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PUSH BUTTON ELECTRO-PNEUMATIC NETWORKS FOR SAWMILL

Filed July 10, 1950

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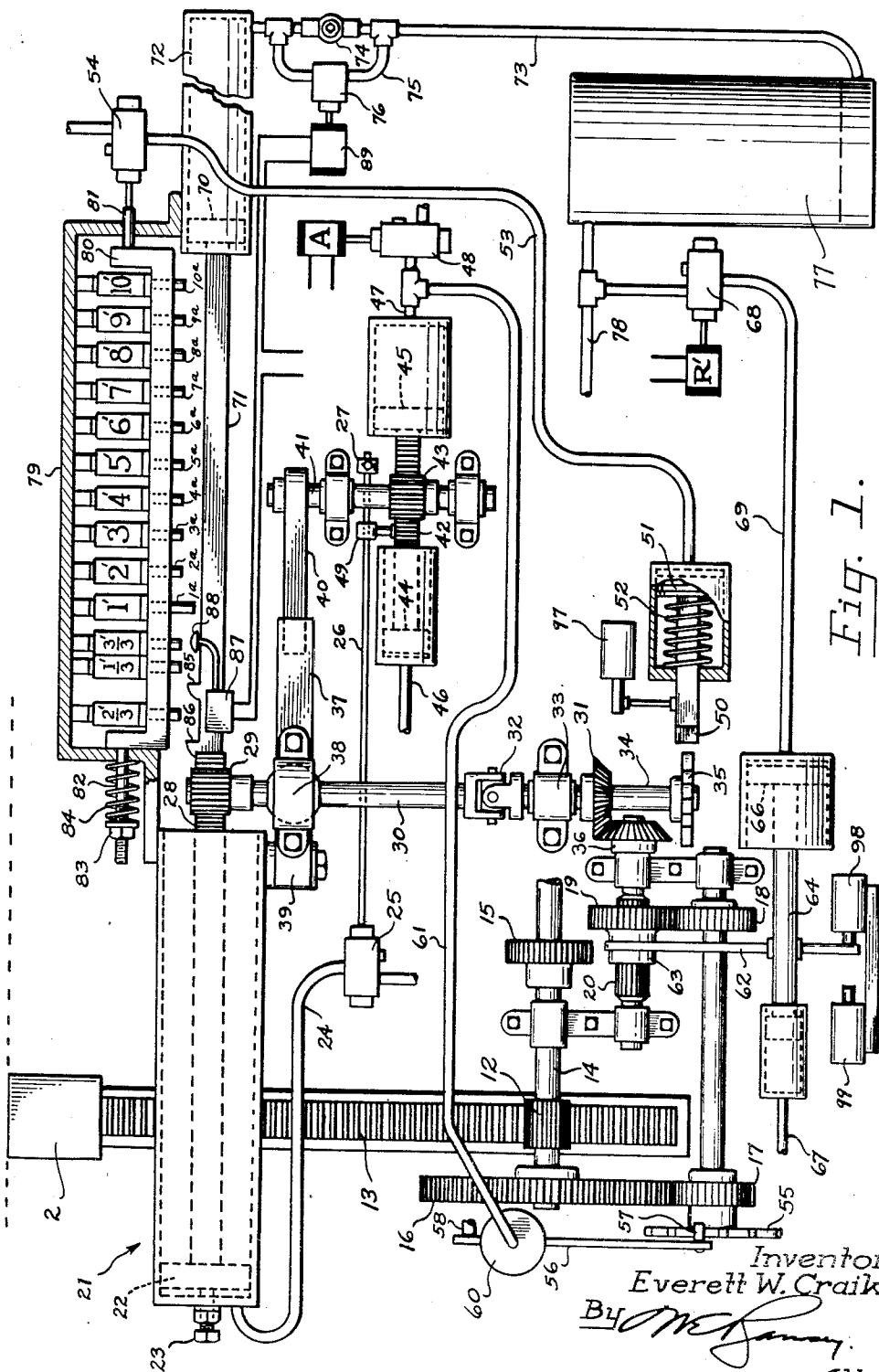


Fig. 1.

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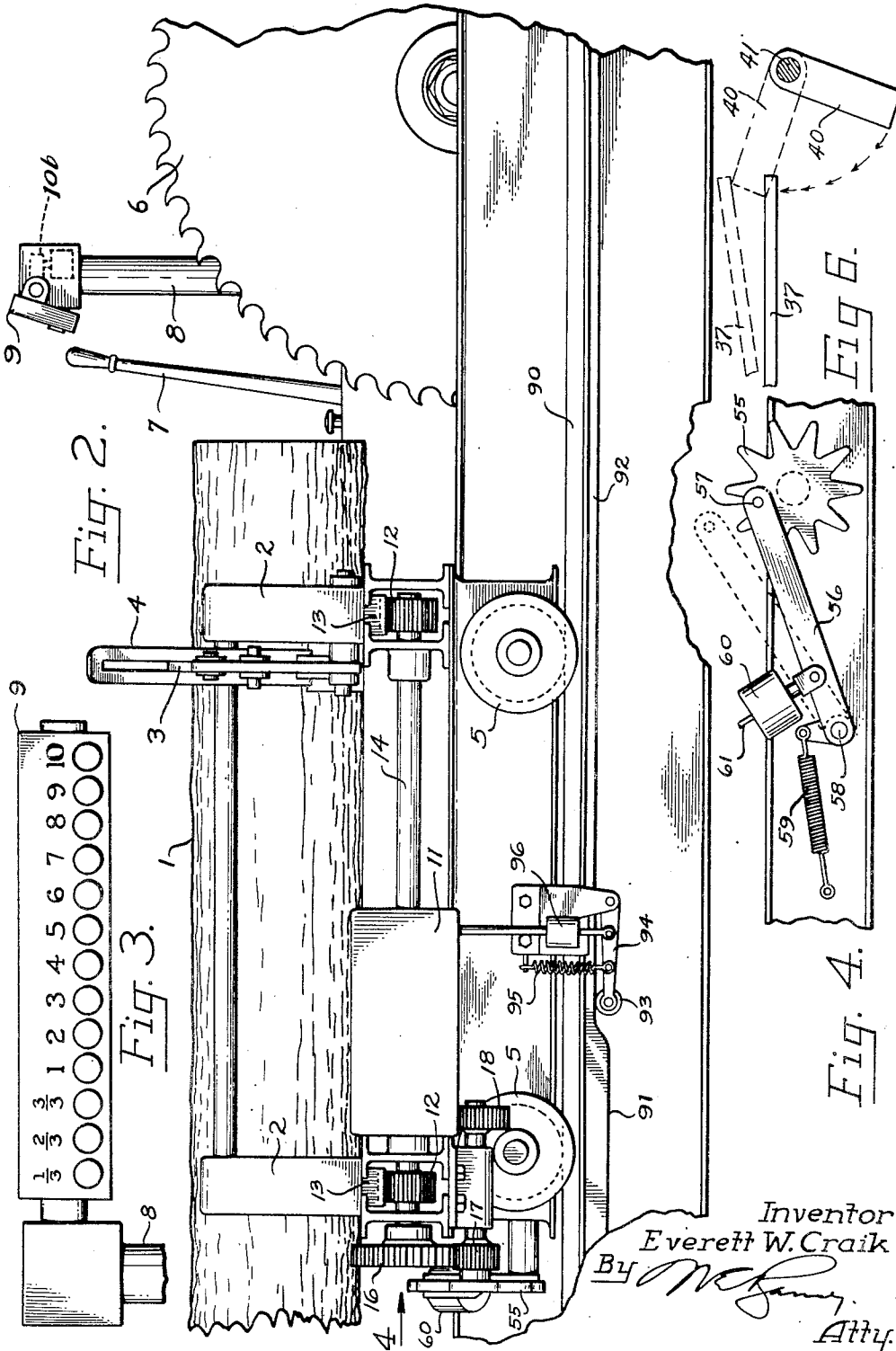
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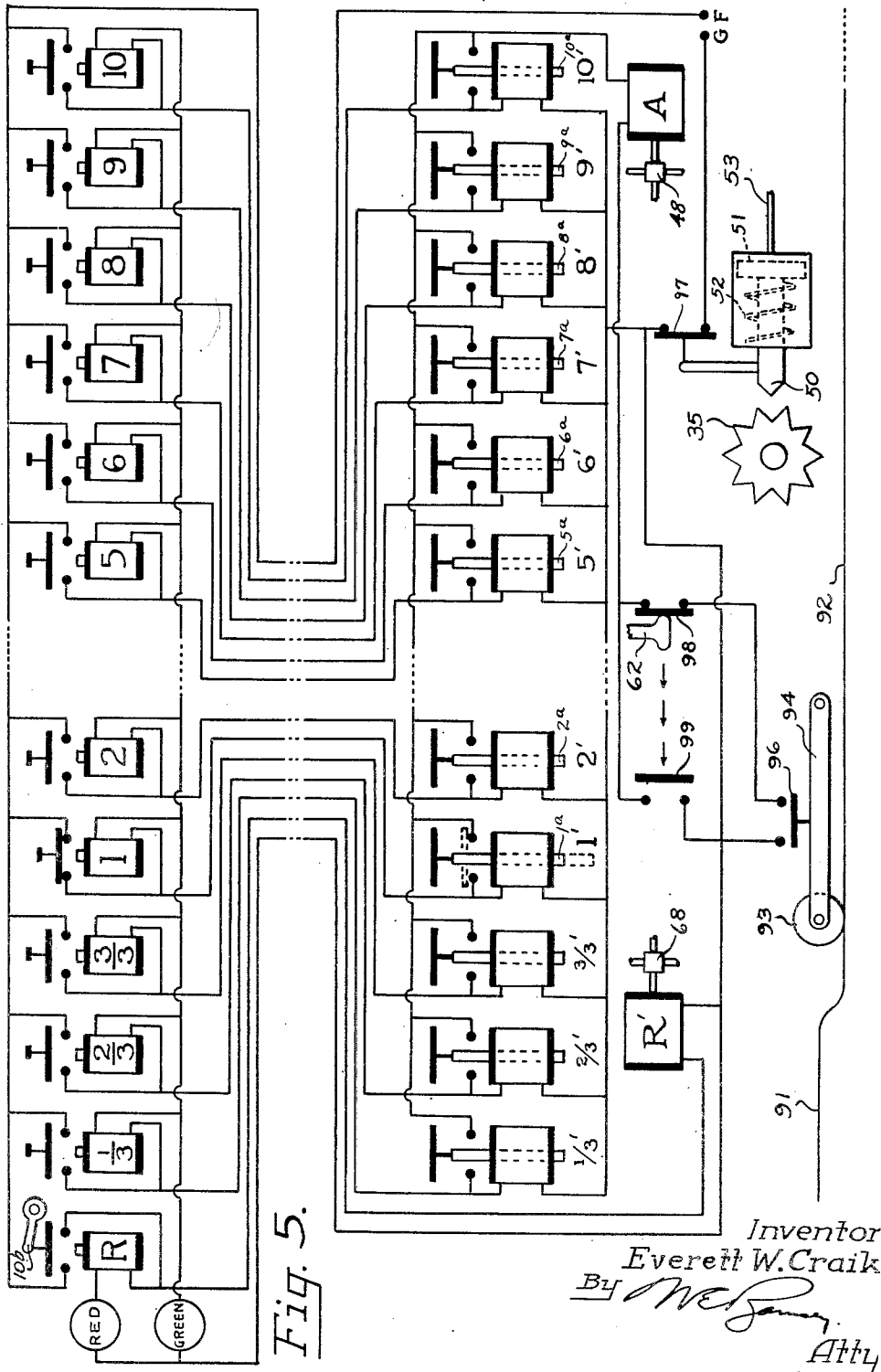
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PUSH BUTTON ELECTRO-PNEUMATIC NETWORKS FOR SAWMILL

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20 Claims. (Cl. 143—118)

This invention relates to a networks for a sawmill carriage wherein the lateral travel of the knees is controlled by an electromagnetic push button circuit and is actuated by an electropneumatic drive.

One object of my invention is to provide a networks for a sawmill carriage in which an electromagnetic push button control circuit initiates the lateral knee travel, slows the travel velocity as the terminus is approached, and stops the knees in a preselected sawing position, sequentially, automatically, and exactly, after the mere touch of a single push button by the sawyer.

A networks for a sawmill carriage is a coordinated driving adjustment, and control system by which the setting movements of a massive log, supported on the carriage, are effected. Thus, the conventional networks is designed to shift a log laterally a distance corresponding to the thickness of the board to be cut. Such a shift is made after each successive swing past the cutting saw. Two or more knees are mounted to travel with the carriage and effect the shift. The setting movements thereof are controlled, conventionally, by an indexing rotary set shaft.

When a log which is to be cut into rough boards has been pulled from a sawmill pond, it is positioned against the knees on the carriage and is held in place, securely, by one or more dogs. Thereafter, the networks is adjusted and, in response thereto, a power drive mechanism positions the log laterally relative to the cutting saw by movement of the knees so a portion of the log overlies the far side of the carriage. The entire carriage is then moved past the high speed saw and the overlying portion of the log is cut off. Thereafter, the carriage is returned, the lateral position of the knees and the log readjusted, and another cut is made. The initial cuts of a rough log produce nothing but slab wood to be used as fuel. Successive cuts, however, produce rough boards.

The Pacific Northwest, which produces more lumber than any other region, employs thousands of men and hundreds of networks to produce rough boards. Many of the conventional networks so employed, however, are possessed of certain inherent disadvantages. Thus, because of the great size and weight of a log, the conventional sawmill carriage is a massive mechanism driven by a powerful air, steam, or mechanical electric carriage drive. The movements of this massive mechanism are controlled by means of a networks selectively actuated by a skilled sawyer. With such a mechanism, the sawyer experiences an inherent difficulty in obtaining that nicety of control which is desired in the accurate advance of the massive log into successive sawing positions. Consequently, the thickness of the rough board sawed from the log is apt to vary considerably from the intended thickness to which the networks control is set by the sawyer. This results in a considerable wastage and slows the output of the sawmill since the overthick boards must subsequently be reduced to the proper dimension. Many sawmills, to insure that the rough boards will be of a thickness sufficient to dress to a standard dimension,

intentionally cut the boards considerably thicker than is necessary. Such a practice does not produce a maximum footage from a log and is highly wasteful of this most valuable natural resource.

The networks now employed in many Pacific Northwest sawmills may be accurately described as glorified hangovers from the 19th century manual power sawmill networks. This is so since they employ a huge rotary operating shaft with its intricate indexing system to adjust the lateral position of the log. This rotary shaft looks and operates like an old time street car motorman's operating handle and shaft. Originally, it was well adapted to the manual operation of a networks. Today, however, there is no logical reason for its retention. The networks of my invention replaces this historic rotary operating shaft with a simple push button control panel. Furthermore, the improved sequential locking mechanism of my invention is instrumental in reducing the wastage produced by the inaccuracies inherent in these conventional networks.

One object of my invention is to provide a sequential, rough and final, pneumatic locking means for arresting the lateral motion of the knees on a sawmill carriage drive and providing against a slack in the gear train thereof whereby the thickness of a given cut may be controlled accurately by the sawyer.

Another object of my invention is to provide a networks for a sawmill in which an electromagnetic push button circuit controls an electromechanical engaging means for arresting the motion of the drive for the knees in a preselected position thus obviating the necessity for a conventional rotary networks operating shaft.

A further object of my invention is to provide a networks for a sawmill carriage wherein a hydraulic recoil means bears on the drive for the knees to slow the lateral movement of the knees a predetermined distance in advance of the selected sawing position whereby the knees may be eased into an accurate and exact final position.

Yet another object of my invention is to provide a networks for a sawmill carriage wherein an automatic damping means is operatively connected with the drive for the knees to slow, stop, rough lock, and final lock the drive and knees, sequentially, into a predetermined sawing position.

One other object of my invention is to provide an interconnected pneumatic drive and gearing mechanism for a sawmill carriage whereby the movement of the knees is initiated a predetermined time lag after a pneumatic lifting means pivots the gearing into initial driving engagement and whereby the movement of the knees is terminated at substantially the same time the pneumatic lifting means pivots the gearing into final disengagement.

These and other objects and advantages of my invention will be set forth with reference to the drawings, in which:

Fig. 1 is a schematic diagram showing the relative operating positions of the structural elements of my sawmill networks with the gears therefore arranged for forward movement;

Fig. 2 is a foreshortened side view, partially broken away, showing a log in position against the knees on the carriage;

Fig. 3 is a detail view showing the electromagnetic push button control panel for my networks;

Fig. 4 is a detail end view, looking in the direction of arrow 4 in Fig. 2, showing the final lock star wheel for locking the knees in an exact position;

Fig. 5 is a schematic wiring diagram for the electromagnetic push button circuit controlling the movements of the networks; and

Fig. 6 is a diagrammatic detail, illustrating by movement arrows and by full and dashed lines, the sequential

movements of the machine elements provided to effect disengagement of a rack and pinion portion of my drive mechanism.

In Fig. 2, I have indicated a log 1 resting against two knees 2 on a sawmill carriage. The log is held in place by means of a dog 3 which is mounted in a guide 4. As with a conventional sawmill, the log 1 overlies the far side of the carriage and, as the carriage moves to the right on the wheels 5, a high speed saw 6 will cut a rough board therefrom. This longitudinal movement and cutting operation are controlled by a lever 7 but form no part of my invention. Thus, the networks of my invention may be used with any conventional saw and longitudinal carriage drive mechanism.

On the far side of the sawmill carriage, adjacent the place where a sawyer stands, I mount a tubular stand 8 which carries the push button control panel for my networks. This control panel 9 is pivoted to the upper portion of the stand 8 and is operatively joined to a reverse tilt switch 10b (see the dashed outline in Fig. 2). The front of the control panel 9 carries a series of push buttons as shown in Fig. 3 and each such button is wired to an electric circuit to be hereinafter described. The numbering above the push buttons identifies the inches of lateral movement which each push button controls. Thus, to feed a log toward the saw 6, the sawyer pushes a button corresponding to the thickness of the rough board desired and, to reverse the movement as when a new log is placed in position, the sawyer tilts the entire control panel 9 to actuate the reverse tilt switch 10b.

To drive the knees and thus to move the log into successive sawing positions, I prefer to employ a pneumatic drive such as is shown in Fig. 1. Such a drive is not only practical since most sawmills are equipped with compressed air lines, but it is the safest type of power supply. Thus, should the driving gears of the networks become jammed accidentally, the pneumatic drive stops since it does not possess enough power to break a gear tooth or snap a shaft.

In order to correlate the view shown in Fig. 1 with that shown in Fig. 2, it should be pointed out that a majority of the mechanism shown in Fig. 1 is enclosed within the gear box 11 of Fig. 2. Thus, the lateral movement of the log 1 is effected by means of a pair of pinions 12 geared to a pair of co-operating racks 13 to which the knees 2 are joined. The pinions 12 are keyed to a journaled shaft or set shaft 14 which is driven by either a reversing gear 15 or a 3:1 reduction gear train 16, 17, 18. Thus, it is the set shaft 14 which controls movement of the knees 2. The reversing gear 15 and forward drive gear 18 are engaged, selectively, by the main drive gear 19 which is mounted to shift from right to left on the elongate toothed gear shaft 20. The gear 16 has three times as many teeth as does the gear 15 so the rack 13 will travel three times as fast in reverse as it does going forward.

The pneumatic drive for the carriage originates with an expansible chamber air motor 21 having a piston 22 and an adjustable stop 23. Air is admitted to and exhausted from the motor chamber through an air line 24 controlled by a spring-biased motor control valve 25. This valve 25 is biased to exhaust position and is moved to the supply position by means of an elongated control rod 26 having an adjustable catch 27 on the terminal end thereof. The piston 22 drives a rack 28 which, when in the operative position, engages a pinion 29 to rotate the journaled shaft 30. The shaft 30, in turn rotates a bevel gear 31 through a universal joint 32 and journal 33. Bevel gear 31 is made integral with a jack shaft 34 carrying a star wheel 35 and is arranged to engage a second bevel gear 36. It is this second bevel gear 36 which rotates the gear shaft 20 to

drive the knees of the sawmill carriage into successive sawing positions.

A universal joint 32 is a necessary element of the shaft 30 because the latter must reciprocate or pivot to disengage the pinion 29 and rack 28 when the piston 22 is to be returned to the position shown in Fig. 1. Reciprocation is effected by means of a lever 37 and journal 38 which are mounted to pivot on a rocker arm 39. Thus, when the lever 37 is lifted, the pinion 29 and rack 28 are disengaged and, when the lever 37 is lowered, as by a gravity bias, the pinion and rack are engaged. The lever 37 is raised by means of a cam 40 (see Fig. 6) which rotates with a journaled shaft 41 driven by a rack 42 and pinion 43. The terminal ends of the rack 42 are made integral with a small piston 44 and a large piston 45. Each of these pistons is an element of an expansible chamber pneumatic motor controlled from the air lines 46 and 47 respectively. The air line 46 is connected to a source of constant air pressure but the air line 47 is controlled by a motor valve 48. Therefore, when the motor valve 48 admits air behind the piston 45, the rack 42 moves to the left and the cam 40 lifts the lever 37 to disengage the pinion 29 from the rack 28. Conversely, when the motor valve 48 exhausts air from behind the piston 45, the constant air pressure against the piston 44 moves the rack 42 to the right and the pinion 29 is lowered into operative engagement with the rack 28.

The rack 42 also carries a pierced engagement member 49 for co-operation with the previously mentioned adjustable catch 27. These two elements constitute a time lag means for initiating movement of the air motor 21. Thus, when the motor valve 48 is opened to exhaust and the rack 42 moves to the right to lower the pinion 29 into engagement, the pierced member 49 also moves to the right, yet it does not immediately contact the catch 27. Instead, a predetermined time lag takes place dependent upon the position to which the catch 27 is adjusted. After this time lag, the pierced member 49 moves the catch 27 and the control rod 26 to the right and the motor control valve 25 allows air to flow through the line 24 to initiate movement of the air motor 21. On the other hand, since the motor control valve is biased to the exhaust position, the control rod 26 is allowed to return to its initial position simultaneously with the disengagement of the pinion 29 and rack 28.

Turning now to the sequential rough and final locking means for my networks, it will be noted that the jack shaft 34 carries an integral star wheel 35. This star wheel 35 co-operates with a wedge 50 driven by a pneumatic piston 51 and biased out of engagement by a compression spring 52. Air is supplied to and exhausted from the space behind the piston 51 through an air line 53 controlled by a motor valve 54. When the motor valve 54 is opened to the supply position, the piston 51 moves to the left and the wedge 50 enters a valley in the star wheel 35 to rough lock the shaft 30 and the knees in position.

Adjacent the small gear 17 and mounted for rotation therewith, I prefer to locate a second or final lock star wheel 55. As best shown in Fig. 4, an arm 56 and tooth-engaging member 57 are pivoted at 58 to cooperate therewith. The arm 56 is biased to disengagement by a tension spring 59 and is actuated by a pneumatic motor 60. Air is fed to the pneumatic motor 60 through the air line 61 which is controlled by the aforementioned motor valve 48. The small gear 17 and the final lock star wheel 55 rotate with the movement of the racks 13 whether the knees of the sawmill carriage are moving forward or in reverse. The same is true of the star wheel 35. This is necessary since it is these two star wheels which comprise a positive locking means for jockeying or easing the knees of the sawmill carriage into a rough and a final position, sequentially. Thus, as will be hereinafter set forth, the

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engagement of the wedge 50 with the star wheel 35 takes place prior to the engagement of the member 57 with the star wheel 55.

The main drive for the knees is shifted from forward to reverse and back again by means of a bifurcated or pierced shifting lever 62 which engages a collar 63 made integral with the main drive gear 19. The movement of the shifting lever is controlled by a rod 64 carrying a small air motor piston 65 and a large air motor piston 66 on the terminal ends thereof, respectively. The small piston 65 is fed by a constant pressure air supply through the line 67 and the large piston 66 is controlled by a motor valve 68 through the air line 69. Thus, when the motor valve 68 is opened to exhaust, the rod 64 and the shifting lever 62 are moved to the right by means of the small piston 65. In this position, the knees of the sawmill carriage will move forward to expose more area of the log to the rotary saw 6. On the other hand, when the motor valve 68 is moved to supply air to the large piston 66, the rod 64 and the shifting lever 62 are moved to the left to engage the reversing gear 15 with the main gear drive 19 and the knees of the sawmill carriage return, at a three-fold speed, to the desired position.

In order to return the air motor 21 to the position of Fig. 1 after each successive setting operation, I have connected the piston 70 of a hydraulic recoil mechanism to the rack 28 by means of an elongated bar 71. Oil is supplied to the cylinder 72 of the hydraulic recoil mechanism through a line 73 having an adjustable bleed valve 74 and a parallel line 75 controlled by the valve 76. The oil in the reservoir 77 is kept under a constant pressure by air supplied thereto through the line 78. Since the hydraulic piston 70 is smaller in area than the pneumatic piston 22 and since the air pressure in 77 is the same as that behind 22, the small piston 70 slows but cannot stop the movement of the large piston 22. However, when the motor control valve 25 is opened to exhaust, the air pressure above the fluid in the oil reservoir 77 pushes the fluid through the line 73 and the hydraulic piston 70 returns the air motor 21 to the position shown in Fig. 1. The control valve 76 is of utility in regulating the velocity of the air piston 22. Thus, while the piston 22 is moving to the right with the control valve 76 open, the carriage moves at a relatively high velocity. When the control valve 76 is closed, however, the oil from the cylinder 72 must flow past the bleeder valve 74 and such flow is considerably restricted. This restriction slows the movement of the piston 70, bar 71, and piston 22. In effect, this makes the air motor 21 a two-speed motor.

Referring now to Figs. 3 and 5, a comparison thereof will show that each of the push buttons on the control panel 9 is represented by a corresponding push button and electromagnetic solenoid in the electric circuit of Fig. 5. Similarly, the reverse tilt switch 10b, which is actuated by a rotation of the entire control panel 9, is represented by a reverse solenoid R. The feed connection and feed line F supply the electric circuit and the ground connection and ground line G ground the circuit of Fig. 5. Furthermore, each of the numbered push buttons is in series with an electromagnetic relay carrying a corresponding number to which a prime mark is added. Thus, by way of example, when the push button 1 is depressed, the solenoid 1 holds the push button 1 depressed and the circuit is completed through the electromagnetic relay 1' to move the armature 1a down into the dashed line position of Fig. 5. Each of these relays and armatures, such as 1a, is shown enclosed within the box 79 in Fig. 1 to form an electromechanical engagement means. Thus, when push button number 1 is depressed, the armature 1a protrudes below the level of the other armatures in box 79 as shown in Fig. 1.

The enclosing box 79 is secured (by means not shown), to the frame of the sawmill networks so as to remain immovable with respect thereto. The numbered solenoid relays, however, rest on a slidable U-shaped carrier 80

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for movement therewith (see Fig. 1). The carrier 80, in turn, is suspended on two journal rods 81 and 82 which slide in a pair of aligned holes pierced through the walls of the box 79. The journal rod 82 terminates in a threaded portion which accommodates a nut and washer 83 whereby a compression spring 84 may be mounted to bias the carrier 80 to the left. The journal rod 81 is, in effect, the control rod for the motor valve 54. Thus, the compression spring 84 is also a bias for the motor valve 54 and this bias is overcome by a movement of the carrier 80 to the right.

The elongated bar 71, previously described, has, integral therewith, two abutment ears 85 and 86 which move with the elongated bar 71 and air motor piston 22 to engage whichever one of the armatures 1a, 2a, etc., is depressed. Thus, since each of the armatures slides through a hole in the U-shaped carrier 80, the engagement of an abutment ear, such as 85, with an armature, such as 1a, moves the entire U-shaped carrier and all of the relays to the right against the force of the compression spring 84 and opens the motor valve 54 to the supply position. Thereafter, the carrier 80 is stopped by the engagement thereof with the end of the box 79 and this forces the piston 22 to stop. Just prior to this stop, however, air is supplied to the pneumatic piston 51, via the air line 53, to move the wedge 50 into engagement with the star wheel 35 and rough lock the sawmill carriage in an approximate position.

In conjunction with the movement of the elongated bar 71 and the U-shaped carrier 80, I have provided a means for actuating the control valve 76 to slow the velocity of the air motor 21 prior to the engagement of the abutment ear 85 with one of the relay armatures. This means includes a mushroom feeler switch 87 actuated by a contact 88 to trip the control valve 76 by means of the solenoid 89. The mushroom feeler switch 87 is secured to and travels with the elongated bar 71 and the air motor piston 22. The contact button 88 is placed somewhat in advance of the abutment ear 85. Thus, when the contact button 88 engages one of the relay armatures, as for example armature 1a, the button 88 slides thereunder and trips the switch 87 to close the control valve 76 through the solenoid. As previously set forth, the closing of the control valve 76 forces the oil which is escaping from the cylinder 72 to bleed through the restricted valve 74. Thus, the movement of the piston 70 to the right is slowed a short time before the abutment ear 85 actually engages one of the relay armatures.

In Fig. 5, each of the relay solenoids or electromagnets has been arranged from left to right in an increasing numerical order, yet in Fig. 1, relay 2 1/3' is to the left of relay 1 1/3'. This apparent discrepancy is explained by the fact that Fig. 1 represents the actual physical arrangement of the relays whereas Fig. 5 is a mere symbolized diagram illustrating the electrical connections. As was previously set forth, the numerals on each push button and on each relay refer to inches and are related to the lateral movement of the knees and the log. Furthermore, each of the whole numbers includes an undivided additional fraction of an inch to allow for the thickness of the saw kerf. For example, a depression of push button 1 advances the knees and the log one inch plus the thickness of the saw kerf so the board cut from the log will be exactly one inch thick. The fractional inch buttons and relays, however, do not allow for the saw kerf. Thus, if a mere trim is desired, the sawyer may depress the 1/3 push button and the rotary saw 6, which is 1/3 inch thick in the installation illustrated, will not saw a board but will merely produce sawdust and trim the log the thickness of the saw kerf itself. Similarly, when the 2/3 button is depressed, the saw will cut a board 1/3 inch thick and produce sawdust of the other 1/3. When the 3/3 button is depressed, the saw will produce a board 2/3 inch thick. A relay itself, however, is more than 1/3 inch thick so two abutment ears 85 and 86 must

be formed on the elongated bar 71. The abutment ear 86 is employed to contact the $\frac{3}{4}$ ' relay armature only, whereas the abutment ear 85 is employed to contact the other armatures. This explains the sequential arrangement of the relays which is shown in Fig. 1.

Comparing the diagram of Fig. 5 and the side view of Fig. 2, it will be seen that the track 90 for the carriage wheels 5 carries a cam on the under surface thereof. This cam has a high face 91 and a low face 92 for co-operation with a follower wheel 93. The follower wheel 93 is held against the cam by means of a tension spring 95 secured to a pivotable arm 94. This arm 94 makes and breaks a safety switch 96 as the follower wheel 93 rides on the high and low faces of the cam, respectively. Thus, as shown in the electrical schematic diagram of Fig. 5 where the switch 96 is represented by its electrical function which is a reverse of the physical structure in Fig. 2, the safety switch 96 is in series with the solenoid A which controls the motor valve 48. When the follower wheel 93 rides on the low face 92 of the cam, the solenoid A cannot function so the pinion 29 and rack 28 must remain disengaged at all times while the sawmill carriage is making a swing past the rotary saw 6.

My networks includes two other safety features. The first of these is employed in conjunction with the shifting lever 62. A comparison of Figs. 1 and 5 reveals that the end of the shifting lever 62 is engageable selectively with two reversing switches 98 and 99. These reversing switches are biased open, but are moved to the closed or make position by the shifting lever 62. Thus, whenever the shifting lever 62 is in transit between the forward and reverse positions, both reversing switches 98 and 99 are open to prevent damage to the other elements of the networks. In a similar manner, I have secured a contact arm of a ground break safety switch 97 to the pneumatic wedge 50. This switch 97 breaks the ground line G whenever the wedge 50 moves to engage the star wheel 35. Thus, the entire electric circuit is broken and the parts thereof return to their original position while the sawmill carriage is rough locked by the wedge 50. The return movement of the circuit elements is made possible by a conventional spring bias incorporated within the housing of each push button and each relay armature.

In the forward operation of my networks, let it be assumed that a massive log has been placed in position on the carriage against the knees 2. The sawyer's first cut conventionally produces a slab. If this cut is to be one inch thick, the sawyer will depress the push button 1 on the control panel 9 to rotate the set shaft 14 and to move the knees and the log one inch, plus the width of the saw kerf, laterally. As shown in Fig. 5, depression of the push button 1 establishes the circuit from the feed line F across the push button 1 contacts, through the holding solenoid 1, through the green light, and back to the ground line across the ground break switch 97. At the same time, current will flow across the push button 1 contacts to the relay 1' and back to the ground line G across the same switch 97. As the relay 1' is actuated, the armature 1a is depressed and the relay contacts are bridged by the movable switch carried by the top of the armature 1a. Thus, the armature 1a is lowered (see the dashed line position in Fig. 5 and the full line position in Fig. 1) and the relay contacts establish a second circuit which includes the solenoid A controlling the motor valve 48. The circuit through the solenoid A is completed via the reversing switch 98, which is closed, and safety switch 96 which is also closed since the sawmill carriage has not yet moved longitudinally. Movement of the motor valve 48 to exhaust position lowers the pressure in the lines 47 and 61. Since the star wheel tooth-engaging member 57 (see Fig. 4) is biased out of engagement and into the dashed line position by the tension spring 59, the reduced air pressure in the line 61 allows the tension spring 59 to act and free the final lock star wheel 55 for

movement. At the same time, the reduced air pressure in the line 47 allows the constant air pressure in the line 46 to move the small piston 44 and large piston 45 to the right as seen in Fig. 1. This movement slides the rack 42 to the right and rotates the pinion 43. The cam 40 is thereby rotated to lower the lever 37 and cause the pinion 29 to engage the rack 28.

After the above described sequence of operation, a time lag takes place while the pierced engagement member 49 continues to slide over the elongate control rod 26. When the member 49 engages the adjustable catch 27, the control rod 26 is moved to the right and the motor valve 25 is opened to supply. Air pressure then is supplied to the air motor 21 behind the piston 22 to drive the rack 28 to the right, rotate the shaft 30, and, through the forward gear train, begin the high speed phase of the lateral shift of the sawmill carriage. The movement of the rack 28 to the right carries with it the elongate bar 71, the abutment ear 85, and the contact button 88. As the contact button 88 passes under and is depressed by the armature 1a, the mushroom feeler switch 87 makes the circuit to the solenoid 89 which causes the control valve 76 to close and inhibit the exhaust of oil from the hydraulic recoil cylinder 72. Thus, the movement of the air motor is slowed somewhat but is not stopped. Thereafter, the abutment ear 85 engages the armature 1a and the carrier 80 is moved to the right against the force of the compression spring 84 to move the motor valve 54 to the supply position. The driving movement of the air motor 21 is stopped when the carrier 80 comes into contact with the end of the box 79. At substantially the same instant, the air pressure which is fed to the pneumatic piston 51 through the air line 53 causes the wedge 50 to engage the star wheel 35. This engagement of the wedge and star wheel 50, 35, locks the sawmill carriage and gear train in an approximate or rough position. I have termed this position the "rough lock" position since a small amount of slack or play may still exist in the gear train between the locked bevel gear 31 and the final racks 13. It is the function of the second star wheel 55 to take up the rest of this slack and position the sawmill carriage exactly and accurately. I therefore term the star wheel 55 the "final lock" star wheel.

Returning now to Fig. 5, the engagement of the wedge 50 with the star wheel 35 breaks the ground circuit G at the switch 97. This break is three-fold in its action. (1) The holding solenoid 1 is de-energized to allow the push button 1 to spring back into position. (2) The relay 1' is de-energized so the abutment armature 1a, which is spring biased to an up position, moves up out of engagement with the ear 85. (3) The circuit through the solenoid A is broken and the tooth-engaging member 57 final locks the sawmill carriage with the star wheel 55. This same sequence of operation causes the green light (see Fig. 5) to go out and the sawyer is thereby informed that he may move the lever 7 to swing the log past the saw 6 and cut the slab wood. The function of the ground break switch 97 can thus be described as two-fold. It is a safety switch as well as a reset switch since the push button, holding solenoid, and relay all are returned to their initial positions as the switch 97 is broken.

The successive swings of the sawmill carriage past the saw should be correlated to the lateral or setting movements of the knees and the log so each successive set will be additive or cumulative. That is to say, in the sequence of operation under discussion, the sawyer does not want the networks to reverse and return to its initial position after each swing but rather wants to advance the log, by successive steps, one or more inches to cut the next boards. Thus, some means must be provided for holding and locking the knees 2, the rack 13, the set shaft 14, and the forward gear train in position while the air motor 21 is returned to the position shown in Fig. 1. In the networks of my invention, this means is provided by a pneumatic drive engaging mechanism actuated through the

ground break switch 97. It will be remembered that the motor valve 48 is biased to a supply position. Therefore, when the ground break switch de-energizes the solenoid A, the motor valve 48 returns to the supply position to feed air to the lines 47 and 61. This supply of air has a dual function in that it disengages the pinion 29 from the rack 28 and engages the member 57 with the final lock star wheel 55 to hold the knees and rack while the pneumatic drive is reset. Furthermore, the final lock of the star wheel 55 positions the sawmill carriage accurately and exactly so as to negative any slack in the gear train 18, 19, 36. It is sequential with and takes place after the rough lock action of the wedge 50 and star wheel 35. Thus, the sawmill carriage drive, in effect, is jockeyed into a rough and into an exact position, sequentially.

Just prior to movement of the log longitudinally toward the rotary saw and as a result of the de-energization of the solenoid A, air is supplied to the large piston 45 through the air line 47. This causes the rack 42 to move to the left and pivot the pinion 29 out of engagement with the rack 28 via the lever 37 and cam 40. At the same time, the pierced engagement member 49 moves to the left with the rack 42 and the spring biased motor control valve 25 is allowed to move to the exhaust position. Meanwhile, the raising of the armature 1a has released the contact button 88 to actuate the mushroom feeler switch 87 and open the control valve 76. Thus, the constant air pressure above the oil in the reservoir 77 forces the oil through the oil line 73 to the cylinder 72. This pressure returns the piston 70, elongated bar 71, and piston 22 to the position shown in Fig. 1. Thereafter, or thereafter, depending on the longitudinal carriage position, the follower wheel 93 rides onto the low face 92 of the cam and the electric circuit is broken at the safety switch 96. Concurrent with the movement of the piston 70 and the elongated bar 71 to the left, or prior thereto, the carrier 80 has been released for movement to the left under the influence of the compression spring 84. This movement to the left opens the motor valve 54 to exhaust and the wedge 50 disengages from the star wheel 35. The disengagement movement also remakes the electric circuit through the ground break switch 97. Thus, the solenoid A cannot be energized until the follower wheel 93 again rides up over the high face 91 of the cam. However, since the switch 97 has again been made, the sawyer may select the number of inches for his next cut while the previous cut is being made. This is done by selecting one of the push buttons on the control panel 9 and depressing the same. Such a depression holds the push button down, lights the green light, and depresses the corresponding relay and armature yet does not actuate the solenoid A. As soon as the sawmill carriage returns to the point where the follower wheel 93 rides over the high face 91 of the cam, the solenoid A will be actuated. This actuates the large piston 45 and causes the pinion 29 to be lowered into engagement with the rack 28, whereupon the entire sequence of operations is repeated, yet the second carriage movement is added to the first carriage movement. Each movement of the sawmill carriage is thereby made cumulative. For example, if the one inch push button is depressed for three successive movements past the rotary saw, the log will have advanced three inches plus three times the width of the saw kerf or approximately four inches in total.

To reverse the lateral movement of the sawmill carriage, the push button panel 9 is tilted (pivoted clockwise as seen in Fig. 2) to actuate the reverse tilt switch 10b. This reverse tilt switch controls a hold down solenoid indicated at R in Fig. 5. It functions to energize the red light and the valve actuation electromagnet R' controlling the valve 68 even though the safety switch 96 may be broken. This is so since the circuit to the valve actuation electromagnet R' is not in series with the safety switch 96. As shown in Fig. 1, the valve actuation electromagnet R'

controls the spring biased motor valve 68 to move the same, against the bias, to the supply position. This movement feeds air to the large air motor piston 66 through the line 69 to move the shifting lever 62 to the left. Thus, the main drive gear 19 is disengaged from the forward small gear 18 and is engaged with the reversing gear 15 to reverse the direction of rotation of the set shaft 14. Both reversing switches 98 and 99 are broken during the time the shifting lever 62 is in transit. Thereafter, the sawyer calculates the distance in which he desires to have the sawmill carriage moved in reverse and divides by three. This division is necessary since, as previously set forth, the large gear 16 has three times the number of teeth as does the small reversing gear 15. If a return of fifteen inches is desired, the sawyer pushes the number 5 push button and the identical sequence of operation as described above takes place to return the carriage fifteen inches. That is to say, the solenoid A is actuated to disengage the final lock star wheel 55 and to engage the pinion 29 and rack 28, the air motor 21 moves the gears 85 and 86 to the right, one of the ears engages an armature to actuate the valve 54 and rough lock the drive train through the wedge 50 and star wheel 35, the circuit is broken and the elements are returned to their point of origin ready for another cycle of operation.

In connection with the operation of my networks for a sawmill carriage, it will be noted that the overall drive therefore proceeds with a fast motion, is slowed, stopped, rough locked, and final locked in sequence. I have adopted the term "damping means" to describe all that structure which is necessary to accomplish this sequential operation. Furthermore, since the ground break switch 97 both breaks the circuit and resets the push buttons and relays, I have termed this switch and its coacting elements a "safety means." In accord with the objects of my invention, my networks provides an electromagnetic push button control circuit which controls the set shaft to initiate the lateral movement of the knees for the carriage, slow the travel velocity as the terminus is approached, and stop the set shaft and knees in a preselected sawing position with a sequential rough and final locking movement. It replaces the historic rotary operating shaft with a simple push button control panel and materially reduces the wasteage produced by those inaccuracies which are inherent in many conventional networks. Furthermore, in order to protect the gear train (including the set shaft) of my invention, I have provided a novel gearing and pneumatic drive, whereby the movement of the knees and the set shaft is initiated a predetermined time lag after a pneumatic lifting means pivots the gearing into an initial driving engagement and whereby the movement of the knees and the set shaft is terminated at substantially the same time the pneumatic lifting means pivots the gearing into final disengagement.

I claim:

1. A push button electro-pneumatic networks comprising; an electric circuit means having a series of electromagnets with longitudinally movable armatures arranged in lateral alignment one with another, a correlated series of push buttons for actuating said electromagnets, and a solenoid means for holding each push button in an actuated position; a pneumatically actuated motor means movable along a predetermined path which intersects only the one of said armatures that is actuated, said motor being controlled by valve means energized from said electric circuit means in response to the actuation of any one of said push buttons; and hydraulic means opposing the movement of said motor with a force which is insufficient to stop the same but which is sufficient to slow the same, the force of said hydraulic means being variable in response to a movement of said motor along said predetermined path for a preselected distance, said distance being preselected by the interception of said path by the armature of one of said electromagnets.

2. A push button electro-pneumatic networks compris-

ing; an electric circuit means having a series of laterally movable electromagnets each with a longitudinally movable armature, a correlated series of push buttons for actuating said electromagnets, and a solenoid means for holding each push button in an actuated position, said electromagnets being aligned in a common plane; a pneumatically actuated motor means movable along a predetermined path which intersects said armatures when the latter are actuated, said motor being controlled by an electromagnetic valve which is energized from said electric circuit means in response to the actuation of any one of said push buttons; and hydraulic means opposing the movement of said motor with a force which is insufficient to stop the same but which is sufficient to slow the same, the force of said hydraulic means being variable in response to a movement of said motor along said path for a preselected distance, said distance being preselected by the interception of said path by the armature of one of said electromagnets; and locking means responsive to a lateral movement of said electromagnets by the engagement of said motor means with one of said armatures to move the motor means to a more exact position and lock it in said more exact position.

3. A networks for a sawmill carriage having knees movable in response to the rotation of a set shaft, comprising an operating means mechanically linked to said knees, an electric circuit means joined to and controlling the operating means for rotating the set shaft into successive preselected positions, and a series of mated electromagnets and switches in said circuit, the armature of each electromagnet being physically engageable selectively with said operating means to stop the rotation of said set shaft in a position preselected by one of said switches.

4. A networks for a sawmill carriage having knees which are joined operatively to a rotatable set shaft, said networks comprising an operating means mechanically linked to said knees, a push button controlled electric circuit means joined to and controlling the operating means for rotating the set shaft in a first direction to define successive correlated positions and for rotating the set shaft in an opposite direction toward the original position, said electric circuit including a series of electromagnets mated to and operable by said push buttons, the armature of each electromagnet being engageable selectively with said operating means to stop the same through physical contact therewith in a position preselected by the mated push button, and safety means operatively joined to said circuit and responsive to the said engagement of one of said armatures for breaking the electric circuit and resetting that push button which was selected.

5. A networks control for the knees on a sawmill carriage, said networks control including an electropneumatic drive means mechanically linked to said knees selectively for advancing the knees into successive sawing positions and for returning the knees to the original position, the improvement comprising an electric circuit means with a plurality of push buttons and a holding solenoid mated to each push button, sequentially for actuating and stopping respectively, the drive means, a sequential rough and final lock means for the two stage positioning of the drive means in a preselected exact position after the electric circuit means has actuated and has stopped the drive means, said lock means including a pneumatically operated wedge which is operatively engageable with said drive means, and safety means operatively joined to said electric circuit and responsive to an operative movement of said rough lock means to disconnect the electric circuit and to reset the push button and the mated holding solenoid.

6. In a control for the networks of a sawmill carriage, an operating means mechanically linked to said knees for advancing a portion of the sawmill carriage laterally into successive sawing positions and for returning the same to the original position, the improvement comprising, an electric circuit means having a series of push button controlled electromagnets sequentially for actuating and for

stopping said operating means, said electromagnets being aligned with the direction of movement of the operating means and each having a movable armature, the armature of each electromagnet being projectable into the path of the moving operating means and being engageable selectively with said operating means to stop the same in an approximate position preselected by the mated push button, and a locking means responsive to the physical engagement of the operating means with one of said armatures for locating the operating means to a preselected exact position.

7. A networks for a sawmill carriage having knees movable in response to the rotation of a set shaft, said networks comprising an operating means mechanically linked to said knees, a push button controlled electric circuit means joined to and controlling the actuation of the operating means selectively for rotating the set shaft into successive positions and for returning the same to the original position, a series of electromagnets in said circuit, each said electromagnet having an armature movable in response to actuation of one of said push buttons, the armature of each electromagnet being movable into abutment with said operating means to stop the same in an approximate position preselected by the mated push button, a locking means actuated by the abutment of said operating means with any one of said armatures for locating the operating means to a preselected exact position, and safety means operatively joined to said electric circuit and responsive to the actuation of said locking means for breaking the electric circuit.

8. A networks control for a sawmill carriage, said networks including an operating means mechanically linked to said knees for advancing the knees of the sawmill carriage into successive sawing positions and for returning the same to the original position, the improvement in the control thereof comprising, an electric circuit means having a series of electromagnets each of which is controlled by a push button to actuate and to stop the operating means, each said electromagnet having an armature which is movable into engagement with said operating means to stop the same in an approximate position preselected by a mated one of said push buttons, a sequential rough and final locking means actuated by the engagement of said operating means with any one of said armatures for rough and final locking the operating means, sequentially, in a preselected exact position, said locking means including a pneumatically operated wedge engageable with a star wheel which is carried by said operating means, and safety means operatively joined to said electric circuit and responsive to the actuation of said rough locking means to disconnect the electric circuit.

9. A control for a networks having an operating means geared to the knees of a sawmill carriage to move the same, said control comprising, an electric circuit means for actuating said operating means, electromechanical means actuated by said electric circuit for engaging and arresting the motion of said operating means in a preselected one of a plurality of positions, a recoil means bearing on said operating means for slowing the movement thereof a predetermined distance in advance of the engagement of said operating means and electromechanical means, and means operative only after said operating means movement has been slowed and arrested for disconnecting the electric circuit.

10. A push button electro-pneumatic networks for a sawmill carriage, said networks having a push button control, an associated electric circuit means, and a drive means operatively geared to the knees of the sawmill carriage for actuating the same in response to signals originating with said push button control and by said electric circuit, the improvement comprising, longitudinally movable electromechanical means actuated by said electric circuit for engaging and arresting the motion of said drive means in approximately a preselected one of a plurality of positions as dictated by said push button control, a re-

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coil means bearing on said drive means for slowing the carriage movement velocity a predetermined distance in advance of the engagement of said drive means and electromechanical means, said electromechanical means being movable laterally a preselected distance by said drive means after engagement, and plural locking means responsive to the lateral movement of said electromechanical means to locate the drive means into a rough and into an exact position, sequentially.

11. A networks for the knees of a sawmill carriage, a push button control and associated electric circuit, a drive means operatively geared to the knees for actuating the same in response to signals from said push button control and circuit, electromechanical means actuated by said electric circuit for engaging and arresting the motion of said drive means in approximately a preselected one of a plurality of positions as dictated by said push button control, a recoil means bearing on said drive for slowing the carriage movement velocity a predetermined distance in advance of the engagement of said drive means and electromechanical means, and plural star wheel locking means controlled by said electromechanical means and engageable with the drive means for jockeying the drive into a rough and into an exact position, sequentially, said circuit including means for resetting the control and the drive means while the carriage is locked to thereby accumulate and make additive successive carriage movements in a given direction.

12. A push button networks control for the knees of a fluid driven sawmill carriage, said control including a push button and an associated electric circuit, a drive means operatively geared to the knees for actuating the same in response to a signal from said push button and circuit, the improvement comprising, electromechanical means actuated by said electric circuit for engaging and arresting the motion of said drive means approximately in a preselected one of a plurality of positions, and a fluid recoil means bearing on said drive means for slowing the movement of the drive means a predetermined interval in advance of the engagement of said drive means and electromechanical means, said recoil means including an electromagnetic fluid control valve operable by an electric switch which moves with the drive means and is actuated by said electromechanical means.

13. A networks control for a sawmill carriage, said networks having an electropneumatic drive means operatively geared to the knees of the sawmill carriage for actuating the same, said control comprising, an electric circuit means for actuating said drive means, electromechanical means actuated by said electric circuit for engaging and arresting the motion of said drive means approximately in a preselected one of a plurality of positions, a fluid recoil means bearing on said drive means for slowing the movement thereof a predetermined distance in advance of the engagement of said drive means and electromechanical means, said recoil means including an electromagnetic fluid control valve responsive to an electric feeler switch which moves with the drive means and is actuated by said electromechanical means, said electromechanical means being movable laterally a preselected distance by said drive, and cam and plural locking means responsive to the lateral movement of said electromechanical means sequentially to jockey the drive into a rough or approximate position and thereafter into a more exact position.

14. In a networks for a sawmill carriage, said networks having operating means geared to the knees of the sawmill carriage to move the same laterally of the carriage approximately to a predetermined position, the improvement comprising, a damping means operatively connected with said operating means for slowing, stopping, rough lock moving, and final lock moving the operating means, sequentially, said damping means including an exhaustible hydraulic element having a variable rate of exhaust, which rate is decreased in response to movement of the operating means in order to slow that movement.

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15. A control for the networks of a sawmill carriage, said networks including operating means geared to the knees of the sawmill carriage for moving the same laterally approximately to a predetermined position, said control comprising, a damping means operatively connected with said operating means for slowing, stopping and rough locking the operating means, sequentially, the portion of said damping means for stopping said drive means including a preselected one of a series of electromagnetically selectable mechanical abutments engageable with a first portion of said operating means to stop the same, and the portion of said damping means for rough locking including a pneumatically actuated wedge responsive to the engagement of the operating means with one of said abutments to engage a second portion of said operating means and rough lock the same.

16. In a networks having drive means for moving the knees of a sawmill carriage laterally to a predetermined position, the improvement comprising, a damping means operatively connected with said drive for slowing, stopping, rough locking, and final locking the drive means, sequentially, said predetermined position being attained with said final locking, said damping means including a variable force hydraulic recoil means opposing the forward movement of said drive means at all times and actuated to increase the force of said opposition by contact of a feeler element with the drive means as said predetermined position is approached, said damping means also including a first and a second wedge, said first wedge being engageable with a first portion of said drive to rough lock the same only after the opposition of said hydraulic means has been increased, said second wedge being responsive to a movement of said first wedge and engageable with a second portion of said drive means to final lock the same in said predetermined position only after said first wedge has effected said rough lock.

17. In combination with a networks having electropneumatic drive means operatively geared to the knees of a sawmill carriage to move the same laterally approximately to a predetermined position, a damping means operatively connected with said drive means for slowing, stopping, rough locking, and final locking the drive means, sequentially, said damping means including a series of electromagnetically selectable mechanical abutments, a preselected one of which is movable laterally toward said drive means to engage the same, said abutments being shiftable yieldingly a preselected distance before stopping said drive means, a first movable wedge actuated in response to the shift of said preselected abutment to engage a first portion of said drive means and rough lock the same, and a second movable wedge actuated in response to a movement of said first wedge to engage a second portion of said drive means and final lock the same in said predetermined position.

18. A push button electropneumatic networks for a sawmill, said networks having a pneumatic expandable motor drive connected through a gearing system to the knees of the networks, said motor drive being operable to advance the knees into successive sawing positions in response to a push button control, the improvement comprising, a gear means defining a portion of said gearing system and being pivotally engageable with said motor drive for engaging and disengaging said drive with said knees, and means responsive to said push button control and carrying a time lag means for initiating the operative movement of said motor drive only after a predetermined time has elapsed after said gear means is pivoted into engagement with the motor drive and for terminating the operative movement of said motor drive at substantially the same time as said gear means is pivoted into disengagement.

19. A push button electropneumatic networks for a sawmill carriage, said networks having a motor connected by a gearing to the knees of the sawmill carriage to advance the latter into successive sawing positions, said gearing comprising, a rotatable transmission shaft carry-

ing a motor engaging gear at one end and a universal joint means for driving the knees on the other end, a movable journal carrying said shaft intermediate the ends thereof, pneumatically actuated means responsive to an electric push button control and operatively engageable with said movable journal for reciprocating the same and said transmission shaft about said universal joint means as a pivot to engage and disengage said motor engaging gear with said motor selectively, and an adjustable time lag means for initiating the operation of said motor only when a predetermined time interval has elapsed after said motor engaging gear is pivoted into engagement.

20. A networks for moving the knees on a sawmill carriage, said networks having a set shaft and comprising a pneumatic drive motor connected by a positive gearing to the set shaft, said positive gearing including a rotatable transmission shaft carrying at one end a drive gear engageable with the drive motor and at the other end a universal joint engaged with the set shaft, a movable journal carrying said transmission shaft intermediate the ends thereof, pneumatically actuated means operatively engageable with said movable journal for reciprocating the same and said shaft about said universal joint as a pivot to engage and disengage said drive gear with said drive motor selectively, a time lag means for initiating the operative movement of said drive motor a predetermined time interval after said drive gear is pivoted into

engagement and for terminating the operative movement of said drive motor at substantially the same time said drive gear is pivoted into disengagement.

References Cited in the file of this patent

UNITED STATES PATENTS

284,081	Snyder	Aug. 28, 1883
627,385	Brockie	June 20, 1899
796,925	McDermott	Aug. 8, 1905
869,627	Cunningham	Oct. 29, 1907
934,866	Wilkin	Sept. 21, 1909
964,750	Carey	July 19, 1910
1,561,341	Martin	Nov. 10, 1925
1,561,342	Martin	Nov. 10, 1925
1,725,861	Grueter	Aug. 27, 1929
1,856,169	Rosener et al.	May 3, 1932
2,007,180	Doran et al.	July 9, 1935
2,175,822	Best	Oct. 10, 1939
2,316,971	Overacker et al.	Apr. 20, 1943
2,342,967	Peters	Feb. 29, 1944
2,362,054	Denison	Nov. 7, 1944
2,362,690	Fichter et al.	Nov. 14, 1944
2,500,150	Bullard et al.	Mar. 14, 1950
2,551,824	Coote	May 8, 1951
2,574,393	Hult	Nov. 6, 1951