement of the switching bar **72** will take place when the saw **22** is being shifted toward the base saw **20**. The reverse will be true when the saw **22** is shifted away from the base saw **20**.

A similar set of switches is provided for cooperative action with the switching bar **74**. Such switches are mounted upon a switch support member **140** which is supported at one end by the supporting element **82** for the switching bar **72** and thus the switch support member **140** is moved as the switching bar **72** moves. The purpose of this will be explained hereinafter. The opposite end of the switch support member **140** is secured to a transverse support member **141** (FIGURES 6 and 8) having bifurcated guides at its opposite ends slidably engaging the support rods **105**. The switch supporting member **140** has secured thereto a plurality of pairs of switch mounting plates **144**, **146**, **148** and **150**. Each pair of plates supports a normally closed and a normally open switch having actuator elements in position to be engaged and operated by the switching bar **74** as it moves longitudinally relative to such switches. The actuator elements of the normally open and normally closed switches of such series are arranged in the same manner as the switches mounted on the switch supporting bar **102**. The switches on the member **140** are indicated in FIG. 11, those supported on plates **144** being **151** and **153**; those on plates **146** being switches **155** and **157**; those on plates **148** being switches **159** and **161**; and those on plates **150** being switches **163** and **165**, the first named switch in each pair being a normally open switch, the second named being the normally closed switch.

Similar series of switches are mounted upon switch supporting members **167**, **169** secured at one end to the supporting elements **84**, **86**, respectively, and slidably supported at their opposite ends from the rods **105** by supporting elements **171**, **173**, respectively.

The spacing between each successive pair of switches is equal to the desired increments of movement of the shiftable saws **22**, **24**, **26**, **28**. Thus in the illustrated embodiment and referring to FIG. 8, the pairs of switches on the support member **102** are mounted at two inch intervals from one another and the switches **120**, **122** are arranged so that the end of the switching bar **72** will engage the actuator **122'** and move the switch **122** to open position, but is just short of engagement with the actuator **120'** for switch **120** when the saw **22** is four inches from the base saw **20**. The switches **124**, **126** are arranged so that when the saw **22** is moved to a position six inches from the base saw **20**, the switch **124** will remain in its normally open condition but normally closed switch **126** is opened. The switches **128**, **130** are in similar position so that when the saw **22** is eight inches from the base saw **20**, the switch **128** will remain open and normally closed switch **130** will be opened. The switches **132**, **134** are similarly arranged so that the normally open switch **132** will remain open and the normally closed switch **134** will be opened when the saw **22** is ten inches from the base saw **20**. The switches on the switch mounting bar **140** are also arranged so that the normally closed switch of a pair will be opened and the normally opened switch will be unclosed when the saw **24** is at desired increments of distance from the saw **22**, such spacing may be, for example, at 4, 6, 8 and 10 inches. The switches for the other saws will be similarly positioned on their respective mounting bars.

With reference to FIGS. 1, 7 and 9, operator control over the positioning of the saws is attained by means of a plurality of operator switches mounted in the control panel indicated generally at **160**. In the illustrated embodiment of the invention, the control system is arranged to permit adjusting of each shiftable saw to any one of four different positions with respect to an adjacent saw. Thus, for the saw **22**, four switches **162**, **164**, **166**, **168** are provided by means of which the operator can cause the saw **22** to be positioned at four inches, six inches, eight inches or ten inches, respectively, from the base saw **20**. A similar series of switches **174**, **176**, **178** and **180** is provided for enabling positioning of the saw **24** at four inches, six inches, eight inches or ten inches, respectively, from the saw **22**. Other switches are indicated, but not specifically identified for controlling the position of the saws **26** and **28** from the saws **24**, **26**, respectively.

Immediately above the control panel **160** is provided a series of indicators which visually show the operator the

relative position of each saw. Referring to FIGS. 6 to 9, attached to and extending upwardly from the switch supporting element 141 is an arm 182 to which is attached at its upper end an indicator plate 184 (FIGURE 7) having a pointer 186 which cooperates with indicia 188 positioned on the frame structure of the edger to show the position of the saw 22 relative to the base saw 20. The indicator 184 is elongated and has a scale marked thereon. Similarly, the supporting elements 171, 173 have arms 192, 194, respectively, secured thereto and which arms extend upwardly and support indicators 196, 198, respectively. Indicator 196 has a pointer 200 cooperatively arranged with the scale on the plate 184 to indicate the relative position of the saw 24 with respect to the saw 22. The indicator 198, on the other hand, has a pointer 202 which is cooperatively arranged with a scale on the indicator 196 to show the relative position of the saw 26 with respect to the saw 24. To indicate the position of the saw 28 relative to saw 26, an arm 204 is secured to the switch bar 78. The arm 204 supports a pointer 206 which cooperates with a scale on the indicator 198 to show the spacing between the saws 26, 28.

Shown in FIG. 11 are suitable electrical and hydraulic circuits for maintaining control over the saw 24, the circuits being in the condition assumed with the saw 24 positioned eight inches from the saw 22. Power is supplied through suitable lines indicated at 220, 222. Operator switch 174 is provided with a pair of normally closed contacts 224, 226, the former of which is connected by a lead 228 to line 220. Contact 226 is connected by a lead 230 to a normally closed contact 232 of operator switch 176. The other normally closed contact 234 of switch 176 is connected by a lead 236 to a normally closed contact 238 of operator switch 178. The other normally closed contact 240 of switch 178 is connected by a lead 242 to one side of operator switch 180. The switch 174 is provided with a pair of normally open contacts 244, 246, the first of which is connected by a lead 248 to the lead 228. The switch 176 has a pair of normally open contacts 250, 252, the former of which is connected by a lead 254 to the lead 230. Lead 236 is connected by a lead 254 to a pair of normally open contacts 256, 258 for switch 178. Switch 180 is also provided with a pair of normally open contacts 260, 262, the former of which is connected to the lead 242. Contact 246 of switch 174 is connected by a lead 266 to the coil 268 of a relay 270 having two pairs of normally open contacts 272, 274 and 276, 278. The contacts 272 and 276 are also connected to the lead 266. The contact 274 is connected by a lead 284 to an indicator lamp 286 which is in turn connected to the power line 220 by a lead 288. The contact 252 of switch 176 is connected by a lead 290 to the winding 292 of a relay 294 having two pairs of normally open contacts 296, 298 and 300, 302 and a pair of normally closed contacts 308, 310. The contact 298 is connected by a lead 312 to an indicator lamp 314, the opposite side of which is connected by a lead 316 to line 230. Normally open contacts 296 and 300 are connected directly to the lead line 290. The normally closed contact 308 is connected by a lead 318 to the winding 268 of relay 270.

Normally open contact 258 of switch 178 is connected by a lead 322 to one side of the winding 324 of a relay 326. Relay 326 which is shown in its activated condition has two pairs of normally open contacts 328, 330 and 332, 334. The relay also has a pair of normally closed contacts 340, 342. Normally open contacts 328 and 332 are connected directly to lead line 322. Normally closed contact 340 is connected by a lead 344 to normally closed contact 310 of relay 294 and by a lead 346 to the winding 292 of relay 294. The contact 330 is connected to lead 236 by lead 335, indicator lamp 333 and lead 331.

Normally open contact 262 of switch 180 is connected by a lead 350 to one side of the winding 352 of a relay 354, the opposite side of the winding being connected by a lead 356 to the power line 222. Relay 354 has two pairs of normally open contacts 358, 360 and 362, 364. It also has a pair of normally closed contacts 370, 372. Normally open contacts 358 and 362 are connected directly to the lead line 350. Normally closed contact 370 is connected by a lead 374 to the normally closed contact 342 of relay 326 and by a lead 376 to the winding 324 of relay 326.

Redirecting our attention to relay 270, the normally open contact 278 thereof is connected by a lead line 380 to the contact 382 of switch 151 and the contact 384 of switch 153. The other contact 386 of switch 151 is connected by a lead line 388 to one side of the operating coil 390 of a fourway hydraulic valve 392. The opposite side of the coil 390 is connected by a lead 394 to power line 222. The operation of a valve 392 will be described in greater detail subsequently. A contact 396 of switch 153 is connected by a lead 398 to one side of the operating coil 400 for the valve 392, the opposite side of the coil being connected by the lead 402 to the power line 222.

Normally open contact 302 of relay 294 is connected by a lead 404 to a contact 406 of normally open switch 155 and to a contact 408 of normally closed switch 157. The other contact 410 of switch 155 is connected by a lead 412 to the lead line 388. Contact 413 of switch 157 is connected by a lead 414 to a lead 416 which is in turn connected to the line 398.

Normally open contact 334 of relay 326 is connected by a lead 417 to normally open contact 418 of switch 159 and to normally closed contact 420 of switch 161. The contact 422 of switch 159 is connected by a lead 424 to the lead 388. The other contact 426 of switch 161 is connected by a lead 428 to the lead 416.

Normally open contact 364 of relay 354 is connected by a lead 430 to a normally open contact 432 of switch 163, the other contact 434 of the switch being connected by lead 436 to the lead 388. The lead 430 is also connected to contact 438 of normally closed switch 165, the other contact 440 thereof being connected to the lead 416.

A pump for supplying fluid to the cylinders 42, 44, 46, 48 is indicated at 450 in FIG. 11. The pump is adapted to supply fluid to an accumulator indicated at 452 which is connected by a conduit 454 to a port 456 in the valve 392. The valve 392 is shown in accordance with the "J.I.C." code and it will be recognized that the valve is a spool valve. Fluid is returned to the pump 450 through a conduit 458 connected to a port 460 of the valve.

The valve 392 is provided with a further pair of ports 462, 464. The port 462 is connected by a conduit 466 to one end of the cylinder 44 while the port 464 is connected by a conduit 467 to the opposite end of the cylinder 44. The valve 392 is shown in its inactive position, that is with no cross connection between the ports 456, 460 and the ports 462, 464.

The valve 392 is provided, however, with port connecting passage portions including a straight through portion 468 and a flow reversing portion 470. Upon energization of the coil 390, the valve is operated to bring the reversing portion 470 into position with the ports 456, 460, 462 and 464. This causes fluid to flow from the accumulator 452 through the conduit 454 to port 456 and through the valve to port 464, then through conduit 467 into the left end of cylinder 44 causing the piston thereof to move to the right. Such movement will, of course, force fluid out of the opposite end of the piston through the conduit 466 to the port 462, then through the valve and out of the port 460 through the conduit 458 to the pump 450.

On the other hand, energization of the coil 400 will bring the straight through portion 468 of the valve in line with the valve ports. In this condition, fluid will flow into the port 456 of the valve, through the valve, and out from the port 462, through the conduit 466 to the right-hand end of the cylinder 44 to cause the piston to move to the left. Such movement of the piston will cause fluid to be forced out of the left-hand end

of the cylinder and be carried through the conduit 467 to the port 464 through the valve to the port 460 and back to the pump 450.

Operation of Electrical Circuit

The circuit is shown in a static condition wherein as mentioned above, the saw 24 is positioned eight inches from the saw 22. If we assume that the operator wishes to change the position of the saw 24 and move it to a position four inches from the saw 22, he will depress the operator button 174. This will break the holding circuit for the relay 326 which normally extends from the line 220 through the lead 228, contacts 224, 226 of switch 174, lead 230, contacts 232, 234 of switch 176, lead 236, lead line 331, indicator lamp 333, lead line 335, contacts 330, 328 of relay 326, lead 322, coil 324 of relay 326, lead 376, normally closed contacts 370, 372 of relay 354 and lead 356 to the opposite power line 222. Upon breaking of this circuit, the relay 326 will drop out opening contacts 328, 330 and 332, 334 at the same time closing contacts 340, 342. Depression of the switch 174 will also cause a circuit to be closed from the line 220 through leads 228, 248, contacts 244, 246 and lead 266 to the coil 268 of the relay 270. This circuit continues through lead 318, normally closed contacts 308, 310 of relay 294, lead 344, normally closed contacts 340, 342 of relay 326, lead 374, normally closed contacts 370, 372 of relay 354 and line 356 back to the opposite power line 222. Energization of the coil 268 will actuate the relay 270 closing all of the contacts thereof. This will close the holding circuit from the power line 222 including lead 288, indicator lamp 286, lead 284, contacts 274, 272, lead 266 back through the coil 268 of the relay and through the normally closed contacts of the other relays to the lead 356 and finally power line 222. Operation of the relay 270 will also close a circuit through the coil 400 of the valve 392. This circuit extends from the power line 220 through lead 288, lamp 286, lead 284, contacts 274, 272, lead 266, then back through now closed contacts 276, 278 of relay 270, lead 380, through the closed contacts 384, 396 of switch 153, lead 398, coil 400, lead 402 to the opposite power line 222. As described before, energizing of the coil 400 will cause the valve 392 to operate to pass fluid into the right-hand side of the cylinder 44 causing the piston thereof to move to the left. This will also cause the switching bar 74 to move to the left and which as it goes will, in order, close switch 159, open switch 157 and close switch 155. These actions will have no effect upon the circuit. However, eventually, the switching bar 74 will open switch 153. This will immediately open the circuit through the coil 400 de-energizing the same and the valve 392 will return to its neutral position stopping the piston of the cylinder 44 so that the switching bar will stop and the saw 24 also will stop and at which time it will be four inches from the base saw 20. However, if by accident the switching bar 74 moves too far to the left and closes the switch 151, the coil 390 of the valve 392 will be energized. The circuit for this extends from the line 220 through the lead 288, lamp 286, lead 284, through contacts 274, 272 of the relay 270, and back through the relay contacts 276, 278 to lead 380, through now closed contacts 382, 386 of the switch 151 and through lead 388, coil 390 and lead 394 to the power line 222. This will, of course, cause the fluid to be passed to the left-hand of the cylinder 44 and move the piston to the right. As soon as the switching bar 74 clears the switch 151 to permit it to drop out, the circuit through the coil 390 will be opened de-energizing the coil and permitting the valve 392 to return to its neutral position, stopping the movement of the piston and the cylinder 44. Thus, the saw 24 will be accurately positioned at four inches from the saw 22 with the switching bar in such position that it retains the switch 153 open while switch 151 remains in its normally open position.

If the operator had desired to move the saw 24 from a position eight inches from the saw 22 to a position at six inches from such saw, this would be accomplished by depressing the operator button 176 to activate the relay 294. In a manner similar to that described previously, a circuit across contacts 300, 302 of relay 294 would have been closed and through switch 157 to energize coil 400 of valve 392 whereupon the cylinder 44 would operate to move the saw 24 toward the saw 22. When the switching bar 74 opened the switch 157, the valve 392 would have returned to its normal condition stopping movement of the piston in the cylinder 44.

If we assume a circuit condition as shown in FIG. 11 and wherein the saw 24 is positioned eight inches from the saw 22, to move the saw 24 to a position ten inches from the saw 22, swtich 180 is depressed. This will close the circuit from the power line 220 through the switches 164, 166 and 168 to lead 242 and through the now closed contacts 260, 262 of the switch, then through the lead 350 and the coil 352 of the relay 354 and then through the lead 356 to the power line 222. Upon energization of coil 352, the relay will actuate to close contacts 358, 360 and 362, 364 and to open contacts 370, 372. When the contacts 370, 372 open, the holding circuit through the relay 326 will open causing the relay to drop out opening the circuits across contacts 328, 330 and across contacts 332, 334. At the same time, the circuit across contacts 340, 342 of relay 326 will be closed. Upon actuation of the relay 354, a holding circuit for the relay will be established extending from the power line 220 through the switches 164, 166, 168 through lead 351, the signal lamp 353, lead 355, across now closed contacts 360, 358 through lead 350 to the coil 352, then through lead 356 to the power line 222. A circuit will also be closed through the actuating coil 390 of the valve 392. This last circuit extends from the lead 350 which, it will be remembered, is hot, through now closed contacts 362, 364 of the relay 354, through lead 430, across the closed contacts 432, 434 of the switch 163 through lead 436 to lead 388, then through the coil 390 and lead 394 to the power line 222. Energization of the coil 390 will cause the valve to move the portion 470 across the valve ports causing fluid to flow through the conduit 467 to the left-hand side of the cylinder 44. This in turn will cause the piston to move to the right to move the saw 24 and the switching bar in the same direction. The switching bar 74 will continue to move to the right until it clears the actuating pin for the switch 163 permitting the switch to drop out. When the switch 163 drops out, the circuit through the coil 390 will open and the valve 392 will return to its inactive position stopping the flow of fluid to the cylinder 44 and thus stopping movement of its piston. If momentum should cause the assembly of the saw 24 to move too far to the right and beyond the ten inch position, the switching bar 74 will move from beneath the switch 165 permitting it to close. This will establish a circuit from the hot line 350 through the now closed contacts 362, 364 of the relay 354 and then through the line 430 to closed contacts 438, 440 of the switch and through lead 416, the coil 400 and lead 402 to the power line 222. This will cause the valve 392 to operate and direct fluid through the conduit 466 to the right-hand end of the cylinder 44 and move the piston and switching bar 74 to the left. The switching bar 74 will move only until the switch 165 is again opened breaking the circuit through the coil 400 whereupon the valve 392 will return to its inactive position and fluid flow to the cylinder 44 ceases stopping movement of the piston. Substantially similar control circuits are provided for controlling adjustment of the position of the other saws and are operated in the same manner. While the illustrated circuit is for obtaining adjustment of a saw to one of four positions, it will be obvious the circuit may be modified to permit adjustment to any desired number of positions.

Simultaneous Shifting of Saws

It will be recalled that an object of the invention is upon shifting of any given saw to cause all of the saws which are on the side of such shifted saw opposite the base saw 20 to shift a corresponding distance. To demonstrate how this is accomplished with the illustrated embodiment of the invention, we will assume an initial condition as illustrated, that is, with the saw 22 positioned eight inches from the base saw 20 and with the saw 24 positioned eight inches from the saw 22. If the operator should now operate the control circuit for the saw 22 to cause it to move to a position six inches from the base saw 20, the motor 42 would be caused to operate and shift the saw and would cause the switching bar 72 to move a corresponding amount and also cause the switch supporting member 140 to move to the left relative to the switching bar 74. With reference to FIGS. 6 and 11, this would mean shifting of the switch 161 to the left of the switch bar 74 and as the switch actuator element clears the end of the switch bar 74, it is apparent that it will close. This will close a circuit through the operating coil 400 of the valve 392 and which circuit extends from the power line 220 through the switches 174, 176 to the leads 236, 331, the signal light 333, lead 335, through the now closed contacts 330, 328 to line 322, then through the closed relay contacts 332, 334, through lead 417, closed contacts 420, 426 of the switch 161 and then through leads 428, 416 and 398 to the coil 400, then through lead 402 to the power line 222. Upon energization of the coil 400, the valve 392 will operate to shift the valve portion 468 across the ports of the valve causing fluid to be directed through the conduit 466 to the right-hand of the cylinder 44. This will cause the piston thereof to shift to the left and also cause the switching bar 74 to shift to the left. It is evident that the piston of cylinder 44 will continue to operate so long as the switch assemblies continue to move to the left. When the saw 22 has reached its stationary position six inches from the base saw 20 and the switch supporting member 140 stops movement and becomes stationary, the switching member 74 will eventually reopen the switch 161. This, of course, will break the circuit through the valve coil 400 causing the valve 392 to return to its neutral position and stop the motor 44 and at which time the saw 24 will be eight inches from the saw 22 or the same distance as it was before the position of the saw 22 was changed. In similar manner and at the same time, the saws 26, 28 will be shifted to the left to maintain the same spacing between the saws 24, 26, 28 as was present before any change was made in the position of the saw 22.

If the saw 22 were moved from its initial position of eight inches from the base saw 20 to a position of ten inches, the saws 24, 26, 28 would move to the right. Such shifting of the saw 22 would, for example, move the assembly of the switches on the switch supporting bar 140 to the right relative to the switching bar 74. This would cause the switch 159 to close as its actuator element rode up over the end of the switching bar 74 causing a circuit to be closed through the coil 390 of the valve 392. This circuit is established from the power line 220 through the switches 174, 176, leads 236, 331, indicator lamp 333, lead 335, closed relay contacts 330, 328 to line 322, closed relay contacts 332, 334 and line 417 through closed switch contacts 418, 422, leads 424, 388, coil 390 and lead 394 to the power line 222. Energization of coil 390 will move the valve portion 470 across the valve ports causing fluid to flow through the conduit 467 to the left end of the cylinder 44 whereupon the piston thereof and saw 24 will move to the right, together with the switching bar 74. When the saw 22 reaches its eventual position ten inches from the base saw 20, its motion will be arrested and the switches carried by the switch supporting bar 140 will stop. The motor 44 will continue to operate, however, until the switching bar 74 clears the switch 159 allowing it to drop out which will open the circuit through the coil 390 and permit the valve 392 to return to its neutral position stopping operation of the motor 44 with the saw 24 positioned eight inches from saw 22. In like manner, the saws 26 and 28 will be shifted to the right to maintain the original spacing therebetween.

In like manner to the operation described above, saws 24, 26 and 28 can be adjusted in their individual positions upon the arbor 16 and in like manner to the procedure described, upon shifting of the saw 24, saws 26 and 28 will be shifted a like amount or upon shifting of the saw 26, the saw 28 will be shifted a like amount along the arbor 16.

It is possible that under some conditions of spacing between the saws, the selected spread between the base saw 20 and the saw 28 would be greater than permitted by the arbor 16. In such a case, the motor 48 for the saw 28 would simply urge the saw to its farthest possible position to the right on the arbor 16 until the circuit conditions change to move the saw 28 to the left. Obviously, a suitable overtravel switch arrangement could be provided also.

Having illustrated and described a preferred embodiment of the invention, it should be apparent to those skilled in the art that the invention permits of modification in arrangement and detail. We claim as our invention all such modifications as come within the true spirit and scope of the appended claims.

We claim:

1. In a device including a frame and having a plurality of load elements supported on said frame in a longitudinally extending series and shiftable to predetermined positions relative to each other and to a fixed element positioned at one end of said series, a plurality of motor means each including a first member fixedly secured to said frame and a second member movable relative to said frame and connected one to each of said load elements for shifting the same, control means for said motor means responsive to predetermined signals to actuate one of said motor means to shift the corresponding load elements a predetermined distance longitudinally of said series, and means responsive to and operable upon shifting of any one of said load elements to cause the motor means connected to the load element next adjacent said one load element on the side away from said fixed element to operate and effect movement of said last mentioned load element a distance equal to and in the direction of the movement of the said one load element.

2. In a device having a plurality of load elements mounted in a longitudinally extending series and shiftable to predetermined positions relative to each other and to a fixed element positioned at one end of said series, a plurality of motor means connected one to each of said load elements for shifting the same, and control means for said motor means including means responsive to predetermined signals to actuate a predetermined one of said motor means to shift the corresponding load element a predetermined distance longitudinally of said series, said control means including an actuatable sensor means for each of said load elements for detecting shifting movement of the load element next adjacent thereto on the side toward said fixed element, and means responsive to actuation of said sensor means operable to operate the motor means of the corresponding load element to effect movement of said last mentioned load element a distance equal to and in the direction of the movement of the said load element next adjacent thereto on the side toward said fixed element.

3. In a device including a frame and having a plurality of load elements supported on said frame in a longitudinally extending series and shiftable to predetermined positions relative to each other and to a fixed element positioned at one end of said series, a plurality of cylinders fixedly

mounted on said frame, a piston in each of said cylinders connected one to each of said load elements for shifting the same, control means for said cylinders responsive to predetermined signals to cause movement of any selected one of said pistons to shift the corresponding load element a predetermined distance longitudinally of said series, and means responsive to and operable upon shifting of any one of said load elements to cause the piston connected to the load element next adjacent thereto on the side away from said fixed element to be driven relative to its cylinder and to shift the load element connected to said last mentioned piston a distance equal to and in the direction of the movement of the said one load element.

4. In a power operated device having a pair of load elements shiftable relative to one another and to a fixed element along a predetermined path, said load elements including a first load element and a second load element, said first load element being positioned between said second load element and said fixed element, a pair of reversible motor means connected one to each of said load elements for shifting the same, control means for said motor means including a plurality of operator controlled switches for each motor means selectively operable to move said first load element to any one of a plurality of predetermined positions relative to said fixed element and to move said second load element to any one of a plurality of predetermined positions relative to said first element, and means operative upon shifting of said first load element automatically to shift said second load element an identical amount, said last mentioned means comprising a plurality of pairs of switches mounted in a longitudinally extending series, and operatively connected to one of said load elements for shifting movement therewith, one of the switches of each pair being for the purpose of controlling movement of a load element in one direction and the other switch being for the purpose of controlling movement of such load element in the opposite direction, a switch operating member operatively connected to the other of said load elements for shifting movement therewith and operatively associated with said series of switches to operate the same seriatim as said switches and operating member move relative to one another, and means connecting said switches to said motor means and operable upon operation of one of the switches of each of said pairs upon shifting of said first load element in a predetermined direction to operate the motor means for said second element so as to shift said second load element in the same direction and operable upon operation of the other switch of each of said pairs to operate the motor means for said second load element so as to shift said second load element in the opposite of said predetermined direction.

5. An edger or the like comprising an arbor, a plurality of shiftable circular saws mounted on said arbor and slidable therealong between predetermined operating positions relative to one another and to a fixed element at one end of said series, a plurality of motor means connected one to each of said shiftable saws for shifting the same on said arbor, and control means for said motor means including operator switch means operable to actuate one of said motor means to move a selected one of said shiftable saws a predetermined distance on said arbor, said control means including an actuatable sensor means for each of said shiftable saws for detecting shifting movement of the saw next adjacent thereto on the side toward said fixed element, and means responsive to actuation of said sensor means operable to operate the motor means of the corresponding saw to effect movement of said last mentioned saw a distance equal to the distance of movement of the said saw next adjacent thereto on the side toward said fixed element.

6. An edger or the like comprising an arbor, a base saw mounted on said arbor adjacent one end thereof, a plurality of shiftable circular saws mounted on said arbor and slidable therealong between predetermined operating positions, a plurality of motor means connected one to each of said shiftable saws for shifting the same on said arbor, and control means for said motor means including operator controlled switch means selectively operable to actuate said motor means to move a selected one of said shiftable saws a predetermined distance on said arbor, said control means including an actuatable sensor means for each of said shiftable saws for detecting shifting movement of the saw next adjacent thereto on the side toward the base saw, and means responsive to actuation of said sensor means operable to operate the motor means of the corresponding saw to effect movement of said last mentioned saw a distance equal to the distance of movement of said saw next adjacent thereto on the side toward the base saw.

7. An edger or the like comprising a frame, an arbor, a base saw mounted on said arbor adjacent one end thereof, a plurality of shiftable circular saws mounted on said arbor and slidable therealong between predetermined operating positions, a plurality of saw shifting members each engaging one of said shiftable saws for shifting the same on said arbor, a plurality of cylinders fixedly mounted on said frame and piston means for each cylinder each including a reciprocable piston rod, each of said piston rods being operatively connected to a separate one of said saw shifting members, a source of actuating fluid, a plurality of valve means operable for controlling the flow of actuating fluid from said source to said cylinders to effect movement of said piston rods, and control means for said valve means including a plurality of operator controlled switches for each saw selectively operable to move a shiftable saw a predetermined distance on said arbor, and means operatively connected to said valve control means operable upon shifting of a given saw to operate the cylinders and pistons of each of the saws more remote from said base saw to shift such more remote saws a corresponding distance so as to maintain the same spacing between such remote saws as was present prior to the shifting of said given saw.

8. An edger or the like comprising an arbor, a base saw mounted on said arbor adjacent one end thereof, a plurality of shiftable circular saws mounted on said arbor and slidable therealong between predetermined operating positions, a plurality of cylinder and piston means operatively connected one to each of said shiftable saws for shifting the same on said arbor, a source of actuating fluid, a plurality of valve means operable for controlling the flow of actuating fluid from said source to said cylinder and piston means to effect movement of said shiftable saws, and control means for said valves including operator controlled switch means for each saw selectively operable to move a shiftable saw a predetermined distance on said arbor, said control means including an actutable sensor means for each of said shiftable saws for detecting shifting movement of the saw next adjacent thereto on the side toward said base saw and means responsive to actuation of said sensor means operable to operate the said valve means of the cylinder and piston means for the corresponding saw to effect movement of said corresponding saw a distance equal to and in the direction of the movement of the said saw next adjacent thereto on the side toward the base saw.

9. An edger or the like comprising an arbor, a base saw mounted on said arbor adjacent one end thereof, a plurality of shiftable circular saws mounted on said arbor and slidable therealong between predetermined operating positions, a plurality of saw shifting members each engaging one of said shiftable saws for shifting the same on said arbor, a plurality of cylinder and piston means each including a reciprocable piston rod, each of said piston rods being operatively connected to a separate one of said saw shifting members, a source of actuating fluid, a plurality of valve means operable for controlling the flow of actuating fluid from said source to said cylinders to effect movement of said piston rods, and control means

for said valve means including a plurality of operator controlled switches for each saw selectively operable to move a shiftable saw a predetermined distance on said arbor, said control means including actuatable sensor means for each of said shiftable saws for detecting shifting movement of the saw next adjacent thereto on the side toward said base saw, and means responsible to actuation of said sensor means operable to operate the said valve means of the cylinder for the corresponding saw to effect movement of the piston thereof and said corresponding saw a distance equal to and in the direction of the movement of the said saw next adjacent thereto on the side toward the base saw.

10. An edger or the like comprising an arbor, a base saw mounted on said arbor adjacent one end thereof, a pair of shiftable circular saws mounted on said arbor and slidable therealong including a first saw and a second saw, said first saw being mounted between said second saw and said base saw, a pair of reversible motor means connected one to each of said shiftable saws for shifting the same on said arbor, control means for said motor means including a plurality of operator controlled switches for each motor means selectively operable to move said first saw to any one of a plurality of predetermined positions relative to said base saw and to move said second saw to any one of a plurality of predetermined positions relative to said first saw, and means operative upon shifting of said first saw automatically to shift said second saw an identical amount, said last mentioned means comprising a plurality of pairs of switches mounted in a longitudinally extending series, and operatively connected to one of said shiftable saws for shifting movement therewith, one of the switches of each pair being for the purpose of controlling movement of a load element in one direction and the other switch being for the purpose of controlling movement of such load element in the opposite direction, a switch operating member operatively connected to the other of said shiftable saws for shifting movement therewith and operatively associated with said series of switches to operate the same seriatim as said switches and operating member move relative to one another, and means connecting said switches to said motor means and operable upon operation of one of the switches of each of said pairs upon shifting of said first saw in a predetermined direction to operate the motor means for said second saw so as to shift said second saw in the same direction and operable upon operation of the other switch of each of said pairs to operate the motor means for said second saw so as to shift said second saw in the opposite of said predetermined direction.

11. An edger or the like comprising an arbor, a base saw mounted on said arbor adjacent one end thereof, a pair of shiftable circular saws mounted on said arbor and slidable therealong including a first saw and a second saw, said first saw being mounted between said second saw and said base saw, means for shifting said shiftable saws on said arbor including a pair of cylinder and piston means each including a reciprocable piston rod, each of said piston rods being operatively connected to a separate one of said saws, a source of actuating fluid, valve means operable for controlling the flow of actuating fluid from said source to said cylinders to effect movement of said piston rods, and control means for said valves including a plurality of operator controlled switches for each saw selectively operable to move said first saw to any one of a plurality of predetermined positions relative to said base saw and to move said second saw to any one of a plurality of predetermined positions relative to said first saw, and means operative upon shifting of said first saw automatically to shift said second saw an identical amount, said last mentioned means comprising a plurality of pairs of switches mounted in a longitudinally extending series, and operatively connected to one of said shiftable saws for shifting movement therewith, one of the switches of each pair being for the purpose of controlling movement of a load element in one direction and the other switch being for the purpose of controlling movement of such load element in the opposite direction, a switch operating member operatively connected to the other of said shiftable saws for shifting movement therewith and operatively associated with said series of switches to operate the same seriatim as said switches and operating member move relative to one another, and means connecting said switches to said valve control means and operable upon operation of one of the switches of each of said pairs upon shifting of said first saw upon said arbor in a predetermined direction to supply fluid to the cylinder of said second saw so as to shift said second saw in the same direction and operable upon operation of the other switch of each of said pairs to supply fluid to the cylinder of said second saw so as to shift said second saw in the opposite of said predetermined direction.

12. An edger or the like comprising an arbor, a base saw mounted on said arbor adjacent one end thereof, a pair of shiftable circular saws mounted on said arbor and slidable therealong including a first saw and a second saw, said first saw being mounted between said second saw and said base saw, means for shifting said shiftable saws on said arbor including a pair of cylinder and piston means each including a reciprocable piston rod, each of said piston rods being operatively connected to a separate one of said saws, a source of actuating fluid, valve means operable for controlling the flow of actuating fluid from said source to said cylinders to effect movement of said piston rods, control means for said valves including a plurality of operator controlled switches for each saw selectively operable to move said first saw to any one of a plurality of predetermined positions relative to said base saw and to move said second saw to any one of a plurality of predetermined positions relative to said first saw, and means operative upon shifting of said first saw automatically to shift said second saw an identical amount, said last mentioned means comprising a plurality of pairs of switches mounted in a longitudinally extending series and operatively connected to said first saw for shifting movement therewith, one of the switches of each pair being for the purpose of controlling movement of a load element in one direction and the other switch being for the purpose of controlling movement of such load element in the opposite direction, and means operatively associated with said series of switches to operate the same seriatim as said switches and operating member move relative to one another, and means connecting said switches to said valve control means and operable upon operation of one of the switches of each of said pairs upon shifting of said first saw upon said arbor in a predetermined direction to supply fluid to the cylinder of said second saw so as to shift said second saw in the same direction and operable upon operation of the other switch of each of said pairs to supply fluid to the cylinder of said second saw so as to shift said second saw in the opposite of said predetermined direction.

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