Sept. 22, 1953 H. S. MESSING 2,652,935

ROTARY FEEDING DEVICE

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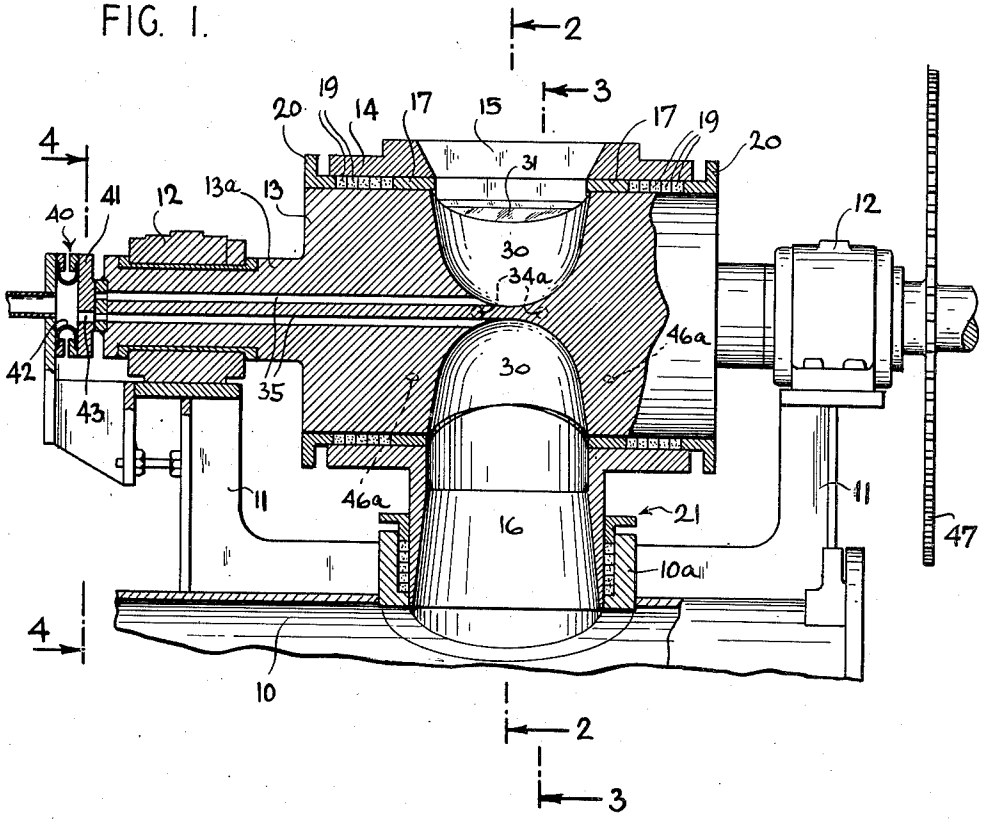
FIG. 1.



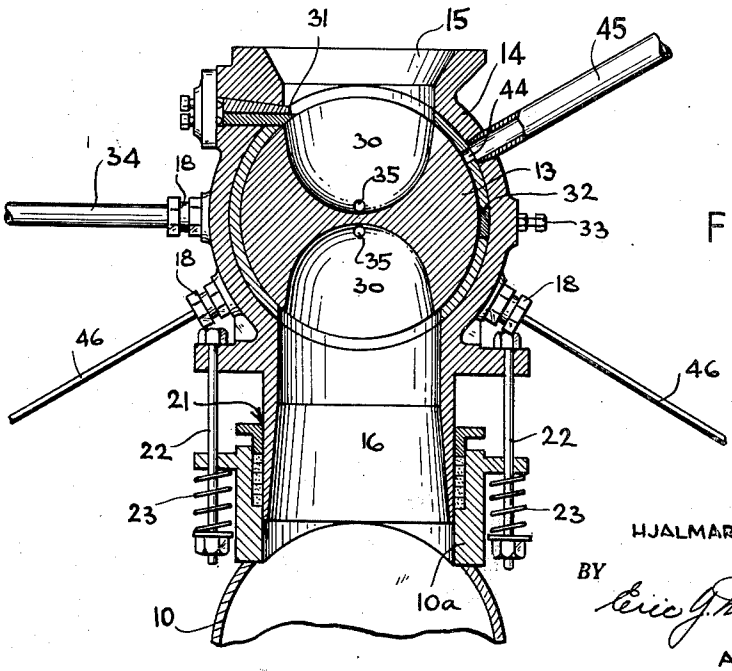


FIG. 2.

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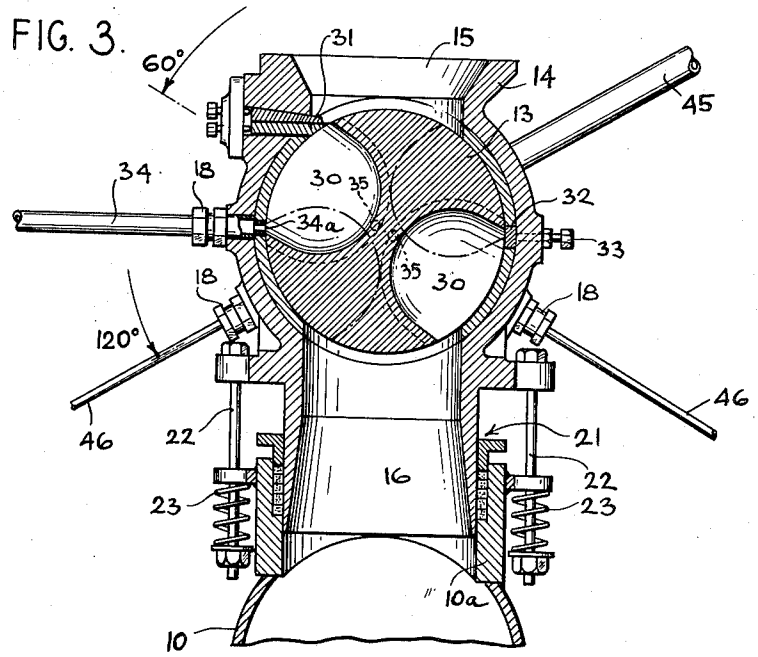
FIG. 3.



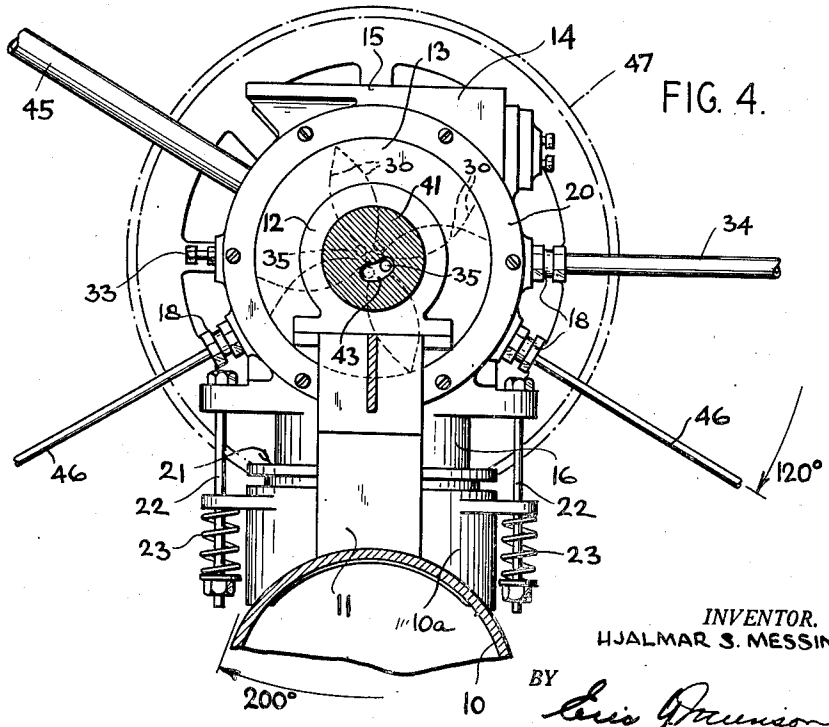


FIG. 4.

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ROTARY FEEDING DEVICE

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FIG. 5.

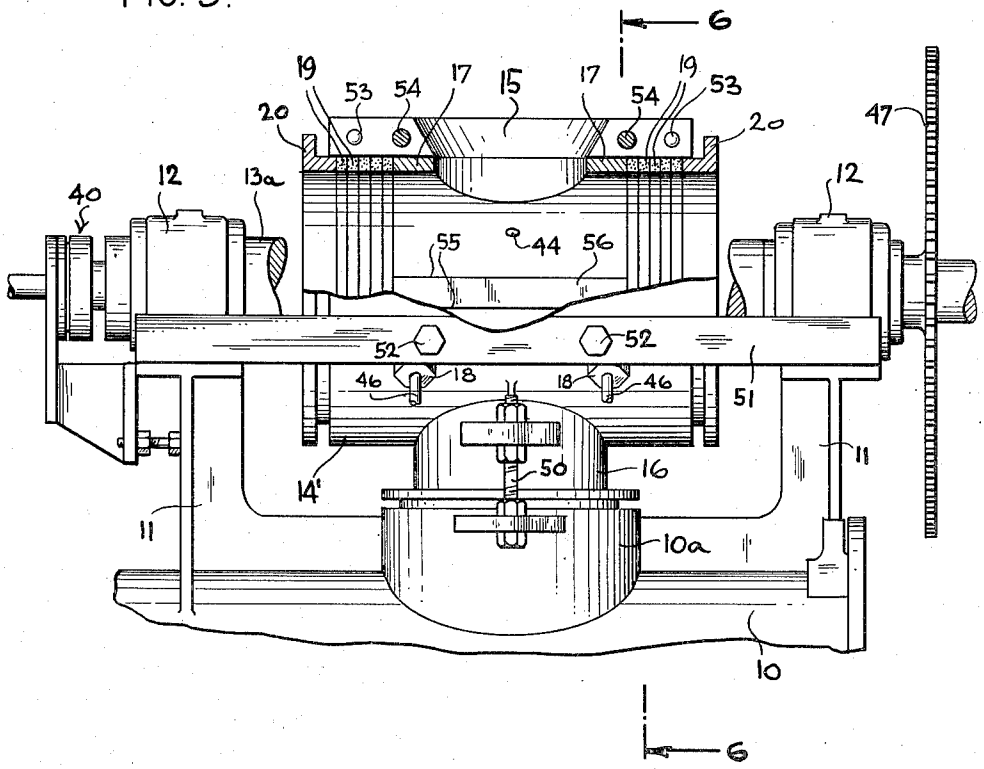
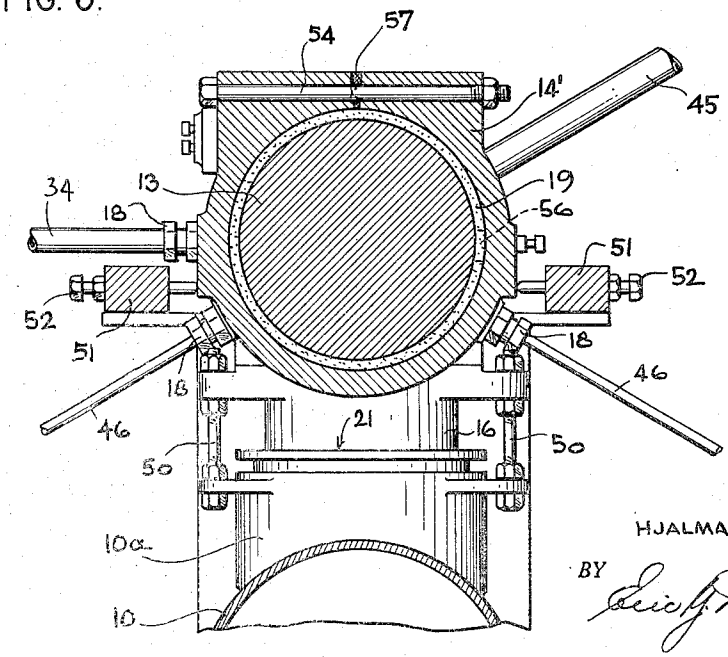


FIG. 6.



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ROTARY FEEDING DEVICE

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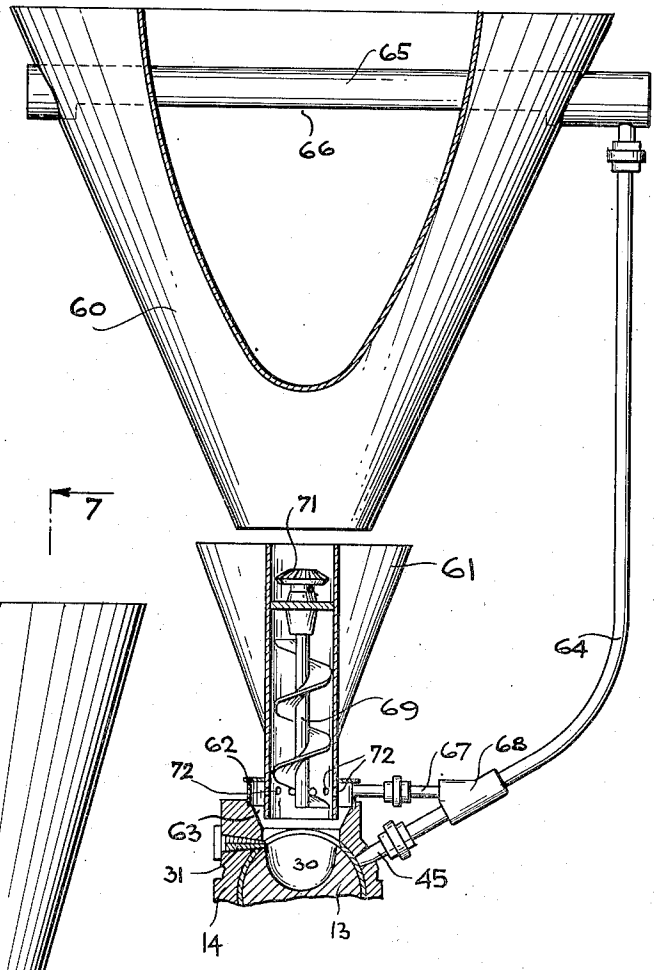
FIG. 7.



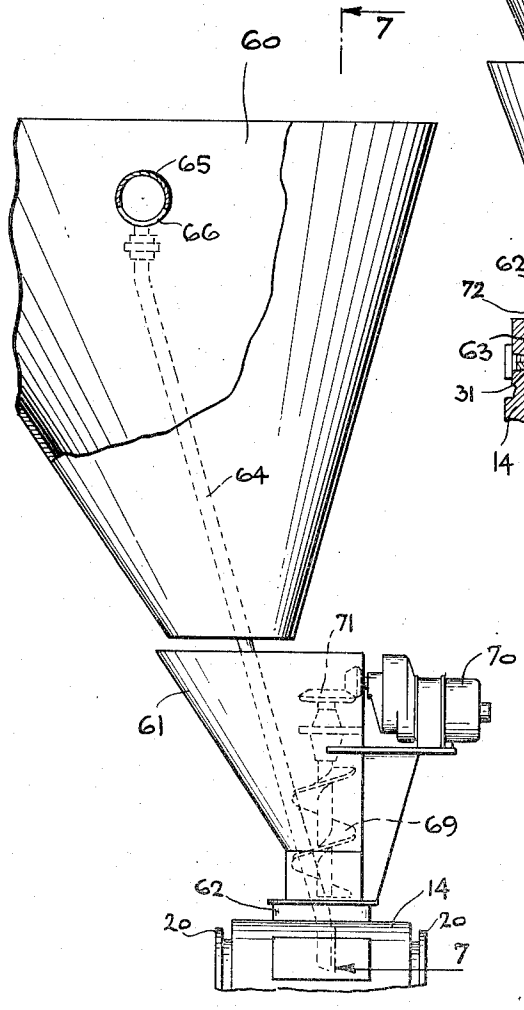


FIG. 8.

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ROTARY FEEDING DEVICE

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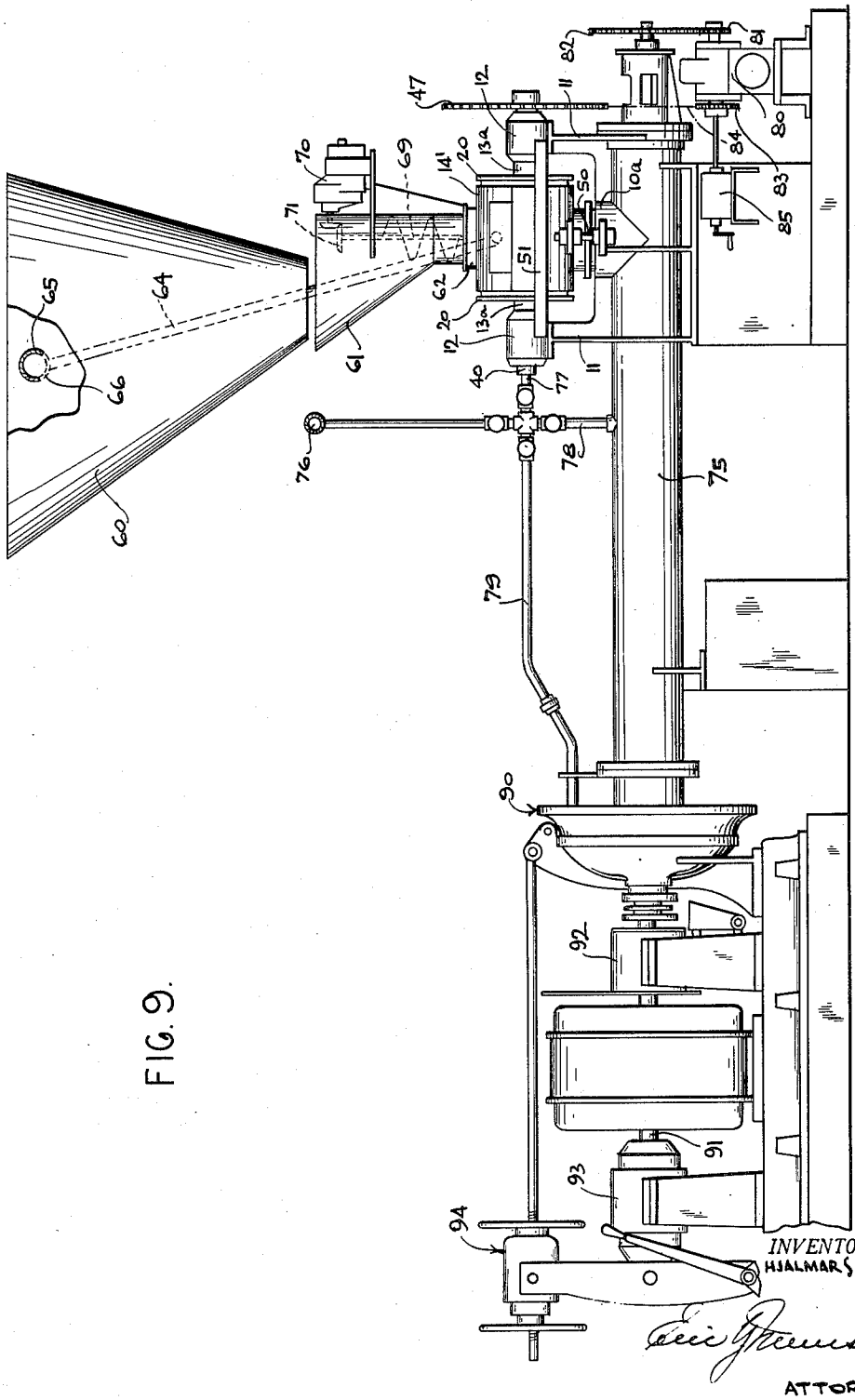

FIG. 9.

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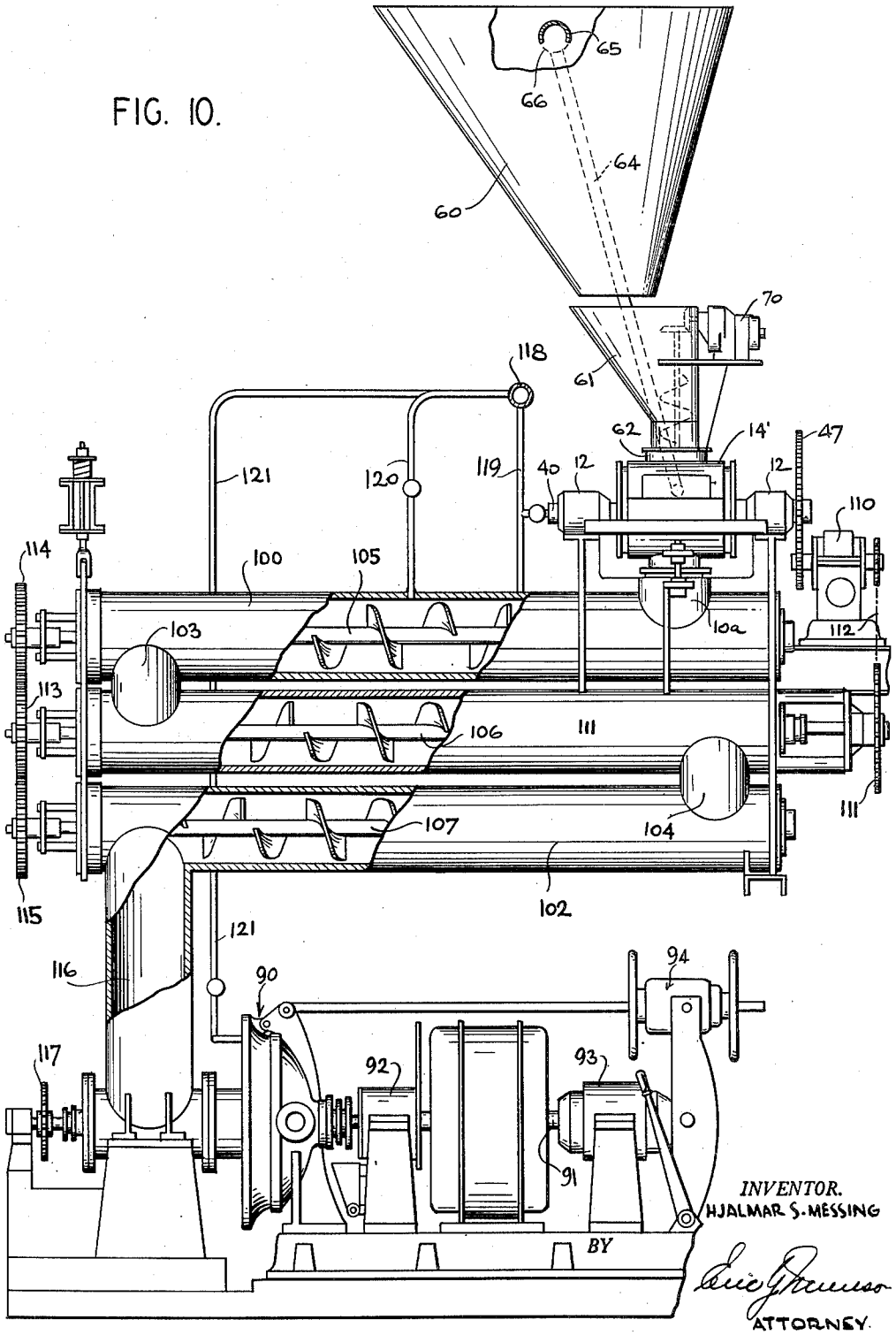
FIG. 10.



Patented Sept. 22, 1953

2,652,935

UNITED STATES PATENT OFFICE

2,652,935

ROTARY FEEDING DEVICE

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Application April 21, 1949, Serial No. 88,733

7 Claims. (Cl. 214—17)

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This invention relates to an improved apparatus for feeding material into a closed pressure system. More particularly, it relates to improvements in feeding devices over that disclosed in U. S. Patent 2,145,851 to Asplund concerning apparatus for the production of pulp from lignocellulose materials, such as wood chips and the like. It should be understood, however, that although the invention has been described specifically as a feeding device, it may also find application as a discharge mechanism for a closed pressure system.

The Asplund system involves the use of a pressure chamber in which the material to be pulped is subjected to an environment of steam or other gaseous environment chemically inert to the material, the temperature of the environment being above 212° F. and sufficiently high to markedly soften the ligneous substance of the middle lamella which binds the individual fibers together, after which the material is mechanically refined or defibrated while in the same environment and under the same conditions. In order to adapt the apparatus for continuous operation the material being fed into the system has heretofore been compacted and compressed into dense plugs by a pressure-feeding device to a sufficient extent to resist the pressure in the pressure chamber and prevent the leakage of steam past the plug in the plug-forming pipe.

The mechanical pressure-feeding device in the Asplund system usually takes the form of a continuously rotating screw feed which compresses the wood chips or other material into a dense plug and maintains a constant pressure against the plug in the plug forming pipe or, alternatively, takes the form of a reciprocating plunger which operates in a similar manner but which requires the formation of stepped corrugations or conical projections on the inside of the plug-forming pipe in order to resist the steam pressure in the pressure chamber during the retraction of the plunger. The plunger exerts a pressure on the material of from 2000 to 3000 pounds per square inch.

It has now been found that the compression of the material into plugs frequently results in damage to the fibers having a deleterious effect on the strength and folding qualities of the pulp and the products made therefrom. Furthermore, while the screw feeder has proven suitable with chips like hemlock, aspen, maple, birch, oak and the like, difficulty has been encountered with resinous materials such as certain of the pine woods, particularly if subjected to treatment with certain types of chemicals such as

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caustic soda, lime and sodium sulfide. Accordingly, it is a primary object of the invention to provide a feeding device which will eliminate the detrimental effects caused by compression of the material and which will obviate the aforementioned disadvantages.

Another object of the invention is the provision of a feeding device of the character indicated which may be effectively employed for feeding almost any kind of material, whether the material be in a dry condition or in a wet and sloppy condition while simultaneously insuring positive feeding and uniformity in the pulp produced in the pressure system. The device is particularly adaptable for use in a process wherein the pulp stock to be treated is a screen reject of relatively low consistency such as obtained in the sulphate and sulphite pulping industries.

A further object is to provide a resilient mounting for a rotary feeding or discharge mechanism for pulp making machinery and the like which will make allowance for thermal expansion, and reduce friction between the stationary and rotary parts, while still maintaining a pressure seal on the system so as to prevent "blow back" of the material which might cause serious injury to the operators.

An additional object of the invention is the provision of a feeding device which is constructed and arranged in such a manner as to allow the convenient addition of chemical reagents where required while the feeding is carried out in a smooth, continuous and uninterrupted manner.

The foregoing objects as well as additional objects and advantages of the invention will be readily apparent in the course of the following detailed description taken in connection with the accompanying drawings which illustrate preferred embodiments of the invention and wherein:

Fig. 1 is a view partly in section and partly in elevation of an improved feeding device embodying the features of the invention;

Fig. 2 is a sectional view taken on line 2—2 of Fig. 1;

Fig. 3 is a view similar to Fig. 2, but taken on line 3—3 of Fig. 1 and illustrating another position of the rotor of the feeding device;

Fig. 4 is a sectional view taken on line 4—4 of Fig. 1;

Fig. 5 is an elevational view, partly broken away to show internal structure, of a modified form of feeding device;

Fig. 6 is a sectional view taken on line 6—6 of Fig. 5;

Fig. 7 is an enlarged sectional detail of the

feeding hopper arrangement taken on line 7—7 of Fig. 8;

Fig. 8 is a side elevation of Fig. 7;

Fig. 9 is an elevational view of the feeding device installed in a typical Asplund system including the pressure vessel, mechanical defibrating apparatus and novel feeding hopper arrangement; and

Fig. 10 is a view similar to Fig. 9 illustrating the feeding device in use in conjunction with a modified form of pressure vessel.

Referring first to Figs. 1 to 4, the pressure vessel upon which the rotary feeder is mounted is designated at 10 and is provided with a pair of fixed bearing supports 11 carrying bearings 12 for rotatably supporting the rotor 13 of the rotary feeder. A housing 14 having an intake opening 15 and a discharge conduit 16 surrounds rotor 13 and is preferably formed with a single circular bore within which is retained a sleeve or liner 17. Said liner may be fastened to housing 14 by means of hollow threaded plugs 18 which also serve as connections for various supply lines for lubrication and chemical-treatment, as will appear more fully hereinbelow. Housing 14 is provided with packing rings 19 and a packing gland 20 at both ends of the rotor 13.

In order to compensate for the heat expansion of the pressure vessel 10 and to balance the housing 14 around the rotor 13 in such a manner that frictional wear between the rotor and liner 17 will be minimized, discharge conduit 16 of the rotor feeder is mounted on the inlet conduit 10*a* of pressure vessel 10 by means of a packing box connection indicated generally at 21 and provision is made to substantially prevent any upward thrust exerted by thermal expansion of the pressure vessel from being communicated to the feeder housing. For this reason spring-loaded tie bolts 22 interconnect inlet conduit 10*a* with housing 14. Said tie bolts are given a downward spring load by means of springs 23 in order to achieve rotor-housing balance. It should be understood, however, that springs may not be necessary to provide a resiliency between the housing and the rotor as this would normally be provided by the conventional packing. Once the housing has adjusted itself around the rotor due to the differential in thermal expansion, its position may be adjusted by the tie bolts 22.

Rotor 13 is provided with a pair of oppositely disposed pockets 30 which alternately receive a charge of fresh chips or other material and discharge the material into the pressure vessel 10 during continuous rotation of said rotor. An adjustable knife 31 is provided at housing intake 15 for cooperating with the trailing edge of each pocket 30 for effective cutting when a fresh charge of material passes downwardly into the housing so that none of the material might lodge between the rotor 13 and the housing liner 17. An adjusting bar 32 may be regulated by means of set screws 33 for adjusting the clearance between the rotor and the liner as required and incident to progressive wear on the parts with continued use. A pair of supply lines 34 may be provided for introducing sulphite solution or any other desired chemical reagent into the charged pocket 30 as the rotor revolves, said supply lines being connected to a pair of threaded plugs 18 and the inner ends of said lines terminating at the liner 17 being designated 34*a* in Fig. 1. Assuming that the reagent openings 34*a* are disposed in horizontal position, reagent will enter the charged pocket during the interval between 60 degrees and 120 degrees rotation of the rotor from its initial charging position, as clearly shown in Fig. 3. It will be understood, however, that the supply lines 34 are not critical to the invention.

Another feature of the invention resides in the provision of an arrangement for discharging the contents of the previously charged pocket 30 into pressure vessel 10 with continuous rotation of rotor 13 and while retaining a permanent seal on the pressure system. As best shown in Fig. 1 rotor 13 is provided with trunnions 13*a* which are supported in fixed bearing 12. An axial passageway or channel 35 extends from the bottom of each pocket 30 to the end of rotor trunnion 13*a* and communicates with a steam box generally designated 40 which is arranged to deliver a jet of steam (at higher pressure than in the pressure vessel 10) to the bottom of pocket 30 as the pocket approaches and passes through its discharge position in registration with the opening of discharge conduit 16. The operation of the discharge arrangement is apparent from Figs. 1 and 4 wherein the steam box 40 is illustrated as comprising a stationary valve or disc 41 constantly urged into steam tight engagement with the rotating rotor trunnion 13*a* by means of a spring-loaded or bellows-type mechanism 42. Disc 41 is provided with an arcuate opening 43 for discharging steam under pressure into the passageway 35 communicating with the bottom of the charged pocket 30 during the interval of rotation of the rotor 13 when said passageway remains in registration with said arcuate opening. The length of the interval of steam penetration will depend of course upon the size and disposition of the arcuate opening 43 and in the particular case illustrated in the drawing steam will be operative to discharge the contents of pocket 30 approximately during the interval between 120 degrees and 200 degrees rotation of the rotor from the initial charging position, as shown in Fig. 4.

It should be understood, however, that the invention is not limited to an arrangement for delivering a jet of steam to the bottom of the pocket 30, but may, under certain circumstances, be used with equal advantage without the introduction of such a jet of steam particularly when the devise is used as a discharge mechanism. In certain circumstances, the force of gravity is sufficient to cause the material to drop from the pocket 30 into the pressure vessel.

After the material in the pocket 30 has been discharged, steam will fill the pocket at the pressure prevailing in pressure vessel 10. In order to relieve the steam pressure in the emptied pocket prior to refilling the pocket with a fresh charge of material, an opening 44 is provided in liner 17 (see Fig. 2) communicating with a blow-off conduit 45. In the illustrated arrangement the pocket steam will empty out through blow-off conduit 45 during the interval of rotation of the rotor 13 from approximately 270 degrees to 330 degrees with respect to the initial position of Fig. 2. In the preferred embodiment of the invention the blow-off steam is arranged to be conveyed to the material to be fed in the feeding hopper, thereby dissipating the pressure and utilizing the heat to preheat the material, as shown in Figs. 8 and 9 and as will be more fully described hereinbelow.

As the pocket 30 again approaches the charging position of Fig. 2 it will be noted that the pocket will dig upwardly into the material being

fed for approximately half of the charging period resulting in a solid filling.

Forced feed lubrication is provided for the rotor 13 by means of oil supply lines 46 connected to two pairs of the threaded plugs 18 on opposite sides of housing 14, the inner ends of said supply lines terminating at liner 17 being designated 46a (see Fig. 1). Rotor 13 may be driven from a suitable power source by means of sprocket 47 and a chain drive or in any other suitable manner.

Figs. 5 and 6 illustrate a modified form of rotary feeder and like parts with respect to the initial embodiment are assigned like reference numerals. Housing 14' is mounted on inlet conduit 10a of pressure vessel 10 using tie bolts 50 which are preferably capable of two-way adjustment. Reinforcing bars 51 are secured firmly between bearing supports 11 on both sides of housing 14' and each of said bars carries set screws 52. By properly adjusting said set screws the housing 14' may be supported and steadied against the pressure kick occurring as the pockets 30 move to horizontal position prior to the release of the steam pressure through the blow-off conduit 45.

Housing 14' is split or cut open longitudinally at the top thereof and provided with a pair of press bolts or stops 53 and a pair of tie bolts 54. By reason of this arrangement the clearance between the rotor 13 and the housing liner 17 may be conveniently adjusted as desired. Liner 17 is cut away at 55 leaving room for the loosely fitting adjusting bar 56, thereby allowing the liner to contract or expand around the rotor by the pull or push exerted by tie bolts 54 and press bolts 53 respectively. The split housing 14' may be effectively sealed after adjustment by a filling of graphite paste or other suitable material indicated at 57 in Fig. 6. The remaining features and the operation of the embodiment of Figs. 5 and 6 are similar to the initial embodiment and need not be repeated.

In the preferred embodiment of the invention the blow-off steam from the emptied rotor pocket 30 is utilized for preheating the material being fed to the pressure vessel and simultaneously for evacuating the pocket in its charging position in order to facilitate charging of the pocket with a solid fill of fresh material. A preferred arrangement for achieving this purpose is illustrated in Figs. 7 and 8. Feeding hopper 60 is arranged to discharge the material by gravity into a feeding funnel 61 mounted at the intake of the housing 14 of the rotary feeder. Funnel 61 is provided with an annular jacket 62 closing the mouth of the housing and defining an intake chamber 63. Steam passes from blow-off conduit 45 to a conduit extension 64 which is in turn connected to a horizontal steam pipe or shield 65 disposed adjacent the top of feeding hopper 60. The lower part of steam pipe 65 is cut away longitudinally at 66 in order to direct the steam (under pressure) downwardly upon the material being fed. An ejector or aspirator pipe 67 extends from intake chamber 63 into blow-off extension 64 by means of a suitable fitting 68. A feeding screw 69 driven by a suitable motor 70 and gearing 71 is arranged vertically in funnel 61 in order to facilitate positive feeding of the material into the intake chamber 63. Funnel 61 extends below the top of outer jacket 62 into intake chamber 63 and is provided adjacent its bottom edge with a series of perforations 72. By reason of the described arrangement it is apparent that as the rotor 13 brings the emptied pocket 30 into charging position the passage of steam through blow-off conduits 45 and 64 will operate to create suction in intake chamber 63 resulting in the evacuation of gas and air from said chamber and from the rotor pocket and thereby facilitating rapid and solid filling of the pocket.

Fig. 9 illustrates the application of the rotary feeder to an Asplund system for manufacturing pulp wherein the feeder is mounted on a pressure vessel or preheating chamber 75 wherein the material is subjected to the action of steam at temperatures above 212° F. and elevated pressure. The shape and size of pressure vessel 75 may be varied in accordance with the desired treating time and capacity of the system required. Steam is supplied to the rotary feeder, the pressure vessel 75 and the mechanical defibrating unit from a steam main 76 of supply line branches 77, 78 and 79 respectively. The material is continuously conveyed within pressure vessel 75 toward the defibrating unit 90 by means of an internal screw conveyor (not shown) which may be driven from a motor 80 by means of gears 81 and 82. The rotor of the feeding device may be powered from motor 80 by means of a sprocket 83 and chain drive 84 operatively connected with rotor sprocket 47, or in any other suitable manner. A lubricator 85 may be provided for forced feed lubrication of the feeder rotor through supply lines 46.

The defibrating unit 90 comprises elements shown and described in the aforementioned Asplund patent and essentially comprises a stationary abrading disc (not shown) and a rotary abrading disc mounted on a shaft 91 journaled in bearings 92 and 93. Adjusting mechanism 94 is provided to exert pressure on shaft 91 in order to regulate the clearance betwen the stationary and rotating abrading discs which mechanically separate and refine the fibers. A detailed description of the defibrator unit may be found in the Asplund patent referred to hereinabove.

Fig. 10 illustrates the use of the rotary feeder of the present invention with a modified form of pressure vessel having a greater capacity and treating time than the pressure vessel illustrated and comprising a compact unit including a plurality of series-arranged horizontal portions 100, 101, 102, interconnected by passages 103 and 104, respectively. The material fed into the system by the rotary feeder is conveyed through upper section 100 toward passage 103 by means of a screw conveyor 105, then through intermediate section 101 toward passage 104 by means of screw conveyor 106 and finally through lower section 102 and toward defibrator unit 90 by means of screw conveyor 107. Screw conveyors 105, 106 and 107 are preferably formed with interrupted flights, as shown in Fig. 10 for thorough mixing of the material and for continuously lifting and dropping portions of the material out of and into the treatment mixture. Intermediate screw conveyor 106 may be driven from motor 110 by means of a sprocket 111 and chain drive 112. Said screw conveyor may carry at its opposite end a gear 113 for driving upper and lower screw conveyors 105 and 107 by means of gears 114 and 115 respectively. All of said screw conveyors are preferably removable from their respective pressure vessel sections for cleaning and repair purposes.

Lower section 102 is connected to the defibrator unit 90 by means of a pipe section 116

through the bottom of which the material is fed to the defibrator unit by an internal screw feed driven by means of a sprocket 117. The remaining essential elements of the defibrator unit having been assigned the same numerals as in Fig. 9. Steam is supplied to the rotary feeder, the pressure vessel sections and the defibrating unit from a steam main 118 by means of supply line branches 119, 120 and 121 respectively.

It should be understood that the foregoing description is given by way of example only and lends itself to a variety of modifications, within the scope of the accompanying claims. Thus while the pockets 30 have been shown as a pair of oppositely disposed pockets, the invention contemplates also one single pocket as well as more than two pockets.

It will also be understood that the invention may be operated with or without means for introducing a chemical reagent depending upon the type of pulp desired.

Furthermore, although the invention has been described as specifically applicable to pulp making machinery, it should be understood that the device may be used in connection with any pressure vessel.

What is claimed is:

1. In combination with a pressure vessel in a closed pressure system, a feeding device for introducing material into said vessel while maintaining a pressure seal thereupon, said device comprising a housing having an intake opening and a discharge conduit, a member supported independently for rotation within said housing on a fixed axis of rotation, said member having pockets for receiving and discharging material into said vessel, said rotatable member having means for conveying a pressure medium to each of said pockets in the discharge position thereof at a pressure higher than the pressure prevailing in said vessel, said housing being split longitudinally for its entire length, tie bolts for pulling the split portions of said housing toward each other and stop members limiting the approach of said split portions for adjusting the clearance between said rotatable member and said housing.

2. In combination with a pressure vessel in a closed pressure system, a feeding device for introducing material into said vessel while maintaining a pressure seal thereupon, said device comprising a housing having an intake opening and a discharge conduit, a member supported independently for rotation within said housing on a fixed axis of rotation, said member having pockets for receiving and discharging material into said vessel, said rotatable member having means for conveying a pressure medium to each of said pockets in the discharge position thereof at a pressure higher than the pressure prevailing in said vessel, said housing being split longitudinally for its entire length, tie bolts for pulling the split portions of said housing toward each other and stop members limiting the approach of said split portions for adjusting the clearance between said rotatable member and said housing, a feeding funnel defining an intake chamber at the intake opening of said housing, said housing defining a blow-off conduit for relieving the pressure within each pocket subsequent to the discharge of material into said pressure vessel and an aspirator conduit interconnecting said intake chamber with said blow-off conduit, whereby to facilitate charging of the pocket and to evacuate said intake chamber while the pocket is in charging position.

3. In combination with a pressure vessel in a closed pressure system, a feeding device for introducing material into said vessel while maintaining a pressure seal thereupon, said device comprising a housing and a rotatable member revolving within said housing, said rotatable member having at least one pocket for receiving and discharging material into said vessel, said housing being resiliently adjustably mounted on said pressure vessel, said rotatable member being supported for rotation on a fixed axis independently of said housing, whereby to accommodate thermal expansion of said vessel and to minimize wear between said rotatable member and said housing.

4. In combination with a pressure vessel in a closed pressure system, a feeding device for introducing material into said vessel while maintaining a pressure seal thereupon, said device comprising a housing and a rotatable member revolving within said housing, said rotatable member having at least one pocket for receiving and discharging material into said vessel, said housing being resiliently mounted on said pressure vessel, said pressure vessel having bearing supports for mounting said rotatable member on a fixed axis of rotation independently of said housing, whereby to accommodate thermal expansion of said vessel and to minimize wear between said rotatable member and said housing.

5. In combination with a pressure vessel in a closed pressure system, a feeding device for introducing material into said vessel while maintaining a pressure seal thereupon, said device comprising a housing having an intake opening and a discharge conduit and a rotatable member revolving within said housing, said rotatable member having at least one pocket for receiving and discharging material into said vessel, a packing box connection between the discharge conduit of said housing and said pressure vessel, spring-loaded tie bolts interconnecting said discharge conduit and said pressure vessel, said rotatable member being supported for rotation on a fixed axis independently of said housing, whereby to accommodate thermal expansion of said vessel and to minimize wear between said rotatable member and said housing.

6. In combination with a pressure vessel in a closed pressure system, a feeding device for introducing material into said vessel while maintaining a pressure seal thereupon, said device comprising a housing having an intake opening and a discharge conduit and a rotatable member having at least one pocket for receiving and discharging material into said vessel, a packing box connection between the discharge conduit of said housing and said pressure vessel, spring-loaded tie bolts interconnecting said discharge conduit and said pressure vessel, said pressure vessel having bearing supports for mounting said rotatable member on a fixed axis of rotation independently of said housing, whereby to accommodate thermal expansion of said vessel and to minimize wear between said rotatable member and said housing.

7. In combination with a pressure vessel in a closed pressure system, a feeding device for introducing material into said vessel while maintaining a pressure seal thereon, said device including a housing having an intake opening and a discharge conduit and a rotatable member having at least one pocket for receiving and discharging material into said vessel, the pressure vessel beng provided with an inlet conduit within which the discharge con-

duit of the housing is fitted and within which the said discharge conduit is axially adjustable, sealing means between said discharge conduit and inlet conduit, spring means connecting the housing and the pressure vessel to permit of movement of the housing relatively to the pressure vessel and to permit of telescoping movement of the discharge conduit within the inlet conduit, said pressure vessel having bearing supports for mounting the rotatable member on a fixed axis of rotation independently of the housing, whereby to accommodate thermal expansion of said vessel and to minimize wear between said rotatable member and said housing.

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