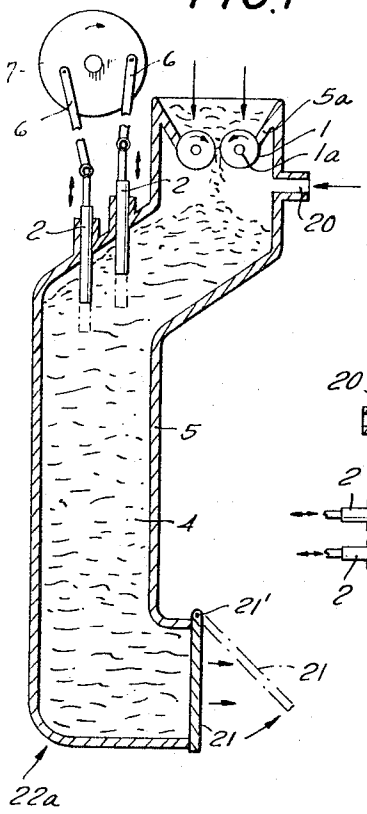
May 16, 1967 H. FLEISSNER ETAL 3,319,441

MATERIAL TREATING APPARATUS

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FIG. 1



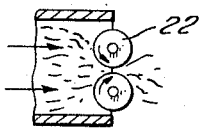


FIG. 3

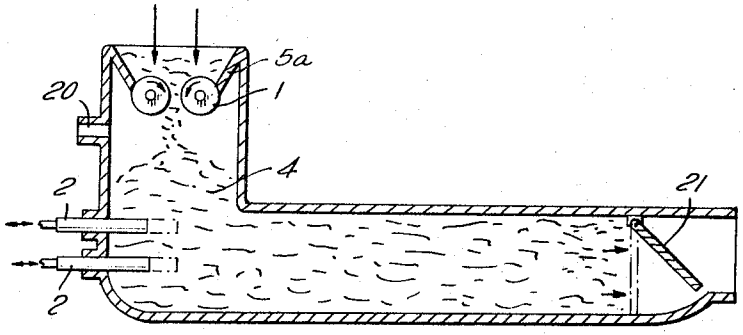
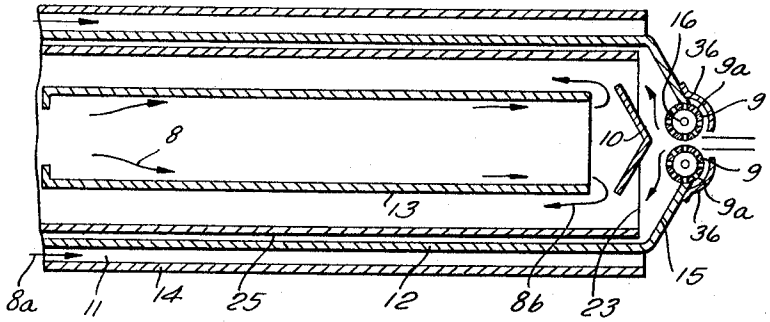


FIG. 2

FIG. 4



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FIG. 5

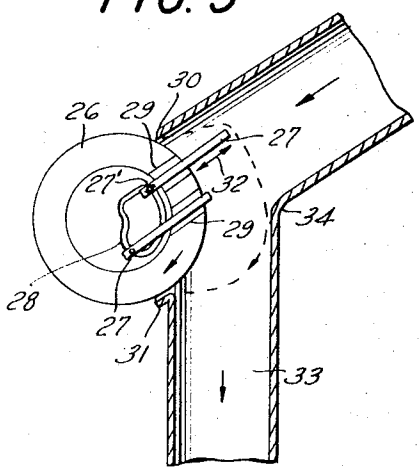
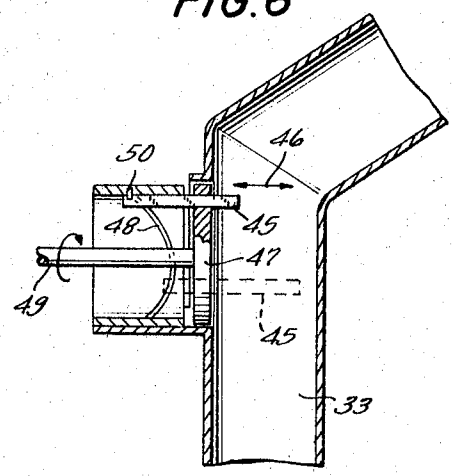


FIG. 6



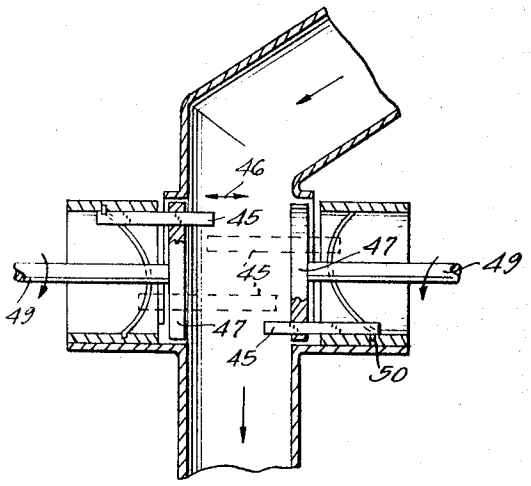


FIG. 6a

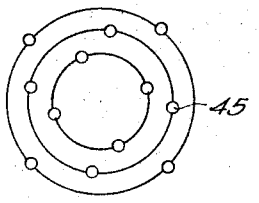


FIG. 7

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BY

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3,319,441

MATERIAL TREATING APPARATUS

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Filed Nov. 12, 1963, Ser. No. 322,789
Claims priority, application Switzerland, Nov. 12, 1962, 13,193/62; Jan. 4, 1963, 93/63
17 Claims. (Cl. 68—5)

The present invention relates to material treating apparatus and in particular to apparatus which is adapted to treat material which can be compacted from a relatively loose condition into a relatively dense condition.

The invention relates in particular to apparatus for treating material of this type with a treating fluid where the treatment must be carried out in a manner closed off from the outer atmosphere.

There are many treatments which require relatively loose material to be uniformly treated with a treating fluid, and often these treatments are required to take place at elevated temperatures. For example, when dyeing textile materials it is necessary to very uniformly treat the textile materials at an elevated temperature with a fluid such as steam in order to fix the coloring of the textile materials and thus prevent non-uniform dyeing which will result in spots and other defects in the final product. Moreover, such treatments should be carried out as much as possible in the absence of atmospheric oxygen.

It is accordingly a primary object of the present invention to provide an apparatus which can uniformly treat material with a treating fluid while maintaining the material during the treatment thereof out of communication with the outer atmosphere.

It is in particular an object of the present invention to provide an apparatus capable of treating material in this way with a fluid such as steam while maintaining the elevated temperature of the treating fluid.

Also, it is an object of the present invention to provide an exceedingly uniform treatment of relatively loose material without interrupting the advance of the material through the treating apparatus.

Yet another object of the present invention is to provide an apparatus which will reliably maintain the material in relatively loose condition during part of the transportation of the material through the treating apparatus so that a very intimate contact between the treating fluid and the material will be provided.

It is furthermore an object of the present invention to provide a structure which is relatively simple and very reliable in operation and which at the same time can accomplish all of the above objects.

With these objects in view the invention includes, in a material treating apparatus, a container having an inlet and an outlet and a compacting means located at least in part in the container between the inlet nd outlet thereof and communicating in a substantially fluid-tight manner with the interior of the container for compacting material in the container and for advancing the material toward the outlet thereof. A feeding means is located at the inlet of the container for feeding into the container a loose material which is capable of being compacted by the compacting means, and a means is located at the inlet of the container for substantially preventing communication between the interior and exterior of the container at the inlet thereof. A retarding means is located at the outlet of the container for retarding the movement of the material out of the container through the outlet thereof, so that in this way the material will be maintained in a relatively loose condition between the compacting means and the inlet of the container and in a relatively dense condition between the compacting means and the outlet of the

container, the compacting means advancing the material toward and out through the outlet in opposition to the retarding means. A conduit means communicates with the interior of the container for introducing a treating fluid into the container to treat the material therein, and of course between the compacting means and the inlet of the container the loose condition of the material greatly enhances the thorough treatment thereof by the treating fluid.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

FIG. 1 is a schematic illustration of one possible embodiment of a structure according to the present invention;

FIG. 2 is a schematic illustration of another embodiment of a structure according to the present invention;

FIG. 3 shows a variation of the structure at the outlet of the treating container of the invention;

FIG. 4 schematically illustrates another embodiment of a compacting means of the invention;

FIG. 5 is a schematic illustration of a further embodiment of a compacting means according to the present invention;

FIG. 6 shows yet another embodiment of a compacting means according to the present invention;

FIG. 6*a* shows a modification of the compacting means shown in FIG. 5; and

FIG. 7 is a schematic illustration of the manner in which shiftable elongated members of the embodiment of FIG. 6 may be arranged on the disc thereof.

Referring now to FIG. 1 it will be seen that the structure illustrated therein includes an elongated container **5** having an upper inlet and a lower outlet, as viewed in FIG. 1. The upper portion of the container has a cranked configuration, as shown in FIG. 1. The material which is to be treated enters the container **5** through the top inlet thereof and a feeding means in the form of a pair of rollers **1** is located at the inlet of the container **5** to feed the material into the same. A means is provided to keep the interior of the container closed off from the exterior thereof at the inlet of the container, and this means includes wall portions **5***a* of the container which closely surround the feeding rollers **1**, which form a hopper for the material, and which thus cooperate with the rollers **1** to substantially seal off the interior of the container from the outer atmosphere, the material simply falling downwardly along the interior of the container after passing through the feeding means **1** which is composed of a pair of rollers rotating in opposite directions as shown by the arrows of FIG. 1 and driven by any suitable drive means located at the exterior of the container **5**, the shafts **1***a* which support the rollers **1** extending fluid-tightly into the walls of the container **5**.

A compacting means is located between the inlet and outlet of the container and communicates fluid-tightly with the interior thereof for compacting the material in the interior of the container, and in the embodiment of FIG. 1 this compacting means takes the form of a pair of tampers **2** which reciprocate in the longitudinal direction of the elongated container **5** and which during their reciprocation will engage the material during the downward strokes of the tampers **2**, as viewed in FIG. 1, for advancing the material downwardly toward the outlet of the container while compacting the material between the compacting means **2** and the outlet of the container, the material of course remaining in a relatively loose con-

dition between the compacting means 2 and the upper inlet of the container 5.

A conduit means 20 communicates with the interior of the container for feeding into the interior thereof a treating fluid such as steam, and because the material is in a relatively loose condition between the inlet of the container and the compacting means 2, there will be a very thorough uniform treatment of the material in its relatively loose condition by the treating fluid. It will be noted that in the illustrated example the conduit means 20 communicates with the container 5 between the compacting means 2 and the inlet of the container 5. The steam which is introduced into the container in this way simply travels with compacted material to the exterior of the container, the compacted material 4 being advanced toward the lower outlet of the container 5 by the compacting elements 2 and leaving the container in a relatively dense condition. A retarding means retards the flow of the material 4 out through the outlet of the container so that the retarding means in combination with the compacting means 2 will result in a relatively dense packing of the material, and this retarding means includes a swingable door 21 pivotally connected at its upper edge by a hinge 21' to the outlet end of the container and capable of being swung away from the outlet of the container to open the outlet by the advance of the material itself, as shown by the dotted-line position of the door 21 at the lower part of FIG. 1.

In addition, the retarding means may simply take the form of a curved portion 22*a* of the container which provides the container at its outlet end with a portion extending in a direction different from the remainder of the container so that because of the change in the direction of the material as it approaches the outlet the flow of the material is necessarily retarded, and thus a curved portion 22*a* by itself or in combination with a door 21, or a door 21 by itself may form the retarding means of the invention.

Any suitable driving structure may be connected to the tampers 2 for reciprocating the latter, and it will be noted that these tampers are guided for reciprocating movement in sleeves which are fixed to the wall of the container so that in this way a fluid-tight communication between the tampers and the interior of the container is guaranteed. The pair of tampers 2 may be driven by a common drive means or may be individually driven, and the synchronism between the strokes of the tampers 2 may be regulated in such a way that the tampers 2 move in synchronism or out of phase with each other to a selected degree. Thus, portions of the tampers 2 which extend upwardly beyond the guide sleeves may be pivotally connected to connecting rods 6 which in turn are pivotally connected to a rotary disc 7 at locations spaced from the center thereof so that in this way a crank drive can be transmitted to the tampers 2 for reciprocating the latter. It is also possible to provide additional tampers at the curved region 22*a* of the container. Moreover, the extent to which the tampers 2 extend into the interior of the container may be greater than that illustrated in FIG. 1.

As is shown in FIG. 3, instead of a tiltable door 21 it is possible to locate at the outlet of the container rollers 22 which also serve to retard the flow of the material out of the container. It will be noted that with such rollers 22 the material will leave the container also in a loose condition so that it is only in a dense condition between the compacting means and the rollers 22 of FIG. 3 which are located at the outlet of the container.

In the embodiment of FIG. 2 the portion of the container between the compacting means 2 and the outlet of the container extends horizontally while between the inlet of the container and the compacting means 2 the container extends vertically. Thus, as is shown in FIG. 2 the material will again simply fall freely from the rollers 1 to the tampers 2 while the steam or other treating fluid is introduced between the compacting means 2 and the inlet of the container by the conduit means 20, and the reciprocating tampers serve to advance the material in compacted condition toward the outlet where the tiltable door 21 is located. In this case the retarding means is additionally formed by a reduction in the cross section of the container at the outlet thereof, as is shown at the right and of FIG. 2, so that the change in the direction of the flow of the material which produces the retarding of the flow thereof can take place by a curved portion of the container at only one side thereof or by a shoulder in the container at only one side thereof providing the junction between container portions of different cross sectional areas.

FIG. 4 shows yet another embodiment of a structure according to the invention. According to this embodiment the material enters the inlet of the container between the rollers 9 which form the feeding means and the material then flows in the direction of the arrows 23 along the space between the frustoconical wall 15 and the conical baffle 10 so as to reach the inner surface of the cylindrical wall 12 of the container to move longitudinally therealong. The rollers 9 can be perforated, i.e., provided with perforations 9*a* and the treating medium in the form of steam or the like can be introduced into the interior of the rollers 9, for example through hollow shaft 16 which are supported in bearings (not shown) and connected to the rollers 9 to support the latter for rotation, so that in this way the steam will enter through the perforations 9*a* of the rollers 9 and thus in this case the rollers 9 themselves form part of the conduit means for introducing the treating fluid into the container. Of course, in this case those portions of the rollers 9 which do not communicate with the interior of the container are covered by suitable curved plates 36 to prevent the escape of steam to the exterior of the container. Moreover, it is possible to provide inlet nozzles communicating with the interior of the container as shown diagrammatically by the arrow 24. The space between the walls 10 and 15 thus forms the space where the material is in relatively loose condition to be thoroughly and uniformly treated by the treating fluid. Moreover, in this relatively loose condition of the material it is capable of being heated very quickly to an elevated temperature.

The material after leaving the space between the walls 10 and 15 will advance along the space between the wall 12 and the inner cylinder 13 located in the interior of the container. A vibratory wall 25 arranged between the cylinder 13 and the cylinder 12 also in the form of a cylinder forms a compacting means, and by vibrating this additional cylinder 25 the material may be advanced and simultaneously compacted, this wall 25 being located at only a slight distance from the wall 12 and surrounded by the latter.

Instead of introducing the treating fluid through perforated rollers 9 or through nozzles 24, it is possible to introduce the treating fluid through the interior of the cylinder 13, as shown by the arrows 8 in FIG. 4, and since the end of the cylinder 13 which is adjacent to the baffle 10 is open, the treating fluid can escape through this open end of the cylinder 13 and can reverse its direction, as shown by the arrows 8*b*, so as to move with the material along the container, and at the right end of the cylinder 13 where the direction of movement of the treating fluid is reversed the material is still in a relatively loose condition so as to be thoroughly treated by the treating fluid. In order to heat the container it may be surrounded by a wall 14 which defines with the container 12 an annular space 11 through which a heating fluid passes in the direction of the arrows 8*a*.

FIG. 5 shows another embodiment of a compacting means which may be used with any of the above-described embodiments of the invention. As may be seen from FIG. 5 the compacting means includes a rotary ring 26 driven in any suitable way in a clockwise direction, as

shown by the arrow in FIG. 5, and the ring 26 carries a bearing 29 in which a material-engaging element 27 is longitudinally shiftable toward and away from the axis of the ring 26. The direction of reciprocation of the element 27 is shown at 32. The ring 26 surrounds a stationary cam 28 which may have an endless camming groove of the configuration shown in FIG. 5, and at its inner end which is nearest to the center of the ring the material-engaging element 27 is provided with a pin 27' which extends into the camming groove 28 and which remains therein so that during rotation of the ring relative to the cam the latter will control the longitudinal reciprocation 32 of the material-engaging element 27. With the structure as shown in FIG. 5 the outer tip of the element 27 will describe a path as shown in the dotted line in FIG. 5 during rotation of the ring 26. Thus, as soon as the element 27 passes the upper end 30 of the opening through which the ring 26 extends into the interior of the container in a substantially fluid-tight manner the cam will cause the element 27 to shift outwardly away from the center of the ring 26 and then while the element 27 remains in its outer position it will turn downwardly and again be retracted at the region 31 at the bottom of the opening through which the ring 26 extends, so that in this way the compacting element 27 will project into the container to compact material therein, feeding and compacting the material in the container 33 downwardly in the direction of the arrows shown in FIG. 5, the material reaching the element 27 by gravity, for example. Thus, from the point 34 until the bottom of its stroke in the container the element 27 is capable of compacting material in the container 33 while advancing the material downwardly toward the outlet of the container.

The material engaging element 27 may have a non-circular cross section so that it cannot turn in the bearing 29 and in this way the cam-follower pin 27' which is connected to the element 27 will remain in the camming groove 28, or any other suitable structures such as rollers and the like may be provided between the element 27 and the cam 28.

Of course, it is possible to provide one or more of the compacting means of FIG. 5 at any desired location or locations in the apparatus.

Another embodiment of a compacting means is illustrated in FIG. 6. In this embodiment a rotary disc 47 is located in an opening of a wall of the container 33, substantially filling this opening so that in this way the rotary disc 47 in fact forms part of the wall of the container, and a shaft 49 fixed coaxially to the disc 47 and extending away from the container 33 can be connected to any suitable drive for rotating the disc 47 around its axis. The disc 47 is formed with one or more openings through which a plurality of material-engaging elements 45 extend, these elements also being non-circular, for example, so that they will not turn relative to the element 47, and at the exterior of the container 33 there is fixedly mounted a cylindrical cam formed at its interior with a camming groove 48 receiving a pin which is fixed to the element 45 so that during rotation of the disc 47 the element 45 will reciprocate as indicated by the arrows 46. The shape of the cam 48 is such that the element 45 will be projected into the interior of the container when the element 45 is at the top of its stroke and will remain in the interior of the container while the element 45 turns downwardly, and the element 45 will be retracted at the bottom of its stroke and will remain retracted while it turns upwardly back toward its top position. Of course, a plurality of such elements 45 may be provided, and the distribution of such a plurality of elements through openings, respectively, of a disc 47 is shown diagrammatically in FIG. 7. Thus, with this construction the compacting means will also compact the material and advance it downwardly toward the outlet of the container 33. It is not essential that the disc 47 be located precisely at the wall of the container 33 and it may be displaced either to a greater extent inwardly toward or outwardly away from the interior of the container. Moreover, any desired sealing means may be located between the rotary disc and the wall of the container. The structure of FIG. 6 also may be located at any desired location or locations of the container.

It will thus be seen that with the above-described structure of the invention it is possible to treat the loose material very thoroughly and uniformly with a treating liquid while the material remains in loose condition and in the absence of the outer atmosphere, since the material is maintained in loose condition between the feeding means which feeds the material into the container and the compacting means, while between the compacting means and the outlet of the container the material is compacted as well as advanced by the compacting means and of course the retarding means which retards the flow of the material out of the container cooperates with the compacting means for contributing to the extent to which the material is compacted before leaving the container.

Of course, all of the material-engaging elements should be made as smooth as possible to prevent the material from sticking to these elements. Thus, the material-engaging elements of the compacting means in all of the above-described embodiments will have extremely smooth surfaces to prevent such sticking of the material to the material-engaging elements. Moreover, wherever possible the material-engaging elements are made of a circular or curved cross section since this will also contribute to the prevention of sticking of the material to the tampers or the like.

It will be noted that with the structure of the invention the material is continuously fed into the container while being uniformly treated while in a loose condition. The structure of the invention is very simple in its manufacture and requires very little attention by people who operate the apparatus and in addition can be very effectively sealed off from the exterior, even though the source of energy for driving the various elements is preferably located at the exterior of the container. As has been mentioned above the container can be provided with a suitable heat-insulation so as to maintain the treating liquid in the container at an elevated temperature, and this may be carried out by providing the container with a double wall in which suitable insulating material is located or by circulating around the exterior of the container hot air, steam or the like, and, as was also mentioned above it is possible to mount heating devices on the container so as to heat the latter and thus maintain the interior of the container at an elevated temperature.

Any suitable valves for the treating liquid may be associated with the container. Thus, suitable steam valves may be located either in the region of the inlet or in the region of the outlet of the container or any other desired location.

With respect to the embodiment of FIG. 5, although a single material-engaging element 27 has been described above, it is of course clear that instead of a ring 26 a plurality of such rings may be connected as a unit or a cylinder may be provided which carries a plurality of elements 27 located in the same plane and all cooperating with the stationary cam so that they are reciprocated as a unit in the manner described above in connection with the element 27, and thus it is possible for the compacting elements to extend all the way across the interior of the container.

It is possible also to combine various structures as described above. For example a pair of the compacting structures shown in FIG. 6 may be situated one opposite the other as shown in FIG. 6*a* with the devices synchronized so that they are, for example, 180° out-of-phase, which is to say that when the elements 45 of one of these devices is retracted the other is extended and is compacting and advancing material, and in this way it is possible to increase the output of the apparatus.

Moreover, a compacting device such as shown in FIG. 5 may be combined with a compacting device such as shown in FIG. 6, depending upon the nature of the material and the container, since in some cases such combinations may be highly desirable.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of material treating apparatus differing from the types described above.

While the invention has been illustrated and described as embodied in apparatus for treating material with heated fluids, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. Material treating apparatus comprising, in combination, a container having an inlet and an outlet; reciprocally mounted compacting means located at least in part in said container between said inlet and outlet thereof and communicating in a substantially fluid-tight manner with the interior of said container for compacting material therein and advancing the material toward said outlet to pass therethrough to the exterior of said container; feeding means at said inlet of said container for feeding into the container and toward said compacting means a loose material which is capable of being compacted by said compacting means; means at said inlet for substantially preventing communication between the interior and exterior of the container at said inlet thereof; retarding means at said outlet of said container for retarding the flow of material out of said container, whereby the material is in relatively loose condition in said container between said inlet thereof and said compacting means and is in a dense condition between said compacting means and said outlet of said container; and conduit means communicating with the interior of said container for introducing a treating fluid into said container to treat the material therein, whereby the material in loose condition between said compacting means and inlet is thoroughly treated by the treating fluid while shut off from the outer atmosphere and the treated material is discharged by the compacting means through said outlet of said container in a dense condition.

2. Material treating apparatus as recited in claim 1 and wherein said container is elongated having an inlet and an outlet respectively located at opposite ends thereof, said compacting means including at least one elongated reciprocating tamper which reciprocates in the longitudinal direction of said container.

3. Apparatus as recited in claim 2 and wherein said conduit means communicates with the interior of said container between said inlet thereof and said compacting means.

4. Apparatus as recited in claim 1 and wherein said container carries heat insulation at the walls thereof for retarding the cooling of a heated treating fluid.

5. Apparatus as recited in claim 2 and wherein said compacting means includes a plurality of tampers which reciprocate in the longitudinal direction of said container and which are coupled to each other for reciprocating in a predetermined sequence.

6. Apparatus as recited in claim 1 and wherein said feeding means includes a pair of rotary feeding rolls for feeding material to the interior of the container and wherein said conduit means is formed in part by said rolls through which the treating fluid is introduced into said container.

7. Apparatus as recited in claim 2 and wherein said compacting means includes a hollow vibratory cylinder located coaxially within said elongated container and defining between said cylinder and said container an annular space along which the material is advanced by said compacting means, and said conduit means being formed by the hollow interior of said cylinder along which the fluid flows toward said inlet of said container, the end of said cylinder adjacent said inlet being open so that the treating fluid flows through said end of said cylinder to reverse its direction and advance with the material along said container toward the outlet thereof.

8. Apparatus as recited in claim 1 and wherein a heating means is carried by the wall of the container for heating the interior thereof.

9. Apparatus as recited in claim 1 and wherein said compacting means includes a rotary member extending partly into the interior of the container and slidably carrying at least one elongated shiftable member for shifting radial movement toward and away from the axis of rotation of said rotary member, and a stationary cam cooperating with said shiftable member for shifting the latter outwardly beyond said rotary member and for retracting said shiftable member back into said rotary member when said shiftable member enters into and leaves said container, respectively.

10. Apparatus as recited in claim 1 and wherein said compacting means includes a rotary ring located in part in an opening in a wall portion of said container and slidably carrying at least one elongated shiftable member for longitudinal shifting movement toward and away from the center of said ring, and a stationary cam surrounded by said ring and coacting with said shiftable member for shifting the latter outwardly of said ring and for retracting said shiftable member back into said ring when said shiftable member enters into and leaves said container, respectively.

11. In an apparatus as recited in claim 1, said compacting means including a rotary ring located in part in an opening in a wall portion of said container and supporting in a common plane a plurality of shiftable members for shifting movement toward and away from the axis of said ring, and a stationary cam coacting with said shiftable members for simultaneously shifting the latter outwardly of said ring and retracting said shiftable members back into said ring when said shiftable members first reach the interior of said container and leave the interior thereof, respectively.

12. Apparatus as recited in claim 1 and wherein said compacting means includes at least one rotary disc located in an opening of a wall portion of said container and forming part of the wall of said container, and at least one elongated shiftable member extending axially through said disc for longitudinal shifting movement relative thereto, and a cylindrical cam located in alignment with said disc at the exterior of said container and coacting with said elongated member for shifting the latter longitudinally toward and away from the interior of said container during rotation of said disc.

13. Apparatus as recited in claim 12 and wherein a plurality of elongated shiftable members pass through said disc for shifting movement parallel to the axis thereof and said cam cooperating with said plurality of elongated members for axially shifting the latter during rotation of said disc.

14. Apparatus as recited in claim 1 and wherein said compacting means includes a pair of rotary discs which face each other, a pair of elongated shiftable members respectively carried by said discs for rotation therewith and for shifting movement into and out of said container, and a pair of cams respectively cooperating with said elongated members for shifting the latter toward and away

from the interior of said container during rotation of said discs.

15. Apparatus as recited in claim 1 and wherein said compacting means includes at least one reciprocating piston.

16. Apparatus as recited in claim 1 and wherein said retaring means is in the form of a door pivotally connected to said container at said outlet thereof and being moved away from said container only in response to movement of the material out of said container through said outlet thereof.

17. Apparatus as recited in claim 2 and wherein said retarding means is in the form of a curved portion of said container adjacent said outlet thereof extending in a direction different from the remainder of said container so as to change the direction of movement of the material and thus retard the flow thereof through said outlet of said container.

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