Feb. 18, 1964 V. C. FUHRWERK ETAL 3,121,387

EXTRUDER WITH COMPACTING FORCE CONTROL MECHANISM

Filed June 7, 1961 2 Sheets-Sheet 1

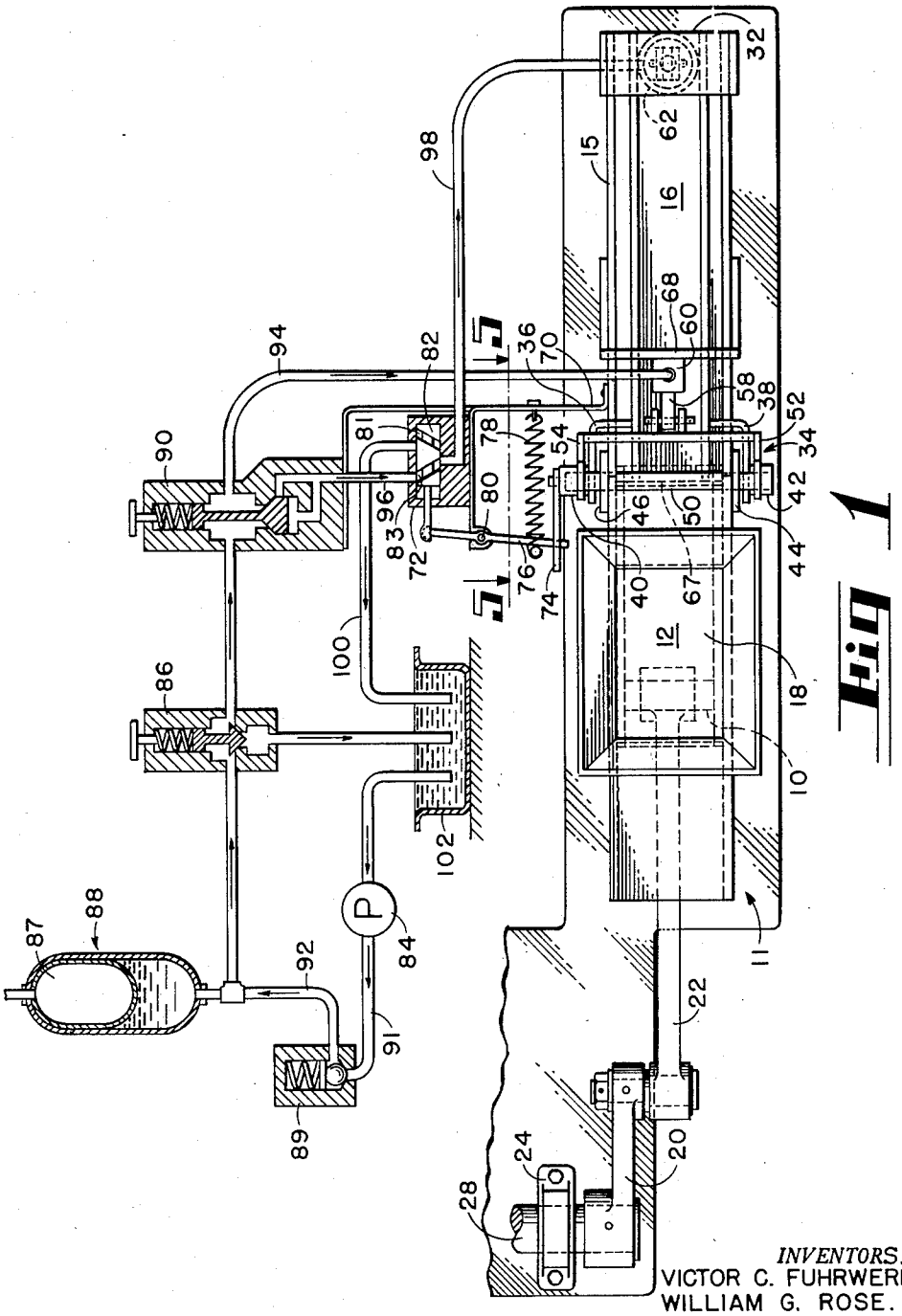


Fig 1

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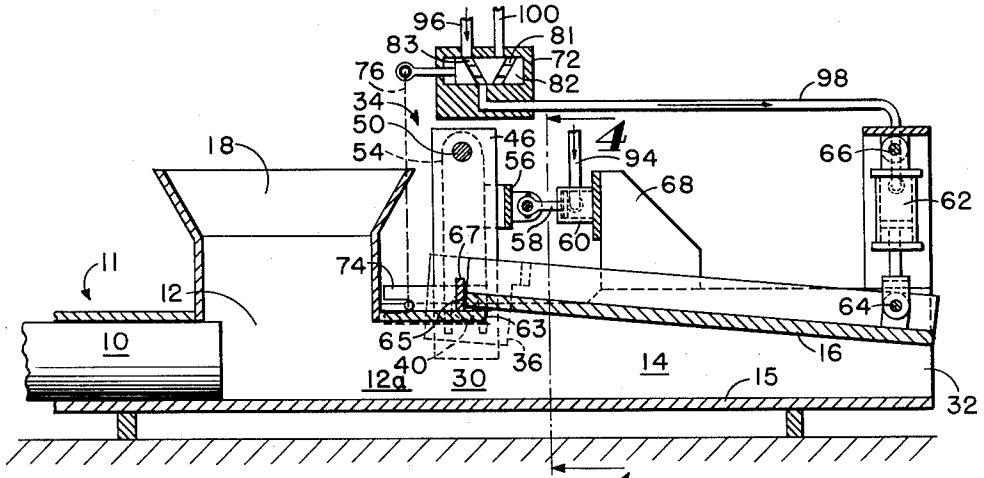


Fig 1

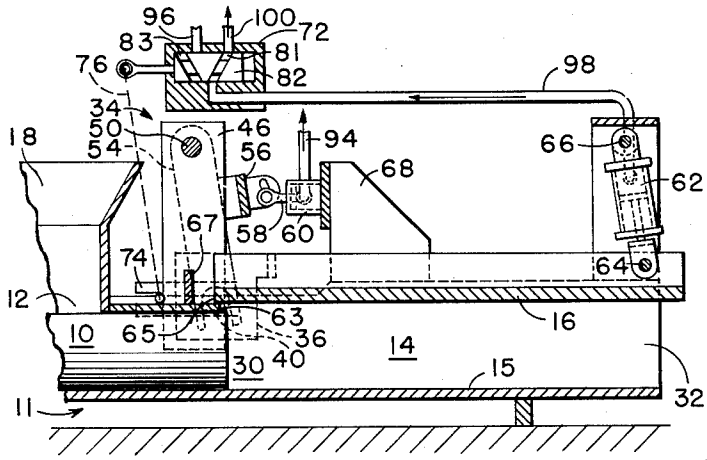


Fig 3

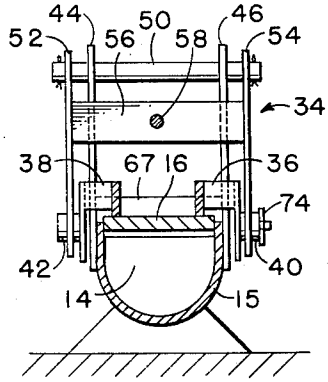


Fig 4

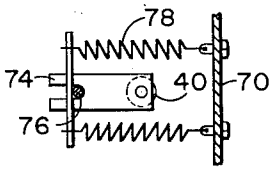


Fig 5

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EXTRUDER WITH COMPACTING FORCE CONTROL MECHANISM

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This invention relates to an extruder with compacting force control mechanism, and more particularly to such mechanism as applied to an extruder type of compacting device suitable among other adaptations to the compacting of crop material, such as hay, into wafers suitable for livestock feed.

The modern development of hay wafering devices, based on the principle of extruding material to be compacted through a tubular die, has demonstrated that an excessive amount of energy is often expended in overcoming friction of movement of material through the extruding tube. There is often a much greater amount of energy required to overcome friction in a conventional reciprocating ram type extruder unit than is required to complete the compaction of the material, and the provision of power for such friction requirements, often greatly increased with the varying moisture content of material to be compacted by field machines, requires power units of large size.

The problem thus presented relates to a limitation and control of the force of compacting and the avoidance of a build up of excessive compressive force, in view of the fact that variations in the properties of the material to be compacted makes it impossible to build a satisfactory extruding tube of definite fixed restriction which will satisfactorily limit the compacting pressure under all conditions.

It is a further important part of the problem that satisfactory mechanism responsive to limit the ram force pressure should be quickly responsive to afford a reduction in this pressure by momentarily reducing the restriction and just as quickly responsive to again bring the restriction under control, so that the restriction is not so much relieved as to require a substantial amount of time in bringing the restriction back to near the value previously available when the compacting pressure was exceeded. With the availability of a mechanism thus quickly responsive to relieve excessive pressure and quickly responsive to return the restriction, it would be possible to take care of changed conditions as required by step-by-step changes coinciding with each new charge. There would be thus afforded a small variation in conditions and by a step-by-step increase or decrease to eventually take care of a large change in conditions which might be brought about by a great variation in the frictional force in the walls of the chamber. Such conditions might occur with an increase in moisture content of the material to be compacted or with other factors which might materially increase the frictional force and consequently the compacting pressure.

It is therefore a primary object of this invention to provide a control mechanism responsive to compacting pressure in the extruding chamber which will, on the attainment of a certain preselected compacting force or pressure, release pressure in the extruding chamber by reducing the restriction therein, thereby releasing the material for passage through the tube and by such passage to release compacted material and as a result avoid the build up of excessive pressure in the extruding chamber.

It is a further object to provide a mechanism, responsive to compacting pressure in an extruding chamber,

actuable to move a wall of such chamber in a direction to reduce the restriction longitudinally relative to said chamber to allow flow of material with less restriction through such chamber, thereby to limit the high value of the compacting force acting in said extruding chamber.

It is another object to provide mechanism responsive to compacting pressure in an extruding chamber in combination with a hydraulic system and controls therefor which will release a transverse holding force on a wall of an extruding chamber in such manner as to afford a quick return of said transverse holding force on the occurrence of a reduction in such pressure, such quick response mechanism affording an important means of control of the restriction in the extruding chamber and affording a change in restriction responsive to small changes in compacting force and variation in the properties of the material compacted.

The above and other objects of the invention will appear more fully from the following more detailed description and by reference to the accompanying drawings, illustrative of a type of mechanism found practical in actual operation, forming part of this application and wherein:

FIG. 1 is a longitudinal view of a compacting extruding mechanism for compacting crop material into wafers with adjacent partially diagrammatic showing of the hydraulic system and mechanism for controlling the compacting pressure.

FIG. 2 is a side view partly in section of mechanism shown in FIG. 1 and includes particularly the showing of the control for the longitudinal wall or press member with connections to the hydraulic units shown in FIG. 1.

FIG. 3 is a view similar to FIG. 2 but showing a section of the mechanism in the region of the extruding chamber with the press member in a relieved position.

FIG. 4 is a sectional view on line 4—4 of FIG. 2.

FIG. 5 is a view taken on the line 5—5 of FIG. 1.

Referring to the drawings of an illustrative mechanism, a feed ram **10** (here used as a means of compacting) is mounted to reciprocate longitudinally relative to an extruding tube or member **11**, and through feed chamber **12** and into compression chamber **12***a*, which chamber extends into extruding chamber **14** which is in this illustration of substantially U-shaped form in cross section (FIG. 4). The extruding chamber **14** has a press member **16** forming a wall through the extruding chamber. Above the chamber **12** there is provided a feed throat **18** through which material to be compacted may be fed, and this feed throat extends into the chamber **12** in such relation, as shown, so that reciprocation of the ram **10** will move material longitudinally through the chamber **12**, **12***a* into the extruding chamber **14**. Feed ram **10** is reciprocated by crank **20** and connecting rod **22**, the crank **20** being supported on bearing **24**. A shaft **28** is rotated by suitable drive means, affording means to reciprocate the feed ram **10** in the chamber **12**, thus to assert a longitudinally directed feeding and compacting force on material to be compacted, such as hay, longitudinally of the chambers **12** and **14**. The extruding chamber **14** has a feed end **30** and a discharge end **32**. The extruding chamber also has the longitudinal wall **16** (sometimes called a press member), the wall **16** being tiltable and movable transversely and longitudinally relative to the chamber **14** and extends longitudinally from the feed end **30** to the discharge end **32** of chamber **14**. A linkage **34**, comprising links **52**, **54**, is pivotally connected to the wall **16** adjacent the feed end **30**. This pivotal connection is made to the wall **16** by brackets **36**, **38** secured to the feed end of the wall **16** to which are attached pivot pins **40**, **42**. The brackets **36**, **38** and pivot pins **40**, **42** are integral with the press

member or wall 16, bracket members 44, 46 secured to the wall 15 of the extruding chamber 14 extend upwardly on each side of the extruding chamber 14 to support a transverse shaft 50. Link members 52, 54 provide a linkage connection between the shaft 50 and the pivot pins 40, 42. The feed end of the wall 16 is thus pivoted for tilting movement about the pivot pins 40, 42 and has longitudinal movement relative to the extruding chamber 14 as allowed by the swing of the link members 52, 54. Abutment 56, extending between link members 52, 54, is resiliently restrained against longitudinal movement in one direction by contact with the extending shaft 58 of hydraulic cylinder 60, the control for which will be more fully described hereinafter, but it is here stated that the hydraulic cylinder 60 affords a longitudinal holding pressure to restrain movement of the links 52, 54 and the wall 16 in a longitudinal direction toward the right, as viewed in FIGS. 2 and 3. The rear or discharge end portion of the wall 16 is restrained by a hydraulic cylinder 62 through pivot connections 64, 66. The rear or discharge end support, thus effected by the cylinder 62 and a pivot connection 64, 66, allows longitudinal movement of the wall 16 and transverse movement of the wall at this position is restrained by the hydraulic connection to the cylinder 62 in a manner later to be set forth. Therefore, the longitudinal wall 16 will have longitudinal freedom toward the discharge end 32 through pivots 64, 66, 50, 40, 42. Also, at this point it is to be noted that the center line through pivots 40, 42 coincides with the feed end lower edge of the longitudinal wall 16. This arrangement substantially eliminates vertical movement of this front edge of wall 16, as tilting movement of the discharge end of the wall 16 may be allowed by cylinder 62.

The wall 16 is restrained in longitudinal movement, in its movement toward the discharge end 32 of the extruding chamber 14 by pivot pins 40, 42, links 52, 54, abutment 56, cylinder 60 with its contacting shaft 58, the cylinder 60 being held in position by support 68, which support is attached to the wall 15 of the chamber 14. A stop 67, contacting the forward end of wall 16, limits the forward travel of the longitudinal wall 16 and the wall is thus limited to rearward or so-called compacting direction travel against the holding force of cylinder 60 longitudinally toward the discharge end 32 of the extruding chamber 14 and to tilting movement of the wall 16 about the axis of pivots 40, 42 as allowed by the hydraulic cylinder 62 effecting a transverse holding element at the rear or discharge end of the wall 16, previously mentioned.

Supported also on the wall 15 (see FIG. 1) is a bracket 70 which supports a hydraulic control valve 72 and supports, as well, an actuated linkage from valve 72 to the pivot 40 composed of links 74, 76. Also, two linkage tension springs 78 are attached to link 76 and bracket 70. When the wall 16 is moved in the direction of compaction in the extruding chamber 14, that is, in the direction toward the discharge end 32, the springs 78 cause the linkage 76 to move around pivot 80 (FIG. 1) causing movement of the piston 82 of the control valve 72 from the position shown in FIGS. 1 and 2 to the position shown in FIG. 3 (the effect of which will be later described).

The hydraulic system is shown in partially diagrammatic form in FIGS. 1, 2 and 3. The system comprises a hydraulic pump 84, pressure relief valve 86, accumulator 88, pressure reducing valve 90, the previously-mentioned two-position three-port mechanically-controlled control valve 72, and cylinders 60 and 62, previously mentioned. The system is a two-pressure system in that pressures in cylinders 60, 62 can be independently controlled through pressure relief valve 86 and pressure reducing valve 90 respectively. The accumulator 88 provides reserve energy by compression of a gas in chamber 87 against which the hydraulic system operates in the usual manner and affords a rapid response for both

cylinders 60 and 62. A check valve 89 is provided between the pump 84 and the accumulator 88, as shown. The control valve 72 is mechanically actuated through the links 74, 76 in response to longitudinal movement of the wall 16. The maximum forward movement of the wall 16, that is, movement toward the feed end 30 against stop 67 will afford a position of the valve 72, as shown in FIGS. 1 and 2, while longitudinal movement in the direction toward the discharge end 32 will cause the valve to move to the position shown in FIG. 3.

The hydraulic pump 84 supplies oil under controlled pressure to cylinder 60 through conduits 91, 92, relief valve 86 and conduit 94. Pressure to cylinder 62 is supplied through conduits 91, 92, reducing valve 90, conduit 96, valve 72, piston 82 having suitable passageway 83 in the position shown in FIG. 1 to connect with conduit 98 leading to cylinder 62. With the valve 72 in the position shown in FIG. 3, however, the passageway 81 in valve 72 causes conduit 98 to be connected to return discharge conduit 100 which releases the hydraulic pressure in cylinder 62 by connection of the conduit 100 to the reservoir 102.

It is important that with the valve 72 in the position shown in FIGS. 1 and 2 that hydraulic pressure is available to both cylinders 60 and 62. However, when the longitudinal ram force pressure on the wall 16 causes movement of the linkage 34 to move the valve 72 to its position shown in FIG. 3, the hydraulic pressure on cylinder 62 is momentarily released during the time such valve is in that position, but the remainder of the system is closed off with the passageway 83 and pressure is retained to the pressure allowed by the relief valve 86. Under the control of the accumulator 88 and the remainder of the hydraulic system there is assured an adequate pressure which will immediately be thrown into the conduit 98 on the return of the valve 72 to its FIG. 1 and 2 position. It is an important feature of the mechanism that it is possible by this arrangement to effect a very positive and very quick release and reapplication of a pressure on the cylinder 62 so that any movement of the wall may be quickly responsive to the change in compacting pressure and a change in the restriction will thus be gradual.

This operation of the mechanism is as follows. With the hydraulic pump 84 supplying controlled pressures to cylinders 60 and 62, material to be compacted, such as hay, is introduced into feed throat 18 and into the feed end 30 of the extruding chamber 14 by the reciprocating action of the feed ram 10, compaction of material in the extruding chamber 14 being thus effected because of the restriction of the extruding chamber 14 afforded by the inclined position of the wall 16, as shown in FIG. 2, and because of the frictional resistance of the walls of the chamber 14. On continued reciprocation of feed ram 10 compacting material into chamber 14, the frictional force in the chamber 14 may, if conditions warrant, build up to an amount sufficient to move the longitudinal wall 16 in a direction toward the discharge end 32. Such movement will occur when the rearward longitudinal force toward discharge end 32 is sufficient to overcome the restraining force of cylinder 60 on the abutment 56, which can be controlled by the setting of pressure relief valve 86. This force is resiliently maintained by the action of the pump 84 and the accumulator 88 with the hydraulic fluid acting against the compressible gas in chamber 87. This longitudinal rearward movement of the wall 16 will move the pivots 40, 42 and the linkage 52, 54 and the link 74, 76 in such amount as to shift the piston 82 of the valve 72 from the position shown in FIG. 2 to the position shown in FIG. 3. This movement will cause the pressure to drop in cylinder 62, inasmuch as the conduit 98 from cylinder 62 will be connected to the oil return conduit 100 to the reservoir 102 through the openings 81 in piston 82 of the valve 72. The same movement of the valve 72 which connects the conduit 98 to the conduit 100

to release pressure also seals off the connection of the conduit 98 to the pressure system and leaves that system available to furnish pressure for later, and very prompt, use of the pressure to again actuate the cylinder 62. The drop in pressure in the cylinder 62 will remove the restraining transverse force at the discharge end of the wall 16 and permit that end of the wall 16 to tilt and lift due to the expansion of the compacted material, thus reducing the compacted material pressure in the extruding chamber 14. Such action reduces frictional force on the walls of the chamber 14 allowing the cylinder 60 to move the wall 16 forward. The cylinder 60 has a continuing sustaining force maintained therein to return the wall 16 to a position against the stop 67 which will force the link 74 forward, resulting in a return of the piston 82 of the valve 72 to its position as shown in FIG. 1. Such action will immediately throw the pressure of the system, maintained by the accumulator and the pressure relief valve 86 and the pump 84, through the reducing valve 90 to very promptly reactivate cylinder 62. In most instances the tilting of the wall 16 from the position shown in FIG. 2 will result in small increments of change in tilt of the wall 16, and in such manner that there is only a small change in the inclination of the wall 16 with one cycle of operation very quickly accomplished. It is possible over a multiplicity of cycles to go from the condition of FIG. 2 to the condition of FIG. 3 if the material handled requires such a change to satisfy the maintenance of the longitudinal compacting force in the amount set on the cylinder 60 through the adjustment of the restricting valve 90.

Thus, with the continued operation of the compacting element, here shown as the reciprocating feed ram 10, the material to be compacted is thus moved through the extruding chamber 14 with a controlled ram force resulting from the variation in restriction afforded by the change in the inclination of the press member or wall 16, as above described. The material is thereby compacted under a predetermined controlled compacting force and is ejected at the discharge end 32 of the chamber 14.

It is to be noted that, since reciprocation of the ram 10 continues, compaction of each new charge takes place previous to the release motion of the charges in and from the discharge end of chamber 14 so that the release of compacted material at 32 does not materially affect the results (wafer density). It is important to note that the movement of the wall 16 is rearward and the rear or discharge end thereof moves upward, the latter being a partial relief. Also, regardless of the motion of the rear portion of the wall 16, that is, the retraction and extension of cylinder 62, the front lower edge 65 remains essentially in the same vertical location. To be noted also is the fact that if there is insufficient resistance in the chamber 14 to cause the wall 16 to move backward or towards the discharge end there is no relief action. Another feature is that as repeated relief cycles occur the (discharge end) rear portion of wall 16 is allowed, through the action of cylinder 62, to seek automatically a position compatible with the material going through the extruding chamber and the hydraulic pressures established in the respective cylinders 60, 62.

Another important feature is that the feed ram 10 at the end of compression stroke extends to the end of the compression chamber 12 at feed end 30 of extruding chamber 14. The compressed charge is thus forced completely into the extruding chamber 14 by this action. The advantage of this arrangement is that the introduced charge expands upward after passing the upper edge 63 (FIG. 2) of the chamber 12 and is held at this location when the ram 10 goes back on the return stroke. The offset afforded by overlap of edges 63, 65 accomplishes this result. This prevents feedback of the compressed charge into the compression chamber 12.

Wall 16 is allowed by the linkage to move a longitudinal distance at least equal to the full length of a compressed charge and this has the advantage that it is moving with the hay, thus eliminating the effects of variations in frictional resistance in that part of the chamber. Since the pressure in cylinder 60 is constant, the force necessary to move the wall 16 longitudinally will remain constant. Because of variations in the compressed charge lengths, and because of feeding variations and because control valve 72 with its piston 82 has a fixed movement, link 74 (see FIG. 5) is slotted around link 76. The slotted end of link 74 allows longitudinal wall 16 to move rearward without limitation imposed by the stroke of the piston 82 of the valve 72.

The mechanism herein made available provides a longitudinally movable and tiltable wall 16 supported as a restriction varying wall of extrusion chamber 14 with a hydraulic cylinder 62 for transverse support at the discharge end and a linkage at the feed end. The motion of the wall 16 in a compaction direction is restrained by the longitudinally acting cylinder 60, affording a continuous resilient restraining force of predetermined amount against the front support links 52, 54.

Summarizing the operation: the mechanical linkage 74, 76 between the feed end of the wall 16 and the valve 72 being available, the resulting movement of the wall 16 allowed by the restraining cylinder 60, caused by build up of excessive compacting force, results in a movement of the hydraulic control valve 72 from the position shown in FIGS. 1 and 2 to that of FIG. 3, and a pressure drop follows in the discharge end supporting cylinder 62. Such a release of pressure on the hay being extruded through the extruding chamber 14 and a discharge of compacted material with releasing of the pressure thus afforded permits the rearward restraining cylinder 60, having at all times a substantially constant pressure, to return the wall 16 to the forward position and with this movement to bring the valve 72 again to the position shown in FIG. 2 which connects the conduits 98 to conduit 96 to again build up pressure in the transverse cylinder 62 at the discharge end. The release of compacted material at the discharge end 32 may be continuous without change in the position of wall 16 if conditions are unchanged, but may also result at the time of relief of the pressure in the cylinder 62. Another cycle or increment of movement of wall 16 may be started by the build up of pressure in the cylinder 62, again positioning the longitudinal wall 16 in an inclined position slightly relieved from that of FIG. 2. It is important that the cycle above described may occur, and usually does occur, in response to a one crank impulse of compaction. Although the change in position of the wall 16 may not be great, it follows the change in conditions by increments and a large change in conditions could result in a maximum position of FIG. 3 after a plurality of position changing cycles.

The over-all effect of the mechanism herein disclosed is to sense the frictional or compacting force in the direction of compaction in the extrusion chamber and to limit such force to that allowed by the preselected pressure in restraining cylinder 60. Thus, when the compacting force pressure becomes too great the wall 16 will move longitudinally against cylinder 60 and by the resulting release of the cylinder 62 relieve this pressure. Thus the excessive compacting forces that are often produced by variable material conditions in extruding mechanisms are controlled and limited. The power saving realized by control of the compacting pressure is one of the major advantages resulting from the mechanism herein disclosed.

The invention has been illustrated by reference to a specific structure found practical in actual operation and without detracting from the generality of the statement that various modifications are intended without departing from the fundamental principles disclosed in this illustrative mechanism, it is the specific intention that the principles of control of compacting force by mechanism employing these principles is particularly not limited to

use with any one compacting force generating mechanism, here illustrated as a reciprocating element, the use of other mechanical equivalents for generating compacting force being definitely within the concept of this invention. It is also pointed out that the illustrative embodiment disclosed employs only one compacting chamber and the use of a multiple number of such chambers with mechanism for control of compaction using the principles herein disclosed is contemplated. Such multiple chambers might be arranged in positions relative to each other as the specific means of compaction or the feed mechanism employed might require. It is therefore the intention to limit the invention only by the scope of the following claims.

We claim:

1. In a compacting and extruding mechanism wherein a feeding means is employed to feed and to compact material through an extruding chamber, the combination: a longitudinal wall mounted in said extruding chamber for limited longitudinal and transverse movement, a first support member for said wall allowing limited longitudinal movement of said wall in the direction of compacting force from a forward to a rearward position, a second support member for said wall also allowing rearward longitudinal movement but actuable for positioning said wall transversely of said extruding chamber, an hydraulic system for controlling the movements of said wall comprising: a pump, means to afford a resilient and limiting pressure in said system including an accumulator and a pressure relief valve, a longitudinally positioned hydraulic cylinder for actuating said first support member whereby said first support member is resiliently and hydraulically supported in a longitudinal direction with a substantially uniform longitudinal force over its limited range of movement, a second hydraulic cylinder mounted to actuate said second support member in transverse direction while allowing limited longitudinal movement thereof with said wall as allowed by said first hydraulic cylinder, a control valve providing selective connection and disconnection of said hydraulic system to and from said second hydraulic cylinder, a linkage actuated by longitudinal movement of said wall for actuating said control valve whereby said control valve is actuated to release hydraulic pressure in said second cylinder when said wall is moved from its forward position longitudinally against the pressure of said first hydraulic cylinder, conduits in said control valve for connecting and disconnecting of said second cylinder to and from said hydraulic system and including means to release said pressure on said second cylinder on disconnection while retaining pressure in said system whereby on the movement of said control valve on return of said wall to its forward position the pressure of said hydraulic system is again quickly available to reactuate said second hydraulic cylinder.

2. In a compacting and extruding mechanism wherein a feeding means is employed to feed and to compact material through an extruding chamber, the combination:

a longitudinal wall mounted in said extruding chamber for limited longitudinal and transverse movement,

a first support member for said wall allowing limited longitudinal movement of said wall in the direction of compacting force from a forward to a rearward position,

a second support member for said wall also allowing rearward longitudinal movement but actuable for positioning said wall transversely of said extruding chamber,

means for controlling the movements of said wall, comprising:

a resilient support means contacting said first support member and resiliently supporting said first support member in a longitudinal direction with a substantially uniform longitudinal force over a limited range of movement;

a hydraulic system;

means to afford a resilient and limiting pressure in said hydraulic system including an accumulator and a pressure relief valve;

a transverse hydraulic cylinder mounted to actuate said second support member in transverse direction while allowing limited longitudinal movement thereof with said wall as allowed by said resilient support means;

a control valve providing selective connection and disconnection of said hydraulic system to and from said transverse hydraulic cylinder;

a linkage actuated by longitudinal movement of said wall for actuating said control valve whereby said control valve is actuated to release hydraulic pressure in said transverse hydraulic cylinder when said wall is moved from its forward position longitudinally against said resilient support means;

conduits in said control valve for connecting and disconnecting of said transverse cylinder to and from said hydraulic system and including means to release said pressure on said transverse hydraulic cylinder on disconnection while retaining pressure in said system, whereby on the movement of said control valve on return of said wall to its forward position the accumulated pressure of said hydraulic system is again quickly available to reactuate said transverse hydraulic cylinder.

3. In a compacting and extruding mechanism wherein a feeding means is employed to feed and to compact material through an extruding chamber, the combination:

a restricting member mounted in said extruding chamber for limited longitudinal and transverse movement for effecting variations in restriction to movement of material through said chamber,

a first support member for said restricting member allowing limited longitudinal movement of said member in the direction of compacting force from a forward to a rearward position,

a second support member for said wall also allowing rearward longitudinal movement but actuable for positioning said restricting member transversely of said extruding chamber,

means for controlling the movements of said restricting member, comprising:

a resilient support means contacting said first support member and resiliently supporting said first support member in a longitudinal direction with a substantially uniform longitudinal force over a limited range of movement;

a hydraulic system;

means to afford a resilient and limiting pressure in said hydraulic system including an accumulator and a pressure relief valve;

a transverse hydraulic cylinder mounted to actuate said second support member in transverse direction while allowing limited longitudinal movement thereof with said restricting member as allowed by said resilient support means;

a control valve providing selective connection and disconnection of said hydraulic system to and from said transverse hydraulic cylinder;

a linkage actuated by longitudinal movement of said restricting member for actuating said control valve whereby said control valve is actuated to release hydraulic pressure in said transverse hydraulic cylinder when said restricting member is moved from its forward position longitudinally against said resilient support means;

conduits in said control valve for connecting and disconnecting of said transverse cylinder to and from said hydraulic system and including means to release said pressure on said transverse hydraulic cylinder on disconnection while retaining pressure in said system, whereby on the movement of said control valve on return of said restricting member to its forward position the accumulated pressure of

said hydraulic system is again quickly available to reactuate said transverse hydraulic cylinder.

4. In a compacting and extruding mechanism wherein a feeding means is employed to feed and to compact material through an extruding chamber, the combination: a restricting member mounted in said extruding chamber for limited longitudinal and transverse movement for effecting variations in restriction to movement of material through said chamber, a first support member for said restricting member allowing limited longitudinal movement of said restricting member in the direction of compacting force from a forward to a rearward position, a second support member for said restricting member also allowing rearward longitudinal movement but actuable for positioning said restricting member transversely of said extruding chamber, means for controlling the movements of said restricting member, comprising: a resilient support means contacting said first support member and resiliently supporting said first support member in a longitudinal direction with a substantially uniform longitudinal force over a limited range of movement; a hydraulic force generating means to afford a resilient and limiting force, including a force accumulator in said force generating means; a hydraulic transverse force applying means to actuate said second support member in transverse direction while allowing limited longitudinal movement thereof with said restricting member as allowed by said resilient support means; a control connecting

means providing selective connection and disconnection of said hydraulic force generating means to said transverse force applying means; a linkage actuated by longitudinal movement of said restricting member for actuating said control connecting means, whereby said connecting means is actuated to release said transverse force applying means when said restricting member is moved rearward from its forward position longitudinally against said resilient support means; elements in said control connecting means for connecting and disconnecting of said hydraulic transverse force applying means, and means actuating said control connecting means on return of said restricting member to its forward position to positively and immediately reactuate said hydraulic transverse force applying means.

5. The invention as defined in claim 4 wherein said means actuating said control connecting means comprises means to cause said restricting member to seek a position compatible with the resistance to compaction of said material.

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