United States Patent

[11] 3,601,267

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[73] Assignee Mo och Domsjo Aktiebolag
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[33] Sweden
[31] 7742/68

[54] INSTALLATION FOR STORING WOOD CHIPS
9 Claims, 3 Drawing Figs.

[52] U.S. Cl. 214/10, 302/28
[51] Int. Cl. B65g 65/28
[50] Field of Search 214/10, 17.64, 16; 193/23; 302/28, 56, 17

[56] References Cited

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3,298,749	1/1967	Croon et al.	302/56
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Primary Examiner—Gerald M. Forlenza
Assistant Examiner—Frank E. Werner
Attorney—Janes & Chapman

ABSTRACT: An installation for storing wood chips is provided, which includes a cylindrical support centrally positioned within and extending upwardly from the center of a generally circular chip storage space. A chip delivery arm carrying pneumatic chip delivery conduits is rotatably mounted on the support above the storage space and extends radially beyond the wall of the support so as to overhang the storage space and deposit the wood chips for storage around the wall of the support. Means for removing the chips which have been stored for a predetermined time are also provided. The support prevents the stacked chips from interfering with the operation of the chip delivery and removal mechanisms and serves as a central core for the installation through which are conveyed the chips to be stored and chips being removed from the storage space.

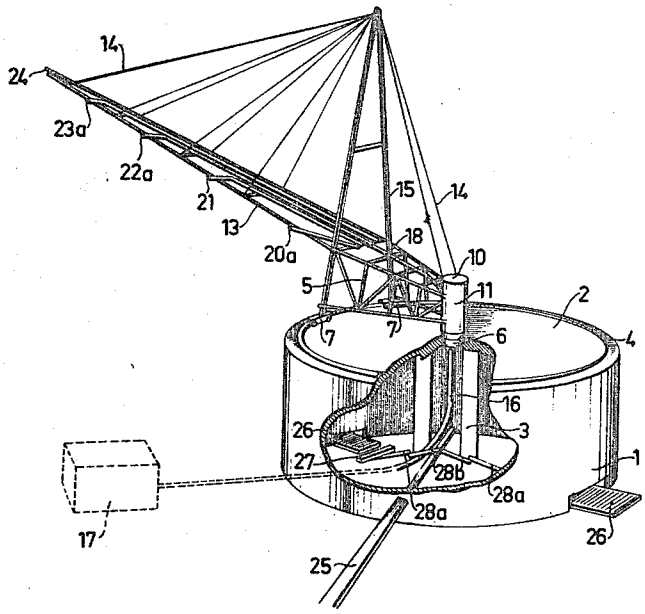

Fig. 1

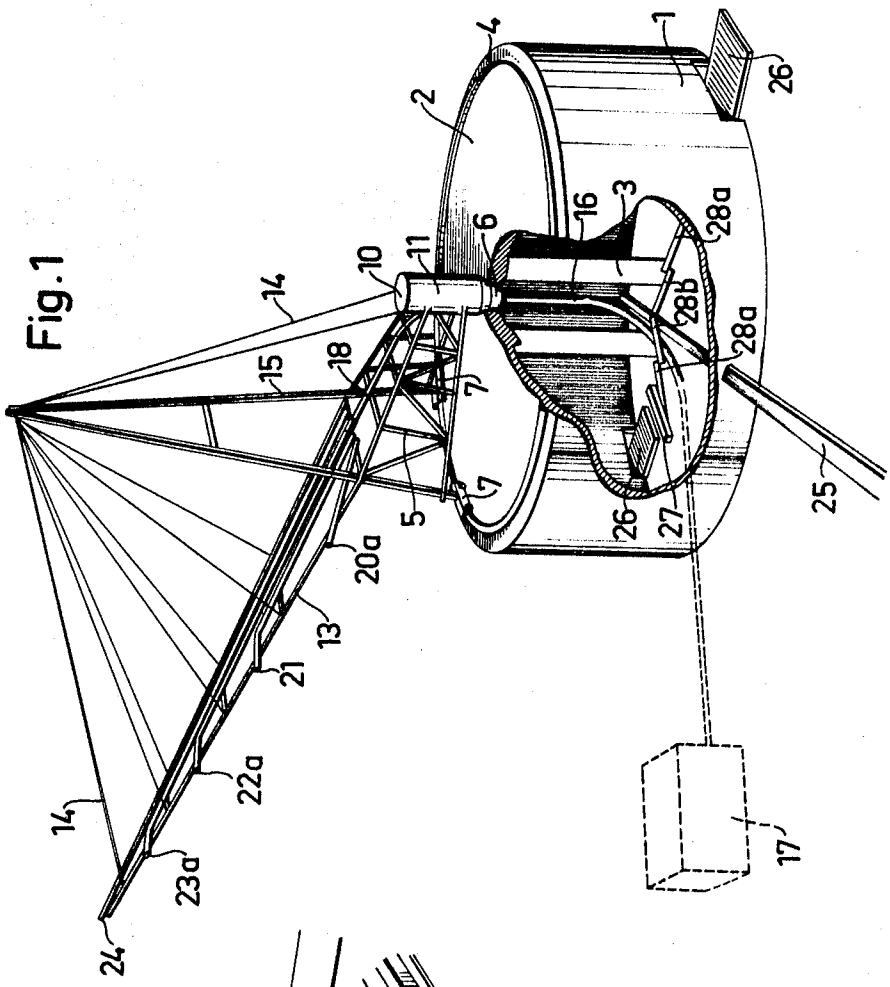
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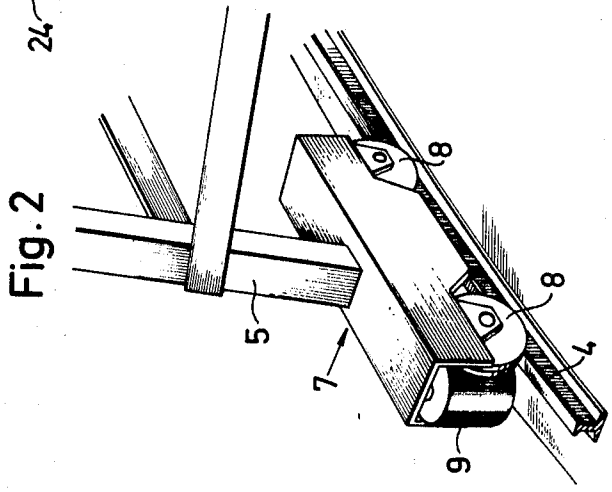
Fig. 2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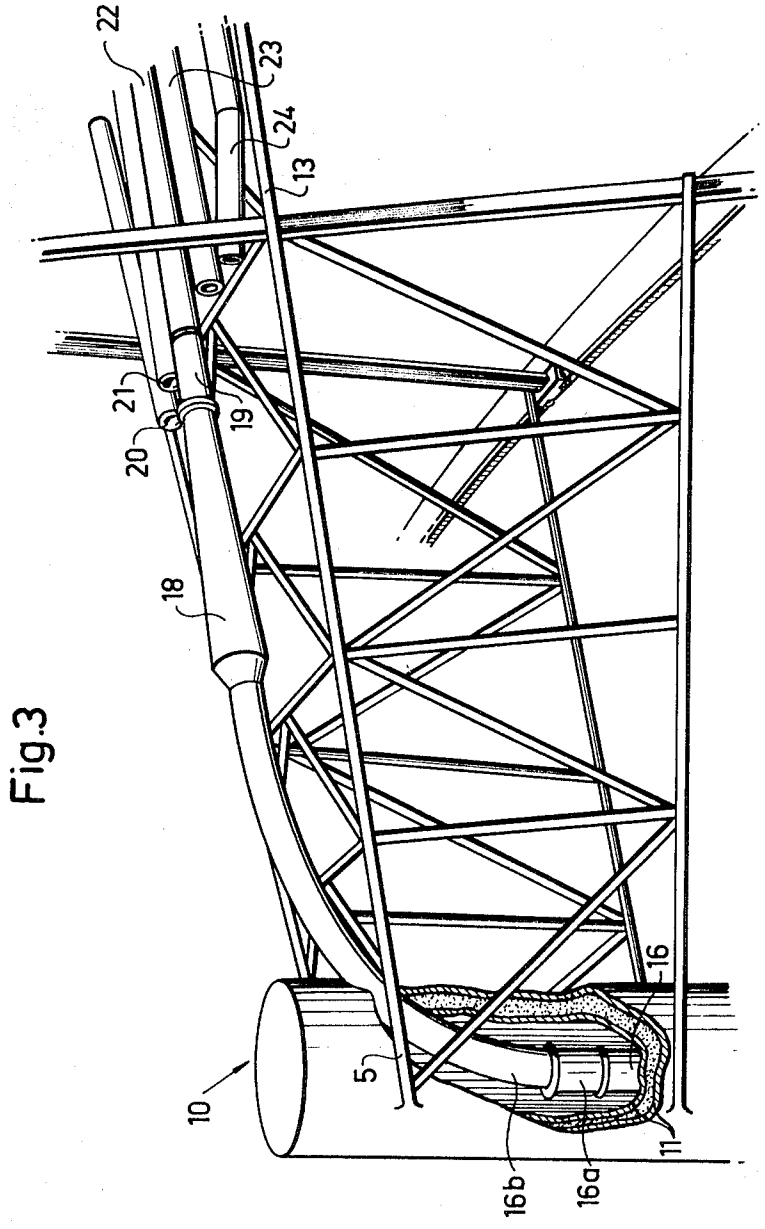

Fig.3

INSTALLATION FOR STORING WOOD CHIPS

This invention relates to an installation for storing wood chips in one or more stacks, and more particularly it relates to such an installation in which wood chips are fed onto one side of the stack for storage and removed from the opposite side of the stack in approximately equal amounts constant.

In cellulose pulp plants, wall board plants, and in sawmills, wood can and often is, stored in the form of stacked wood chips. This type of storage has been found to be advantageous for different reasons in different types of plants and mills. For example, in a sulfate mill it has been found that the most convenient and inexpensive method of handling the wood used in the mill is in the form of stacked wood chips. In a sulfite mill, however, wood chips are stored in stacks to improve the quality of the raw wood used in the mill.

Due to the chemical and biological processes which take place in the stack of wood chips, the temperatures which occur in the stack are normally much higher than the surrounding ambient temperature. Temperatures in the range of 30° to 60° C. are common although even higher temperatures do occur. In the warm moist atmosphere within the chip stack the extractable substances of the wood are oxidized by the oxygen in the air, and rapid enzymatic hydrolysis of these substances of the wood also occurs as compared to the rate at which such hydrolysis occurs in the normal storage of logs. Due to the rapid enzymatic hydrolysis, the extractable substances of the wood are modified in a very short time in the chip stack so that these substances are readily liberated during the sulfite pulp process resulting in a pulp of low extract content. In order to achieve the same low extract content for ordinary logs or crude wood forms, using the known storage techniques for such wood, a considerably longer storage time would be necessary.

In the known methods for stacking wood chips for storage, the chips are pneumatically fed through a feed conduit on to the stack site to form the stack. The chips deposited onto the site are leveled, usually with the aid of a tractor. This technique, however, has several serious drawbacks. Tractors are expensive to purchase and operate. Moreover, in the stacks of wood chips it is conventional to heat the stack of chips with warm air or steam supplied to the stack by conduits positioned within the stack. If the stack is levelled by tractors, these conduits can cause a serious obstacle to the efficient operation of the tractor. A further and quite serious problem occurs due to the fact that the weight of the tractor on the stack of work chips tends to produce locally compact areas and low density areas in the stack as compared to the relatively uniform compactness of chips in the stack produced when the chips are merely deposited onto the stack by means of a pneumatic feed conduit. The nonuniformity in compactness of the chips in the stack permits air to penetrate into the stack causing local areas of low temperature in the stack. In winter, such areas can be low enough in temperature areas to cause the enzymatic decomposition process to temporarily halt in those cool area. This produces nonuniform quality in the resulting chips at the end of the storage period. When such chips are used for example, in a pulp or wall board plant, the predetermined process conditions employed in the plant are no longer applicable to all the chips, and severe processing problems can result. For example, the chips in which there has been an insufficient cellulose decomposition can, during processing, produce resin deposits in the conduits and on the wires of the processing apparatus. If on the other hand, in an attempt to avoid such problems, the storage time for the entire wood chip stack is lengthened so as to ensure that decomposition occurs in the cooler areas of the stack, the wood chips in the warmer areas of the stack undergo decomposition for too long a time and this results in appreciable wood losses. Thus, the use of tractors to level the chip stack has caused several problems.

A further problem has occurred in the chip-stacking method described above in the use of the pneumatic feed conduits. As the size and height of the chip stack increases, it is necessary to change the position or length of the pneumatic feed conduit. In order to position the feed conduit in the proper location, it is often necessary to support it against the existing stack of wood chips. Since the pipes used to feed conduits, which normally are made up of several joined sections of pipes, are quite heavy and positioning of the feed conduits can be quite time consuming, Furthermore, it often happens that if the preexisting stack of chips is subjected to the weight of the pipes for an extended period of time, the stack of chips collapses under the weight of the pipes. The problem is particularly acute since the direction in which the feed conduit ejects the chips onto the stack is to a large extent dependent upon the strength and direction of the wind. Thus, it can be necessary to repeatedly adjust the position of the feed conduit in order to form the stack into the desired shape. Furthermore, the repositioning of the feed conduits often must be carried out above the stack and at a relatively high level above the pipe even more complicated.

Wood chip stacking installation are known which provide simplified feeding of the chips onto the stack and in which wood is continuously fed onto the stack for storage at the same rate at which treated wood is removed therefrom so as to obtain uniform storage time. One such installation for such storage of wood chips is shown in U.S. Pat. No. 3,298,749. In the installation shown in this patent, the wood chips are stored by forming an annular wood chip stack which is generally trapezoidal in cross section. A portion of the annulus is occupied not by the wood chips, but by a mechanism for feeding the chips onto the stack for storage and for removing the stored chips from the stack. The mechanism for feeding the chips onto the stack and removing chips from the stack is moved around the annular stack so that as stored chips are removed, new chips for storage are added to the stack, thus, providing for a a generally uniform storage time. All wood chips which are added to or removed from the stack are transported via conveyors to and from the center of the annulus.

In the installation described above, large diameter stacks i.e., 200 meters or more in diameter are required since it is not possible to stack the chips close the the center of the annulus. The reason for this is that the chips stacked close to the center tend to fall onto and interfere with the operation of the conveyors and mechanisms by which the chips are fed onto and removed from the stack. As a result of this, it is necessary to stack the chips at a predetermined distance from the center of the storage area. This means that the annular space required to accommodate a given number of chips is somewhat larger than might otherwise be required. Consequently, the conveyors must be longer than would otherwise be required, and more flat ground space for the chips will be occupied. This raises the cost of the operation of the chip storing installation and the cost for its original construction.

The instant invention overcomes the problems of the prior art by providing an installation for storing wood chips in which the chips can be stored in a circular storage space without the possibility of the chips falling onto to or interfering with the mechanism for feeding the chips onto the stack or removing them therefrom. Furthermore, the chips can be continuously fed onto and removed from the stack at the same rate so as to ensure uniform storage time and not tractors of the like which can adversely affect the density of the stack are needed to level the chip stacks for storage.

The installation for storing wood chips of the invention comprises, in combination, a support positioned centrally within a chip storage space in the form of a generally circular area, said support having at least one wall extending upwardly from the storage space; pneumatic chip delivery means rotatably mounted on the support above the storage space and extending radially over the wall of the support so as to overhang the storage space in a manner to deposit wood chips for storage around the wall of the support, such that the support

serves as a central core for the installation and the deposited chips; and means for supplying the delivery means with wood chips for storage.

The chip delivery means, which is more particularly described below, pneumatically feeds the chips onto the stack and is rotatable about the support so as to spread the chips uniformly over the stack thus eliminating the need for a tractor or the like in order to spread and level the chips. The chip delivery means also has a plurality of outlets which are radially spaced apart so that it is unnecessary to adjust the length of the feed pipes or change the positioning of the feed pipe outlet relative to the stack as the stack grows in size.

The support structure of the invention, which is also described more particularly below, on which the chip delivery means is positioned, and about the delivery means rotates makes it possible to stack the chips much closer to the center of the circular storage area than was previously possible. This is due to the fact that the feeding mechanism is located on top of the support and the drive mechanism and conveying mechanism for rotating the chip delivery means are located either above or within the support. Therefore, there is not possibility that the chips can interfere with the operation of the pneumatic feeding means, or the conveyors or drive mechanism since the support prevents this. Thus, support acts as a core for the installation and the deposited chips, and the chips stack can be formed at or adjacent the walls of the support. The stack can be as high as height of the support without in any way interfering with the mechanisms referred to above. By this construction it is possible to reduce the conveyor lengths between the periphery of the stack and the central distribution point by as much as 20 percent or more. This means that less energy and time is consumed in conveying the chips to and from the stack. Furthermore, for a given volume of wood chips, the chip delivery arm need not be as long as would otherwise be required and it is thereby less expensive to manufacture.

The above advantages can be appreciated by comparison of the structure described hereinafter and that shown in U.S. Pat. No. 3,049,244 to Hansen. The ore stacking device shown in the Hansen patent does not employ pneumatic feed, but has a belt conveyor which is mounted on a radially extending boom. As can be seen from the patent drawings, the boom is quite long as compared to the feed arm described hereinafter for comparable size and height stacks and the stacked material, is dislodged, can fall onto or otherwise interfere with the stacking apparatus. In the drawings:

FIG. **1** is a view in perspective and partially broken away of the installation of the invention,

FIG. **2** is an enlarged view of a portion of the installation shown in FIG. **1**, and

FIG. **3** is an enlarged view in greater detail of another portion of the installation shown in FIG. **1**.

In FIG. **1** an installation particularly suited for storing wood chips is shown. The installation has a support in the form of a tower **1** which can be made of any rigid material, of sufficient strength but preferably is made of concrete. The tower **1** is cylindrical and the upper end of tower is closed off by a platform **2** such that the cylindrical wall and platform **2** is supported at its center by several columns **3** positioned within the open interior of the tower between the ground and the platform **2**. The dimensions can be selected in relation to the size of the stack of chips but in the best mode contemplated for carrying out the invention the tower **1** is 12.5 meters high and has a diameter of 31 meters. A track **4** (also shown in FIG. **2**) is positioned on the tower near the periphery of the platform and is fixed thereto. The tower, as shown, is cylindrically shaped and has a single continuous wall extending thereabout. It is also possible to form the support in any closed configuration. For example, the support could be rectangular, pentagonal, hexagonal or the like in cross section. A cylindrical shape is preferred. The means for feeding or delivering the wood chips and forming one of more stacks (not shown) about the wall of the support is rotatably mounted on the top of the support on the platform **2**. The means for feeding the wood chips includes a support carriage **5** which is made up of an open framework structure extending between the periphery of the platform and the center thereof. The carriage is generally trapezoidal in cross section, i.e., the lower portion of the carriage has a wider span than the upper portion of the carriage. The struts of the framework converge radially toward the center of the platform at an angle such as for example, about 30° such that the carriage expands in width toward the periphery of the platform and converges to a cylindrical hub **11** at the center of the platform. The struts are fixed to this hub. The hub **11** is pivotally mounted for rotation relative to the support on an annular slide bearing **6** positioned at the center of the platform. The base of the carriage is provided with trucks **7**, each of which has two wheels **8** arranged one behind the other for movement along the track **4** when the carriage **5** moves pivotally about the center of the support. At least one of the trucks **7** is driven by an electric motor **9** via a gear drive (not shown). Alternatively, the wheels need not be driven if a drive mechanism is provided at the central hub **11** of the carriage. However, it is preferred that separate drive motors are positioned in each truck for rotating the carriage **5** about the support. Hydraulic, pneumatic or other motors can be employed. The number of trucks provided is dependent upon the pressure exerted on the wheels by the chip delivery mechanism and by the stability considerations. Tow trucks, as illustrated, have been found to be normally sufficient.

A jib arm structure **13** also of open framework construction extend radially outwardly from the carriage **5** and overhang the area in which the chips are to be deposited. In the preferred embodiment the jib arm **13** extends for a length of about 60 meters and is positioned at an angle of about 20° relative to the horizontal. The jib arm is supported by a plurality of wire or cable supports **14** which are fixed to an upright frame **15** extending from the carriage **5** adjacent the periphery of the tower. Tow of the cables **14** extend from the top of the A-frame upright **15** to the central cylindrical hub **11** at the center of the support. The wires are held in tension by tensioning devices (not shown). The hub **11** has two concentric walls which define an annular space filled with concrete so as to form a concrete balance column **10** which counterbalances the jib arm, relieves the strain on the bearing **6** and stabilizes the carriage **5**. This concrete column **10** in the preferred embodiment weighs about 80 tons. It is also possible to counterbalance the jib arm **13** without employing a support post **15** on the carriage and a concrete column **10** as shown in the drawings. This can be done by providing an extension on the carriage **5** which extends across the diameter of the platform **2** to the opposite side of the track. This extension of the carriage can ride on two two-wheeled trucks which travel on the track **4** and can be weighted with a counterweight. This counterweight should be placed as far from the center of the tower as possible.

In the embodiment shown in FIG. **1**, the jib arm **13** is fixed in position relative to the carriage but it is also possible for the jib arm **13** to be pivoted for example, at the point at which the arm meets the carriage to permit the arm to be raised or lowered to any desired position as the stack of wood chips is formed. This can be particularly advantageous when for example, high winds occur since the raising or lowering of the jib arm makes it possible to accurately control the direction in which the chips ejected from the feed arm travel.

The jib arm **13** carries five feed pipes **20**, **21**, **22**, **23**, **24**, as shown in FIG. **3**, into which the wood pipes are fed by a distributing pipe **18**. The open ends of the pipes **20–24** facing the distributing pipe **18** are arranged in an arcuate path, the radius of which centers at the hub. The distributing pipe **18** is held into the selected pipe **20–24** by a spring loaded retainer sleeve **19** adjacent the pipes **20–24**. In order to change the pipe into which the wood chips are being fed it is merely necessary to pull the retainer sleeve **19** against the force of the spring until it is clear of the pipe in which is it positioned, and pivot the distributing pipe into a position in which it faces the end of the

pipe through which the wood chips are to be distributed The retainer sleeve **19** is then released and the force of the spring holds the retainer sleeve against the pipe and ensures a good seal between the distributing pipe **18** and the pipes **20–24** in which it is fitted. It is to be noted that in place of this coupling mechanism it is also possible to employ a manifold which permanently connects the distributing pipe **18** to all of the five pipes **20–24**. The manifold can be provided with valves which permit wood chips to proceed through the desired pipe. With such construction it is merely necessary to open the valve leading to the desired pipe and close the other valves. It is also possible in such a construction to permit wood chips to proceed through and be ejected from any desired number of pipes simultaneously.

The chip feed pipes **20–24** are of different lengths so that the discharge ends thereof are located at different distances from the tower each about 12 meters from the next. The longest pipe **24** extends to the end of the jib arm. Each of the four shorter pipes **20–23** has a bent portion **20*a*–23*a*** at the discharge end thereof. The bent portion forms an angle of about 30° degrees to the longitudinal axis of the pipes. The bent portions of the pipes **20*a*** through **23*a*** are formed by separate pipe segments which are pivotally mounted at the ends of the straight portions of the feed pipes. These pipe segments can be locked into different positions for the distribution of the wood chips at different angles. It is possible to provide all or just the shortest of the feed pipes with a deflector which controls the direction in which the chips following from the pipe proceed. The number of pipes employed need not be five as shown in the drawings, but can be any number of feed pipes from one pipe up to the number of pipes which can be fitted onto the jib arm. The pipes can be of any diameter capable of carrying a sufficient flow of wood chips to provide an adequate rate of feed for the wood chips stacks. In the embodiment shown in the drawings the pipes **20–24** have an inside diameter of 450mm.

The distributing pipe **18** is connected to a pipeline **16** which extends upwardly through the center of the tower via a rotatable coupling **16*a*** mounted in the hub **11**, and a bent portion **16*b*** which is connected to the distributing pipe **18**. The pipe portion **16** extends from the rotary coupling **16*a*** in the hub **11** along the carriage to the distributing pipe **18**. The combination of the bent portion **16*b*** and the rotary coupling makes it possible for the distributing pipe **18** to be rotated for distributing the wood chips into the desired feed pipe **20–24** as the jib arm **13** is rotated while sealed against the bent portion **16*b***. The construction of the rotary coupling **16*a*** and the pipe portion **16*b*** and distributing pipe **18** can best be seen by reference to FIG. 3. The means for pneumatically conveying the chips through the pipes and pipelines comprises conventional cyclones, valves, commonly employed in pneumatic chip ejection apparatus.

The pipeline **16** is connected to a chip-producing apparatus **17** as shown in dotted lines in FIG. 1. The wood-chipping apparatus **17** and the portion of the pipeline **16** leading from the chipping apparatus into the tower are disposed beneath ground level. Since the chipping apparatus and the pipeline **16** are underground they present no obstacle to any mechanism such as a tractor which may be employed in removing chips from the installation. It is also possible to place the wood-chipping apparatus **17** within the tower and thereby shorten the distance over which the chips must be conveyed to reach the chip stack.

The tower **1** is also provided with means for removing from the chip stack the wood chips which have been stored for a sufficient period. In the embodiment shown in FIG. **1**, two such chip removal means are provided at opposite sides of the tower, however, a plurality of such chip removal means can be provided at different locations about the tower. For example, four such removal means can be employed are in each quadrant around the tower. The number of chip removal means provided depends on the rate at which chips must be removed and the size of the stack and the tower. In certain instances one chip removal means has been found to be sufficient. The chip removal means can be double grid conveyors **26** such as shown for example in U.S. Pat. application Ser. No. 776,101 filed Nov. 15, 1968 which can be arranged to discharge the chips onto screw conveyors **27** provided with two oppositely threaded worms which discharge the chips onto sequentially arranged conventional screw conveyors **28*a*** and **28*b***. The conveyors **26** are arranged at ground level and extend from a point beyond and beneath the stack of wood chips through an opening in the wall of the tower so as to move the chips radially into the tower and discharge them onto the screw conveyors **27** arranged therein. The screw conveyors **27** are at a somewhat lower level than the level of the conveyors **26** and extend tranversely of the conveying direction of the conveyors **26**. The outer ends of the screw conveyors **27** extend somewhat beyond the ends of the conveyors **26** so as to ensure that all the chips moved into the tower by the conveyors **26** are deposited onto, and moved forward by the screw conveyors **27** for removal from the tower. The screw conveyors **28*a*** are also positioned at a level slightly lower than the level of the conveyors **27** and with the inlet ends positioned between the worms of each of the conveyors **27**. The conveyors **28*b*** are positioned between the conveyors **28*a*** and a conveyor belt **25** carries the wood chips from the tower **1**. It is possible and is often desirable for the conveyor **25** to be disposed below ground so that it travels beneath the stack of wood chips when leaving the tower. The conveyors **26**, **27**, **28*a***, **28*b*** and **25** need be of the same types and arrangement as those described above. Other suitable conveying means and arrangements are well known to those skilled in the art.

In operation, wood chips supplied from the chipping apparatus **17** are pneumatically transported through the pipeline **16** to the bent portion **16*b*** thereof and into and through the distributing pipe **18**. The chips then proceed into and through the particular feed pipe **20–24** to which the distributing pipe **18** is connected. Due to the fact that the pipes **20–24** can discharge the chips over a range of distances and since the carriage **5** is rotatable around the tower, the chips conveyed through the feed pipes are distributed in an annular space limited only by the walls of the tower and the reach of the longest pipe **24**. The normal stacking procedure is for a primary stack of chips to be formed to a desired size and then a new stack is formed to a desired radial distance from the first stack by merely switching the distributing pipe to the next feed pipe. In this manner a number of small chips stacks positioned in radial sequence are formed. The jib arm **13** is then rotated through a predetermined angle by the drive means on the boggie **7** of the carriage **5** whereupon a new radial series of small stacks is formed in a similar manner at a distance from the first series of stacks. The sequence is then repeated until the chips form an annular array of small stacks of chips surrounding the tower. Thereafter, the chips are then discharged onto the portion of the stacks first formed. By use of the conveyors **26** it is then possible to simultaneously remove chips at about the same rate as they are discharged onto the stack so that the portion of the stack which has been stored for the predetermined storage time is removed as new chips are added. It is also possible to carry out removal of the stacked chips which have been stored for the predetermined storage time is removed as new chips are added, or immediately prior to the new fresh chips being deposited onto that location. This can be done employing a removal means which removes the chips when the chip delivery arm is in the next adjacent preceding position. As a further possibility the chips need not be stacked in the manner described above, but could be stacked in a series of concentric annuluses or in one large annular stack. When the conveyors **26** such as shown in FIG. **1** are employed, the chips which have been stored for the predetermined length of time can be moved to the grid by tractor means located at or on the chip stack on the conveyor. The chips passed to the conveyor are then conveyed by the conveyors **27**, **28*a***, **28*b***, to the belt conveyor **25** and are moved from the tower to receiv-

ing stations. As the chips which have been stored for the predetermined length of time are removed from the stack, the location from which they are being moved progresses around the stack. As this location approaches the other chip removal conveyor **26** at the opposite side of the tower, the tractor then moves the chips onto this chip removal conveyor **26** for discharge.

The instant invention has been described in connection with the storage and handling of wood chips for which it is particularly well suited. However, the invention herein is applicable to other particulate materials which are normally stored in stacks.

Having regard to the foregoing disclosure, the following is claimed as the inventive and patentable embodiments thereof:

1. An installation particularly suited for storing wood chips comprising, in combination, means defining a wood chips storage space in the form of a generally circular area, a support positioned centrally within the chip storage space, said support having at least one wall extending upwardly from the storage space and restricting entry of wood chips into the support; and pneumatic chip delivery means rotatably mounted on the support and extending radially beyond the wall of the support so as to overhang the storage space in a manner to deposit wood chips for storage around the wall of the support, wherein the chip delivery means comprises a radially extending arm supporting chip feeding conduit means having a plurality of radially spaced outlets for discharging the chips at a plurality of different radially spaced distances from the support and a carriage rotatably mounted on the support, and supporting the arm, whereby the support serves as a central core for the installation and the deposited wood chips.

2. An installation in accordance with claim **1** in which the support comprises a generally cylindrical enclosure having a platform thereon on which the chip delivery means is mounted.

3. An installation in accordance with claim **1** including a track on the support on which the carriage travels.

4. An installation in accordance with claim **1**, in which the chip feeding conduit means comprises at least two pipes of different lengths.

5. An installation in accordance with claim **1**, in which the carriage is supported on trucks having drive means associated therewith for rotational movement of the carriage.

6. An installation in accordance with claim **1**, in which the arm is counterbalanced by means fixed to the carriage.

7. An installation in accordance with claim **1**, including means associated with the support for removing wood chips from the stored deposited wood chips.

8. An installation in accordance with claim **7**, including means associated with the support for conveying wood chips into the interior of the support and from the interior of the support.

9. An installation in accordance with claim **1**, including means for supplying the chip delivery means with wood chips for storage.

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(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,601,267 Dated August 24, 1971

Inventor(s) RUNE AXLING; KARL BRANDSTROM.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 7	:	"to" should be -- as --
Column 2, line 21	:	after "above" , second occurrence add -- the ground. This makes the problem of readjusting the position of --
Column 2, line 23	:	"installation" should be -- installations --
Column 2, line 38	:	Delete first "a"
Column 2, line 64	:	"not" should be -- no --, and change "of" to -- or --
Column 3, line 15	:	After "about" add -- which --
Column 3, line 22	:	"not" should be -- no --
Column 3, line 45	:	"is" should be -- if --
Column 3, line 47	:	"In the drawings: " should start new paragraph, and be underlined.
Column 3, line 74	:	"of" should be -- or --
Column 4, line 27	:	"Tow" should be -- Two --
Column 4, line 37	:	"Tow" should be -- Two --
Column 4, line 74	:	"is it" should be -- it is --
Column 5, line 1	:	After "distributed", add -- [period] (.)

Column 5, line 29 : "following" should be -- flowing --

Column 6, line 15 : "tranversely" should be -- transversely --

Column 6, line 48 : "chips" should be -- chip --

Signed and sealed this 11th day of April 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents