March 27, 1962 J. O. CONVERSE 3,027,100

MILLING APPARATUS

Filed May 22, 1958

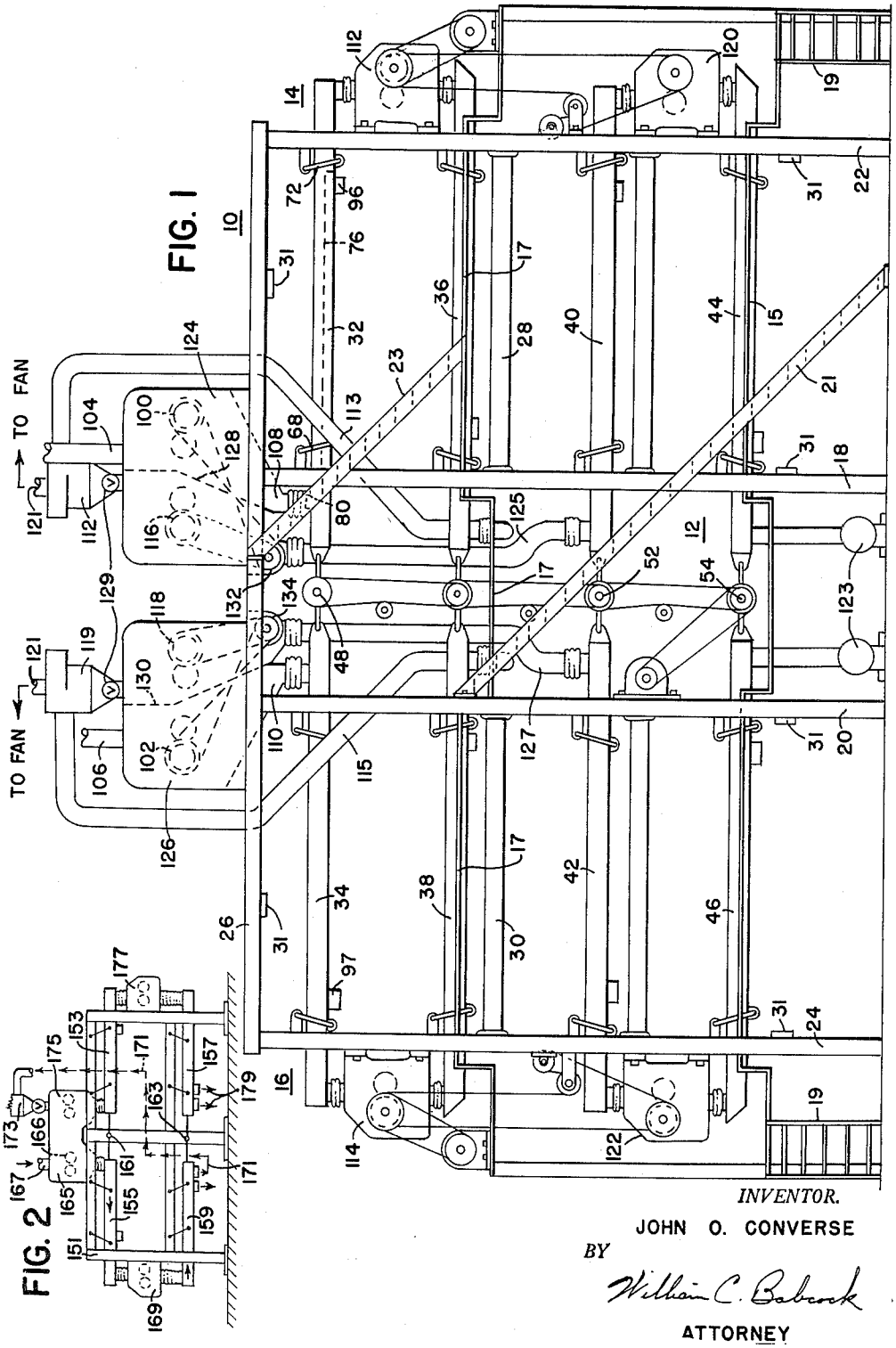

FIG. 1

FIG. 2

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United States Patent Office 3,027,100 Patented Mar. 27, 1962

3,027,100

MILLING APPARATUS

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Filed May 22, 1958, Ser. No. 737,011
9 Claims. (Cl. 241—78)

This invention relates to milling apparatus and more particularly to the construction of special stack units for compact flour milling installations.

Some attempts have been made in the prior art to arrange flour milling apparatus in a stack or frame in which the stock is fed to successive breaking or reduction rolls and intermediate sifting devices. One such unit is shown, for example, in Buchholz United States Patent No. 97,038, issued in 1869, in which reciprocating sifters are mounted in a stack between successive roller milling units.

Stacked milling units of the Buchholz type were apparently subject to a number of problems, including mechanical difficulties such as excessive height and vibration and difficulty of control. Also, modern milling emphasis on the use of air purifiers and gyratory sifters and on complex flows for greater extraction have required an abundance of equipment, and the use of large mill buildings, which are often many stories high in order to minimize mechanical conveying by more extensive vertical conveying of the stocks. Thus such stacked mills never achieved substantial popularity or utility.

One improved stacked milling unit which avoids a number of mechanical difficulties of the earlier units is described and claimed in the copending application of Nandor Szasz for "Milling Apparatus," Serial No. 737,132, filed on the same date as the present application. The present invention relates to further improvements in stacked milling units and particularly to an improved arrangement of milling units in balanced stacked mills of the Szasz type.

It is one object of the present invention to provide an improved stacked milling unit.

It is a further object to provide a stacked milling unit in which reciprocating sifters are arranged to minimize vibrations of the unit and in which a plurality of milling machines, such as roller mills or other breaking or reducing units, are mounted at convenient points on the stack for easy access and control.

It is a still further advantage to provide a stacked milling unit which can achieve advantages of minimum handling between successive breaking or reduction steps to the maximum degree consistent with convenient access to the individual milling machines in the stack.

It is another object to provide an improved stack of minimum size for performance of up to four milling operations with intermediate sifting.

Other objects and advantages will be apparent from the following specification, in which certain preferred embodiments of the invention are described.

In the drawings which form a part of this application,

FIGURE 1 is a side elevation of one form of stacked milling unit according to the present invention; and

FIG. 2 is a schematic side elevation of another embodiment of the invention.

As shown in FIG. 1, the invention contemplates the use of a stacked mill which includes a supporting frame indicated generally at 10. The supporting frame includes a central supporting section 12, and oppositely extending end sections 14 and 16 which are in longitudinal alignment with each other and with the center section 12. The center support section may include at least two pairs of vertically extending columns 18 and 20 with one column of each pair at each side of the stack.

The respective end support sections include at least a pair of vertical columns 22 for the end section 14 and a pair of vertical columns 24 for section 16. An upper connecting beam 26 rigidly connects the various vertical columns. Additional longitudinal beams or braces 28 interconnect the columns 18 and 22, while further beams 30 connect columns 20 and 24. Suitable cross braces or beams are also used as needed to obtain the desired rigidity, such beams extending in a direction which would be generally perpendicular to the plane of the paper (as shown in the drawing) at suitable locations, such as 31.

According to the invention described in the copending Szasz application, a plurality of pairs of reciprocating classifying units are mounted in the respective end frame portions. These units are arranged in pairs. Thus the pair 32 and 34 is the uppermost pair of the group. Vertically spaced below the pair 32 and 34, the next lower classifying units 36 and 38 form a second pair. Classifying units 40 and 42 form a third pair below the second pair, and the lowest classifying units 44 and 46 constitute a still lower fourth pair. The individual classifying units of each pair are arranged in generally horizontal longitudinal alignment. The respective classifiers of each pair are adapted to be driven or reciprocated in counterbalancing opposition to each other by suitable eccentrics on drive shafts 48, 50, 52 and 54 which may be driven by belts from a suitable motor 56.

The individual classifying units are supported for the desired reciprocating movement by suitable hangers 68 and 72. Each sifting unit includes one or more screen surfaces 76 adapted to receive the stock which is fed into the receiving end of the sifter through an inlet 80. Suitable reciprocation of unit 32 and other similar units is adapted to convey the stock from this receiving end to the opposite or discharge end of the unit and to sift the desired particles down through the screen surface 76. As described above the respective pairs of units are driven in counterbalancing opposition to each other by suitable eccentrics, with the eccentrics of each pair of sifters arranged exactly 180° out of phase with each other. Thus the sifters are at all times moved in counterbalancing opposition in their common horizontal or longitudinal plane, i.e., either toward each other or away from each other.

According to a further feature of said Szasz application, a plurality of pairs of milling units, such as breaking or reduction machines, are also mounted symmetrically on the supporting frame. Thus a first pair of such units is mounted at the top of the frame in the Szasz case, a second pair of units at the outer ends of the frame beneath the discharge ends of the first sifters 32 and 34, a third pair of units at a location in the central portion of the frame beneath the discharge ends of the next lower sifters 36 and 38, and a fourth pair of units at the outer sections of the frame beneath the third pair of sifters. Thus in each step of the apparatus of said copending application material is discharged downwardly by gravity from one machine to the next lower machine.

According to the present invention, the milling machines are distributed in a novel arrangement which provides complete accessibility to all such units with minimum total height of the installation.

Thus all of the milling machines are located on the outer ends and top of the stack unit, with no milling machines supported within the stack, particularly within the inner central section. By this arrangement, all of the milling machines are easily accessible and can be readily checked by an operator for necessary adjustments, maintenance, and repair.

As shown in FIG. 1, the upper sieve units 32 and 34

receive stock from milling machines shown, for purposes of illustration, as roller mills 100 and 102. The desired stocks are fed to roller mill 100 by an inlet 104 and to roller mill 102 by an inlet 106. The products of these respective milling machines are then discharged at 108 and 110 respectively into the receiving ends of the uppermost pair of opposed sifters 32 and 34.

These sifters in turn discharge a portion of their products to second stage milling machines illustrated as further pairs of rolls 112 and 114 mounted on the outer frame portions 22 and 24. These milling machines 112 and 114 then discharge directly into the receiving ends of the next pair of classifiers 36 and 38.

According to one application of the present invention the milling machines which receive the material discharged by the sieves of this second pair are located at the top of the stack rather than underneath the pair. Thus roller mill pairs 116 and 118 are mounted at the top 26 of the central frame portion, where they can be easily checked and controlled by an operator.

To carry the stocks discharged by sifters 36 and 38 to the respective milling machines 116 and 118 one or more short pneumatic sections, such as 113 and 115, are provided. These pneumatic conveyors pick up the stock from the discharge ends of sifters 36 and 38 and carry such stock upwardly to respective cyclone separators 117 and 119. These separators are provided with connections 121 to a suitable pneumatic fan. The stock which has been lifted to these separators and which settles out of the air stream within the separators then drops to the milling units 116 and 118 through suitable rotary valves 129 of known construction. Such valves prevent the pneumatic system from sucking air and stock up from the milling machines 116 and 118 and thus limit the suction to the upwardly extending pneumatic conveying tubes 113 and 115.

The material discharged by rolls 116 and 118 is then carried downwardly by conduits 125 and 127 to the receiving ends of the third pair of opposed sifters 40 and 42. These sifters in turn discharge their tailings into respective milling machines 120 and 122 mounted on the outer frame portions 22 and 24. These milling machines discharge their processed stocks into the receiving ends of the lowest pair of sifters 44 and 46. The tailings of these sifters are then discharged at 123 for any suitable further processing.

The remaining stocks which are segregated by the various classifying units, and which are not to be fed to the following milling machine, are discharged through separate outlets, as shown at 96 and 97. Such stocks may be collected or subjected to further processing on other apparatus, according to their nature and quality.

One application of the arrangement of milling machines according to this first embodiment of the invention involves the possibility of using conventional double roller mills for the respective first and third milling machines at the top of the stack. Such double roller mills are well known and include two pairs of rolls within a single outer frame and casing, as shown at 124 and 126. Suitable dividers 128 and 130 within the respective casings maintain the desired separation of stocks fed to the different roller pairs. Thus one can take advantage of the availability and economy of double roll stands, each of which may be driven by its own independent power source, such as motors 132 and 134. Such units are available commercially, and their repair and adjustment can be handled in known manner by operators familiar with such equipment in conventional milling installations.

The mounting of the milling machines at the top and ends of the stacked unit, and the location of the sifter drives at the center section of the unit contribute to ease of maintenance and adjustment and to minimum height of the unit. Suitable platforms are provided as shown at 15 and 17 for personnel to inspect, adjust or operate the unit. Thus ladders 19 are used to reach the ends of platform 15 for access to rolls 120 and 122 and to sifters 40, 42, 44 and 46 and their drives. A ladder 21 provides access to platform 17 from the floor level, while a further ladder 23 extends from platform 17 to the top 26 of the unit. Suitable cross braces 31 further strengthen the unit as needed. Thus all portions of the stacked mill are readily accessible to an operator.

It is possible, according to this invention, to vary the exact arrangement of sifters and milling machines to provide increased processing flexibility. For example, if a longer classifying step were needed for material discharged from rolls 112 and 114, the tailings or other material discharged from sifters 36 and 38 could be fed directly to the next lower sifters 40 and 42. In such a case, the upper rolls 116 and 118 may receive stocks from one or more prior external sources, rather than from sifters within the same stack. Or the pneumatic lifting conveyors 113 and 115 could be connected at some other point in the stacked unit, e.g., at two of the outlets 96 and 97, or at outlets 123 to provide a different cycling or recycling flow.

One such preferred modification of this invention is shown schematically in FIG. 2. Here the frame 151 supports upper and lower pairs of reciprocating classifiers 153, 155, 157 and 159. The upper sifters 153 and 155 are driven from a common central drive shaft 161 in counterbalancing opposition. The lower sifters 157 and 159 are similarly driven from a common drive shaft 163. Sifter 155 receives material discharged by a first milling machine 165 which is shown as having a first pair of rolls 166. Stock is fed to roller mill 165 at 167 from any desired source.

One fraction of material from sifter 155 is then discharged into a roller mill 169 at the end of the frame. Roller mill 169 then feeds stock directly to sifter 159. One fraction, such as the tailings from sifter 159, is then fed by a pneumatic conveyor shown schematically at 171 to a cyclone separator 173 and thence to a second pair of rolls 175 at the top of the frame. The two pairs of rolls 166 and 175 are preferably combined in a single housing as a conventional double roll stand.

From rolls 175 the stock is discharged to sifter 153 of the upper pair. One of the fractions discharged from sifter 153 then drops to roller mill 177 at the opposite end of the frame from roller mill 169. From roller mill 177 the stock is discharged by gravity to sifter 157 of the lower pair, and the classified fractions are then discharged from the sifter at 179 for collection or appropriate further processing.

The device of FIG. 2 is particularly useful as a stacked mill unit for performance of successive first, second, third and fourth breaking operations on cleaned and tempered wheat, with intermediate scalping or classifying to separate such middlings stocks and flour as may be produced at each breaking step before the remaining stock is fed to the next break.

In all of the embodiments described, the stacked unit advantageously includes a plurality of opposed sifters mounted in pairs in a frame, and a plurality of milling machines mounted on the top and opposite ends of the frame. The advantages of short direct gravity discharge from upper to lower units and the balancing out of horizontal vibrations which tend to shake and bend the frame can be maintained throughout the major portions of the unit. Yet extreme flexibility in processing sequence and the advantages of ready access to all milling machines can also be achieved by suitable arrangement of the discharge connections and by the use of relatively short pneumatic lifts at not more than one or two points in the unit. In the embodiments shown, the use of one or more conventional double roll stands for the desired pairs of milling machines at the top of the frame offers further advantages of economy, compactness and convenient adjustment by operators already familar with such units.

According to the foregoing description compact arrangements for stacked mill units have been provided with reciprocating sifters arranged in balanced opposed pairs and with associated milling machines, such as roller mills, located in balanced arrangements at the top and ends of the stack for convenient access and control. In this specification the principles of the present invention have been set forth, together with some of the ways of practicing the invention.

I claim:

1. A stacked flour milling unit for a grain milling installation comprising a supporting frame having a central support section and first and second oppositely extending end support sections aligned along a common longitudinal axis with said central support section, at least two vertically spaced pairs of opposed longitudinally reciprocating classifiers mounted in said frame, with the respective first and second classifiers of each pair extending from said central section to said first and second opposite end sections, means for reciprocating each classifier in horizontally counterbalancing opposition to its opposite aligned classifier, first and second pairs of milling rolls mounted at the top of said central frame portion above the upper pair of classifiers, means for discharging material by gravity from said first and second pairs of rolls directly to the inner ends of the respective first and second upper classifiers, third and fourth pairs of milling rolls mounted respectively at the first and second end support sections of the frame in position to receive material by direct gravity discharge from the outer ends of the respective upper classifiers, said third and fourth pairs being located above the lower pair of classifiers in position to discharge stock directly by gravity into the outer ends of the respective first and second lower classifiers, and conveying means located to receive material discharged from the inner end of the first lower classifier and connected to lift said material upwardly and discharge it to said second pair of rolls at the top of the central frame section.

2. A stacked flour milling unit according to claim 1 in which said first and second pairs of rolls at the top of said central support section are combined in the common housing of a double roller mill stand having a separate inlet and outlet for each pair of rolls and a single common power source driving both pairs of rolls.

3. A stacked flour milling unit for a grain milling installation comprising a supporting frame, at least three vertically spaced pairs of horizontally extending, longitudinally reciprocating classifiers in said frame, means supporting said classifiers in opposed pairs, driving means for reciprocating the classifiers of each pair in counterbalancing opposition to each other, and at least four pairs of milling machines mounted on said frame, with two pairs of said machines mounted with one machine of each pair at each end of the frame, and with two pairs of said machines at the top of said frame, means for discharging stock by gravity directly from the milling machines of one of the two pairs at the top of the frame to the inner ends of the classifiers of the uppermost pair, from the outer ends of the classifiers of said uppermost pair to the milling machines of one pair at the ends of the frame, from said one pair of end machines to the outer ends of a second pair of classifiers, from the remaining pair of machines at the top of the frame to the inner ends of a third pair of said classifiers, and from the outer ends of the third pair of classifiers to the milling machines of the remaining pair at the ends of the frame, and means for conveying upwardly and into said remaining pair of milling machines at the top of the stack the stocks discharged by the inner ends of said second pair of classifiers.

4. A flour milling unit according to claim 3 in which said means for conveying stocks upwardly includes two separate pneumatic conveying legs, one conveying stock discharged by one classifier of said second pair to one milling machine of said remaining pair at the top of the stack, and the other leg conveying stocks discharged by the other classifier of said second pair to the other milling machine of said remaining pair at the top of the stack.

5. A stacked flour milling unit for a grain milling installation comprising a supporting frame having a central portion and two oppositely extending end sections aligned along a common longitudinal axis, a plurality of vertically spaced, horizontally-extending classifiers in each section, means supporting each classifier of each such section for longitudinally reciprocating movement along said axis and in substantial alignment with a corresponding classifier in the opposite end section, means for reciprocating each classifier in counterbalancing opposition to its opposite aligned classifier, a plurality of milling machines supported on said frame in balanced pairs, all of said milling machines being mounted at the top and ends of said frame, with the two machines of a first pair mounted at the top of said central portion immediately above the upper pair of classifiers for discharging material from said first two machines directly to the receiving ends of said upper classifiers, a second pair of third and fourth milling machines mounted at the outer portions of said respective end sections immediately below the uppermost classifiers in position to receive material by direct gravity discharge from such classifiers, said second pair of milling machines being located immediately above a second pair of said opposed classifiers in position to discharge stock by gravity directly into said second pair of classifiers, a third pair of fifth and sixth milling machines mounted at the top of said central portion, and means for lifting materials discharged by said second pair of classifiers and conveying said materials into the respective fifth and sixth milling machines at the top of the stack, and a third pair of said classifiers mounted in said frame below said fifth and sixth machines and adapted to receive stock by gravity discharge from said fifth and sixth milling machines.

6. A stack unit according to claim 5 in which said first and third pairs of milling machines consist of two separate standard double roller flour mill machines, each having two sets of rolls with separate inlets and outlets for each set of rolls, and with one set of rolls in each double unit serving as the first pair of milling machines, and with the other set of rolls in each unit serving as the third pair.

7. A stacked flour milling unit according to claim 5 having a fourth pair of seventh and eighth milling machines mounted at the outer portions of said respective end sections immediately below the third pair of classifiers to receive material by direct gravity discharge from the outer ends of said third pair of classifiers, and a fourth pair of opposed classifiers mounted with their outer ends located immediately below to receive stock by direct gravity discharge from the fourth pair of milling machines.

8. A stacked flour milling unit for a grain milling installation, said unit comprising a supporting frame having a central support section and two aligned oppositely extending end support sections, a plurality of vertically spaced pairs of longitudinally reciprocating classifiers mounted in said frame, with the inner ends of each classifier at said central section and their outer ends at said end sections, the discharge end of at least one lower classifier being located at the central support section, driving means for reciprocating the classifiers of each pair in counterbalancing opposition to each other and thereby conveying stock along said classifiers while at least partially classifying the stock, a plurality of pairs of milling machines all mounted at the top and end portions of said frame in positions to discharge material downwardly by gravity to appropriate classifiers in said frame, and means for conveying stock upwardly from the discharge end of at least said one lower classifier at the central support section to one of said milling machines at the top of said unit.

9. A stacked flour milling unit for a grain milling in-

stallation, said unit comprising a supporting frame having a central support portion and two aligned oppositely extending end support portions, a plurality of vertically spaced, horizontally extending longitudinally reciprocating classifiers supported on said frame and arranged in opposed pairs for reciprocating movement of each classifier along a common longitudinal axis in said frame in alignment with the corresponding opposite classifier of the same pair, means for reciprocating each classifier in horizontally counter-balancing opposition to its opposite aligned classifier, a plurality of pairs of milling machines mounted on said frame and connected to appropriate classifiers in a desired processing sequence, all of said pairs of milling machines being mounted at the top and ends of said frame in positions to discharge material downwardly by gravity to appropriate classifiers in said frame, with two pairs of said milling machines mounted at the top of said frame, the classifiers of at least one pair

having their discharge ends located in the central frame portion, and conveying means for receiving stock discharged by said one pair of classifiers at the central frame portion and feeding said stock upwardly to one pair of said milling machines at the top of said frame.

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