This invention relates in general to improvements in hydraulic feed means and is particularly directed to an improved hydraulic power system for advancing a ram such as that found in a slicing machine.

This application is a division of our copending application S.N. 689,860, filed October 14, 1957, now Patent No. 3,015,350, relating to Control of Group Size in Bacon Slicing.

While the present invention is applicable to numerous types of feed mechanisms it has been found to be particularly suitable for use in a bacon slicing machine. This disclosure illustrates such a use; however, it will be obvious that the improvement may be otherwise employed without departing from the invention.

In general, bacon slicing machines comprise a horizontal bed, a rotatable knife means disposed perpendicularly to the bed for slicing material thereon, and a feed carriage movable along the bed at a right angle to the plane of the knife. The feed carriage is usually actuated by a hydraulic piston and cylinder and the rate of advance of the carriage depends upon the amount of fluid introduced into the cylinder to displace the piston. Thus, in prior machines, a flow valve located in the hydraulic line leading to the end of the cylinder opposite the feed carriage has been used to control the rate of feed. Usually, the knife severs one slice each revolution and it clearly follows that the thickness of each slice will be dependent upon the speed of the knife and the rate of feed. Preferably, the knife speed is maintained constant during operation and the slice thickness is controlled by adjusting the rate of feed. An increase in the rate of feed will result in a relative increase in the thickness of the slices and may be obtained by increasing the amount of fluid introduced into the cylinder. Slices have been grouped by either momentarily interrupting the advance of the feed carriage or momentarily accelerating the speed of a take-off conveyor. Both of these provisions have had the drawback of being unadaptable to varying conditions. Prior apparatus have lacked any means to selectively control the number of slices per draft and the space between drafts. Further, a momentary interruption has often been insufficient to space the drafts a sufficient distance and has often caused the first and last slices of a draft to differ in thickness from the remaining slices making up the draft.

It is therefore an object of this invention to provide a novel means to control the flow of hydraulic fluid from a hydraulic feed means in a slicing machine and maintain uniform advance of the feed means to obtain slices of a uniform thickness.

Other objects and advantages of the invention will become apparent upon reading the following description taken in conjunction with the accompanying drawings. One embodiment of the invention has been illustrated, but it is to be expressly understood that said drawings are for purposes of illustration only and are not to be taken as a definition of the limits of the invention, reference being had to the appended claims for this purpose. In said drawings:

FIGURE 1 is a perspective view of one form of slicing machine embodying the present invention; FIGURE 2 is a diagrammatic view, in perspective, showing the relationship of the working parts of the slicing machine of FIGURE 1, the hydraulic system and a control device; and FIGURE 3 is a schematic layout of the hydraulic system shown in FIGURE 2.

The present invention deals with a hydraulic system for regulating the advancement of material into a slicing means so that such advancement is in intermittent periods interrupted by intervals sufficient to achieve a distinction between successive groups of slices. This invention is adapted to regulate the flow of hydraulic fluid from (and consequently to) the cylinder of a hydraulic feed carriage, and basically includes a flow control valve placed in the hydraulic line which normally carries hydraulic fluid leaving the hydraulic cylinder. This valve is operated to control the rate of advance of the feed carriage. A valve is located in the same line between the flow control valve and the hydraulic cylinder and is normally in a first position to direct fluid leaving the cylinder to the flow control valve. An actuating means is provided to move the valve to a second position to block the flow of fluid from the cylinder and thereby interrupt the advance of the feed carriage. Concurrently, the low control valve is connected to a source of fluid under a pressure equal to the pressure of fluid normally leaving the cylinder. This design provides a constant unceasing flow of fluid at an even pressure through the control valve with the result that fluid will not surge from the cylinder when it is re-connected to the flow control valve. Thus, the rate of advance of the feed carriage will be uniform throughout essentially all of each period of advance.

The actuating means to move the valve is connected to a control device generally comprising a cam means which is rotatable at a fraction of the rate of the knife. Each full rotation of the cam means represents a certain number of revolutions of the knife, and likewise an equal number of possible slices. A first and a second sensing means are associated with and actuated by the cam means. The first sensing means is movable through a plurality of positions about the periphery of the cam means (the distance between successive positions is equal to the distance turned by the cam means for each revolution of the slicing machine knife) and is connected to the valve actuating means to cause the latter to place the valve in its second position, blocking the flow of fluid from the cylinders and stopping the feed carriage, when the first sensing means is actuated by the cam means. The second sensing means is connected to the valve actuating means to cause the latter to move to its first position, allowing fluid to flow from the cylinder and advance the feed carriage, when the second sensing means is actuated by the cam means. Thus, the relative positions of the two sensing means with respect to the cam means will control the duration of the periods that material will be advanced into the slicing machine knife, and likewise the periods that the advance of the material will be interrupted.

The slicing machine illustrated in FIGURES 1 and 2 comprises a bed 10 having a flat upper surface 11 upon which a bacon slab may be moved toward a knife 12. Knife 12 is secured to a rotatable shaft 13 which is driven by means of a belt 14 connecting a pulley 15 secured to the shaft 13, to another pulley 16 on a motor 17. For purposes of safety, knife 12 is substantially enclosed in a guard 18. A precision gear reducer 19 having a ratio of one to one is connected to the knife shaft 13 by means of a gear thereon (not shown). A control device generally 20 is connected to the low speed side of the gear reducer 19 in a manner which will be later described. Slidably disposed on the upper surface 11 of bed 10 is a material feed carriage generally 23. This feed carriage consists...
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of a pusher member 24 having a pusher face 25 suitable for engaging the end of the material to be sliced. Located at the end of bed 10, opposite the knife 12, is a hydraulic cylinder 26. The forward end of the cylinder (neaker knife 12) and the rear end of the cylinder are connected to fluid lines 27 and 29 respectively. A piston rod 29 extends from the forward end of cylinder 26. Piston rod 29 is connected to the pusher member 24 and will urge it, and any material forward thereof, toward knife 12 when fluid under pressure is introduced through fluid line 28 to the rear of cylinder 26. The slicing machine also includes a take-off conveyor generally 32 consisting of a plurality of ribbons 33 trained about a pair of drums 34, 35 which are rotatably secured to a suitable stand 36. The take-off conveyor 32 may be driven in any convenient fashion, such as by means of a separate electric motor, or by suitable connection to motor 17 or to knife shaft 13.

The control device generally 20 does not form a part of the presently claimed invention, but is fully disclosed in our aforementioned parent application, now Patent No. 3,015,350, included herein by reference.

Basically, however, the control device as shown in FIGURE power from a 120 volt source through a pair of wires 90 and 100. A solenoid 103 is also connected to the source of electric power by wire 104 directly, and wire 102 through the control device generally 20. Periodically the control device will establish connection between the valve 126 and wire 90 and 102 to intermittently energize the solenoid 103.

Referring to FIGURES 2 and 3, the valve solenoid 103 is connected to a four-way valve 108 which has two operating positions. Normally, valve 108 is spring loaded to a first position when solenoid 103 is not energized. When the solenoid 103 is energized valve 108 will be forced to a second position. Fluid line 27 is connected to one port of the four-way valve 108. A fluid line 109 is connected between a second port in four-way valve 108 and a flow control valve 110. The flow control valve 110 maintains fluid line 109 in communication with a fluid line 111, attached thereto, which empties into a reservoir or sump 112. Flow control valve 110 is adjustable manually to vary the rate at which fluid may pass from line 109 to the sump 112 by means of a dial 113 (shown in FIGURE 1). When the feed carriage is advancing hydraulic fluid will be forced from the forward end of cylinder 26 through line 27 and the valve 108 (in its first position) to line 109. Thence, the fluid passes through flow control valve 110 (by means of which the rate of advance of the feed carriage 23 is regulated) to the sump 112 by way of line 111.

Another fluid line 115 is attached to a third port on the four-way valve 108 connecting it to a pressure reducing valve 116; and a fourth port is closed by a plug as identified in FIGURE 3. Normally, when valve 108 is in the first position, illustrated, the fluid line 115 will be connected by the valve with the plugged fourth port and flow of fluid from line 115 is accordingly blocked. The pressure reducing valve 116 is also connected to a pressure regulator 117 of a centrifugal pump 118 by fluid line 119. A fluid line 120 carries hydraulic fluid from the sump 112 to the inlet port of pump 118, and a line 121 discharges fluid from the pressure regulator 117 back to the sump 112. The pump 118 is driven by an electric motor 123 coupled thereto. In some installations it may be possible to drive the pump 118 by connecting it to the knife motor 17. Pump 118 and pressure regulator 117 are set to deliver hydraulic fluid to the pressure reducing valve 116 and valve 108 at a pressure equal to the pressure of fluid normally leaving cylinder 26 through line 27.

Under usual operating conditions when the feed carriage 23 is being advanced the forces acting on the two sides of the piston in cylinder 26 are nearly balanced. Since the area of the piston on the end connected to piston rod 29 is less than the area of its free end, it is clear that the fluid pressure in the forward end of cylinder 26 (and in line 27) will be somewhat greater than the pressure in the rear end of the cylinder. In the actual machine it was found that when hydraulic fluid was introduced to the rear end of cylinder 26 at 150 p.s.i. the pressure at the forward end of the cylinder was approximately 250 p.s.i. Therefore, the pump 118 and pressure regulator 117 are set to deliver hydraulic fluid at the higher pressure of about 250 p.s.i. to the pressure reducing valve 116. The fluid introduced to line 115 is also at 250 p.s.i.

Timing the machine as it is energized, the four-way valve 108 is moved to its second position, which blocks line 27 and places line 115 in communication with line 109, and higher pressure fluid is directed to the flow control valve 110. Thus, fluid at 250 p.s.i. will normally continuously pass through the flow control valve regardless of the position of four-way valve 108. At the time that the four-way valve 108 is again moved to its first position, and fluid passes from the forward end of cylinder 26 through the flow control valve 110, all of the hydraulic components will contain fluid at about the normal operating pressures. Thus, there will be no tendency for the piston to surge forward at the beginning of a feed cycle.

Another fluid line 125 connects the low pressure end of the pressure reducing valve 116 to a two-position four-way valve 126. The pressure reducer 116 directs fluid at 150 p.s.i. into this line. A manual selector handle 127 is connected to the upper end of the pressure regulator to stop the feed carriage at any time. When the handle 127 is pulled outwardly the valve is placed in its first position directing hydraulic fluid from line 125 to a line 128. When the handle 127 is pushed inwardly valve 126 is placed in its second position which directs line 128 into another line 129 to the sump 112, and at the same time connects fluid line 125 to a line 130. Line 130 is connected to another fluid line 131 at the flow control valve 110 and empties into the sump 112. When the two-way valve 126 is placed in its second position, the 150 p.s.i. fluid from the pressure reducing valve 116 will be returned to the sump 112 and feed carriage 23 will stop. However, when valve 126 is placed in its first position, the fluid at 150 p.s.i. will be directed through line 128 to a reversing valve 132. This reversing valve 132 is a four-way valve having three operative positions. Valve 132 is provided with both a manual control handle 133 and a hydraulic actuator 134. Reversing valve 132 is spring loaded to a first or normal position which connects fluid 128 to line 28 and the rear of cylinder 26. When both valve 126 and valve 132 are in their first positions, hydraulic fluid at 150 p.s.i. will be introduced to the rear end of cylinder 26. Assuming at this time that valve 108 is in its first position (directing fluid from the forward end of cylinder 26 through the flow control valve 110), the feed carriage 23 will be advanced when fluid at 150 p.s.i. is introduced to the rear end of the cylinder.

A fluid line 137 connects the reversing valve 132 with line 27 through a T connector 138. Reversing valve 132 is also connected to the sump 112 by a fluid line 139. Holding the control handle 133 inwardly places the reversing valve in its second position connecting line 128 to line 28 and connecting line 137 to line 139. Thus, when valve 132 is in its second position fluid at 150 p.s.i. will be directed to the rear of cylinder 26 and an unimpeded passage is connected between the forward end of the cylinder and sump 112. This connection provides a means to quickly advance the feed carriage at any time an operator elects to do so. When the control handle 133 is held outwardly, the reversing valve 132 is placed in its third position connecting line 28 to line 139 and connecting line 137 to line 128. In this manner, hydraulic fluid at 150 p.s.i. is introduced to line 27 and the forward end of cylinder 26 while the rear end of the cylinder is connected directly to the sump 112. The effect is to quickly reverse the motion of the piston in cylinder 26 and move the feed carriage 23 away from knife 12.
Valve 132 may also be placed in the third or reversing position automatically by the hydraulic actuator 134. As may be seen in Figure 2, the hydraulic actuator 134 is connected to a rotary pilot valve 141 by a fluid line 142. The pilot valve 141 is in turn connected to an actuator handle 135 by control valve 136. Control valve 136 is in turn connected to the hydraulic actuator 134 by control valve 136. Thus, the pilot valve 141 may direct hydraulic fluid at 150 p.s.i. to the actuator 134 when valve 126 is in its first position. Fluid line 145 connects the pilot valve 141 to the sump 112. Since it is desirable to automatically reverse the feed carriage 23 when it reaches the end of its stroke, suitable mechanical linkages are provided to actuate the pilot valve 141. A rod 147 is slidedly secured beneath the upper surface 11 of bed 10 and extends for a length equal to the maximum feed stroke of the carriage 23. A lug 148 is connected to the end of rod 147 near knife 12 and projects into the path of the pusher member 24. Another end of a lever 150 is pivotally connected to the rod 147. The other end of lever 150 is pivotally connected to an actuator handle 151 of pilot valve 141. The lever 150 is pivoted about a pin 152 so that small movement of the rod 147 will fully actuate the pilot valve 141.

When the feed carriage 23 reaches the end of its forward movement, the pusher member 24 will strike lug 148 and slide rod 147 slightly forward. Lever 150 is pivoted thereby and the pilot valve is turned to direct fluid at 150 p.s.i. to the hydraulic actuator 134. The reversing valve 132 is placed in its third position, thereby, and the feed carriage 23 will be reversed. When the carriage 23 moves to its rearmost position, the pusher member 24 will strike lug 149, and slide bar 147 rearward to pivot lever 150 and move the pilot valve 141 to connect the hydraulic actuator 134 to lines 145 and sump 112. The reversing valve 132 will spring back to its first or normal position, which directs fluid to line 28 and the rear of cylinder 26, when pressure is released in the actuator 134 and therefore the carriage will automatically move forward toward knife 12.

Operation

The operation of the slicing machine should be apparent from the preceding description. The slicing knife 12 and the hydraulic pump 118 are started by connecting the motors 17 and 123 with a suitable source of electric power (not shown). Valve 126 is placed in its first position and the reversing valve 132 is in its third position to move the feed carriage 23 rearwardly, until the carriage reaches the end of its path. At this time, the reversing valve 132 is released (springing to its first position) and valve 126 is placed in its second position, thus stopping flow of hydraulic fluid to cylinder 26 and therefore stopping the feed carriage 23. A bacon slab is then placed upon the bed 10 between the pusher member 24 and the knife 12, and the control device generally 20, is set for the desired number of slices per draft. To do this, crank arm 44 is rotated until the locking pin 49 may be screwed down into the appropriate pin seat 50. At the same time the dial 113 on the flow control valve 119 is adjusted to regulate the proper slice thickness. Valve 126 is then returned to its first position to start the feeding operation, and the reversing valve 132 is held in its second position to quickly advance the feed carriage 23 until the bacon slab engages the bevel of the feed carriage 23 and advances it to the knife 12. The reversing valve 132 is then released allowing it to spring to its first or normal position for normal forward feed. At this time the slicing machine will operate automatically.

If at any time it is necessary to stop the advance of the feed carriage 23, valve 126 is placed in its second position. Or if it is desirable to reverse the carriage 23, the reversing valve 132 is held in its third position.

Control device 20 will periodically cause electric current to be delivered through wire 102 to the valve solenoid 103. The valve solenoid is thereby energized and moves the four-way valve 108 from its first to its second position. This position of the valve 108 prevents fluid from leaving the forward end of the cylinder 26. Valve 108 will return to its first position. This re-connects the forward end of the cylinder 26 to the flow control valve 110 and fluid will pass through the sump 112.

When the feed carriage 23 advances it forces the bacon slab into the path of the blade of knife 12 to sever slices therefrom. These slices fall onto the ribbons 30 of the continuously moving take-off conveyor 32 in a shingled fashion. Interruption of the advance of feed carriage 23 does not effect the take-off conveyor 32; however, no slices will fall thereon during the interval that the carriage 23 is stopped. Thus, a space will be left on the take-off conveyor 32 between the last slice severed during one cycle and the first slice severed upon commencement of the next succeeding cycle.

This automatic operation will continue until the last of the slab is severed and the feed carriage 23 trips the lug 148. The reverse valve 132 is automatically placed in its third position and the feed carriage 23 will be drawn rearwardly until it trips lug 149. During this period the next bacon slab is readied and when the carriage has moved to the rear a sufficient distance it is placed between the pusher face 25 and the knife 12. When lug 149 is tripped the reversing valve 132 will spring to its first position and the feed carriage will start to advance toward knife 12 under automatic control. If necessary, valve 132 may be operated to quickly advance the carriage and take up any excess space between the pusher face 25, the slab, and knife 12. The crank arm 44 of the control device 20 and the flow control valve 110 may be re-positioned for drafts of a different number of slices or slices of a different thickness at any time during the operation of the machine.

Obviously, many modifications and variations of the invention as hereinbefore set forth may be made without departing from the spirit and scope thereof, and therefore only such limitations should be imposed as are indicated in the appended claims.

We claim:
1. In a hydraulic system including a hydraulic means for advancing a feed carriage, in combination: a flow regulator connected to the hydraulic means; a valve connected between said flow regulator and the hydraulic means closeable for fully interrupting the flow of hydraulic fluid therebetween; and a source of fluid under pressure connectable to said flow regulator through said valve when said valve is closed whereby continuous flow of hydraulic fluid is maintained through said flow regulator.
2. In a feed mechanism having a feed carriage and hydraulic means for advancing the feed carriage, the improvement for operating the hydraulic means, said improvement comprising: a source of hydraulic fluid at a pressure substantially equal to the pressure in said hydraulic means when the feed carriage is being advanced thereby; a variable flow control valve connectable to the discharge side of the hydraulic means to regulate the rate of fluid flowing therefrom and the rate of advancement of the feed carriage; a valve connected between the hydraulic means and said flow control valve for fully interrupting the flow of fluid therebetween, said valve also being connected to said source of hydraulic fluid; a solenoid connected to close said valve to interrupt the flow of fluid from said hydraulic means to said flow control valve and concurrently connect said source of fluid to said flow control valve whereby fluid is continuously...
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delivered to said flow control valve; and means associated with said solenoid for intermittently energizing the same.

3. In a hydraulic system for intermittently advancing a feed carriage, the combination comprising: a hydraulic means connected to the feed carriage to advance said carriage in a given direction; a pair of conduits connected to said hydraulic means for delivery and discharge of hydraulic fluid under pressure; a flow regulator connected to one of said conduits to control the rate of operation of said hydraulic means by regulating the rate of flow of hydraulic fluid passing therefrom; a valve in said one conduit positioned between said flow regulator and said hydraulic means for completely interrupting the flow of fluid discharging from said hydraulic means; a source of hydraulic fluid at substantially the same pressure as fluid normally flowing through said flow regulator, said source of fluid being connectable to said flow regulator during periods when said valve interrupts flow of fluid through said hydraulic means, whereby a substantially continuous flow of fluid at normal operating pressure is maintained through said flow regulator.

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