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BATTERY SYSTEM OF ROLLER MILLS

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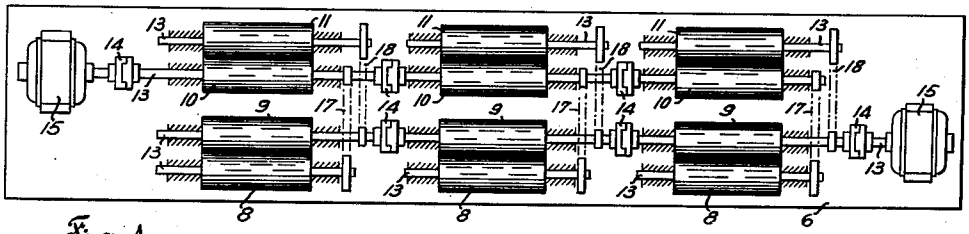


Fig. 1

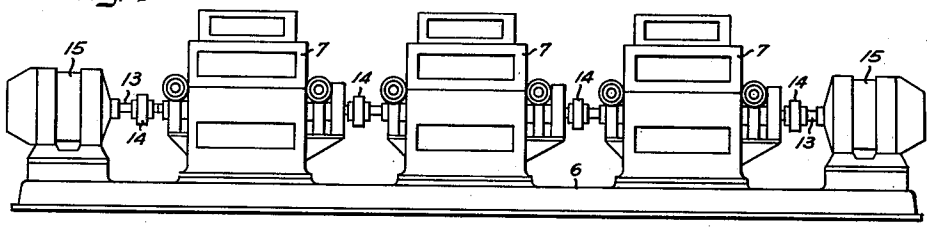


Fig. 2

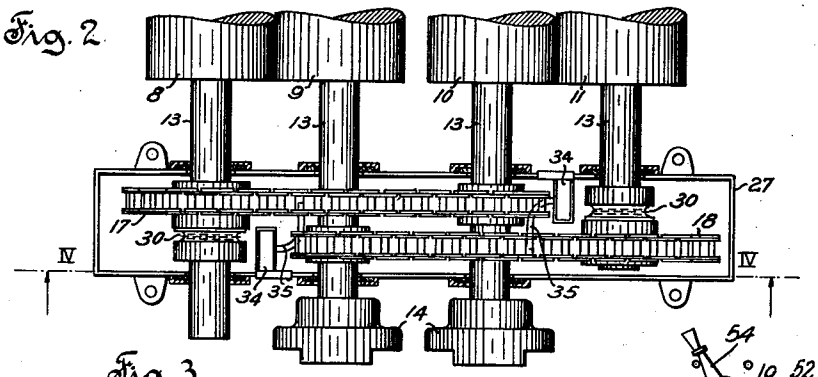


Fig. 3

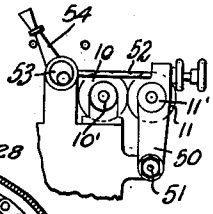


Fig. 6.

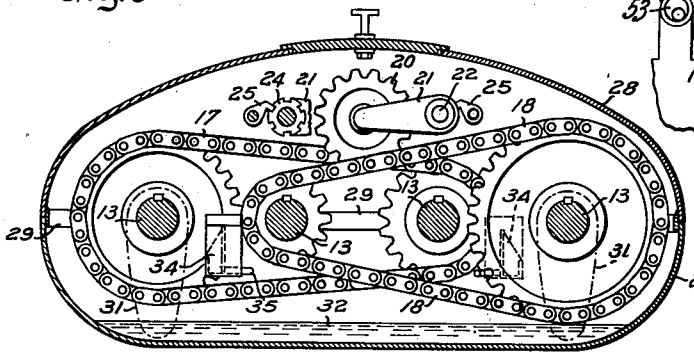


Fig. 4

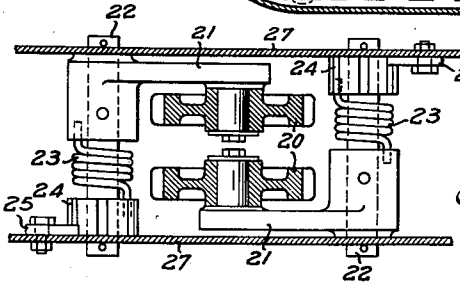


Fig. 5

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## BATTERY SYSTEM OF ROLLER MILLS

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1 Claim. (Cl. 83—12)

This invention pertains to a battery system of roller mills.

The standard roller mill used in breaking, reducing and grinding grain to flour comprises two pairs of rolls, the rolls of each pair being in engagement with each other through a film or layer of the grain being treated.

The two rolls of each pair must be geared to rotate at different speeds to obtain the desired differential surface speed for cooperating rolls. At least one roll of each pair must be movable toward or away from its cooperating roll because the rolls must be started without load, to avoid overloading the motors. This is accomplished by providing a considerable space between coacting rolls when they are to be started, and bringing them into engagement after starting the rolls. Adjustability is also required to regulate the degree of reduction of the material being ground. Moreover, at least one roll of each pair must be adjustable in order that it may be "trammed" or brought into parallel relationship with its cooperating roll.

The power transmission for this type of mill has hitherto been a very complicated construction, and little change has been made in this power transmission for several decades. The tortuous "A" drive, as it is called in the trade, has well been termed a "torture drive". The drive for the two fast rolls consisted of a main driving shaft (preferably under the floor), carrying a pulley which carried a belt which passed over a pulley on one fixed roll, under a countershaft pulley, over a pulley on the other fixed roll and back to the main shaft pulley. At the opposite end of the machine, a pair of belts connected the countershaft to each of the two slow rolls. Such a drive is shown and described in W. D. Gray Patent 228,525, June 8, 1880. Besides being wasteful of power, such a drive involved the use of a main shaft, a countershaft and eight pulleys. It required holes in the floor for the driving belt, and it made it very difficult to maintain the proper tension on all the belts and still keep the countershaft parallel to the rolls.

This invention relates to an arrangement of roller mills and a means for driving them which simplifies the prior art construction, and results in reduced power consumption and many other advantages pointed out below.

In accordance with this invention a plurality of flour roller mills are arranged in line on a unitary base, and the fast rolls of each mill are connected to corresponding rolls of each adjacent mill by shafts and flexible couplings. The fast rolls of each mill, which are preferably the inner rolls, are geared to the outer or slow rolls. Since the slow rolls are not connected to corresponding rolls of adjacent mills, it is a simple matter to make the slow rolls movable toward and away from the fixed rolls. Provision is also made for tramming the slow rolls, to insure that the rolls of each pair are parallel.

The two adjacent series of fast rolls of the battery may be geared together and driven by a single source of power, or each series may be driven independently by a separate source of motive power.

One of the primary objects of this invention is to reduce the power required to operate a plurality of roller mills.

Another object of this invention is to do away with the countershafts, main shaft, pulleys and floor holes heretofore considered necessary in a roller mill installation, by a direct motor drive of the series of alined rolls mounted on fixed axes.

Another object of this invention is to provide a roller mill drive in which the direction of the reactive forces on the rolls of the material being treated is substantially in the plane of the forces on the rolls generated by the driving means therefor, and since some of these forces act in directions opposite to each other, they tend to compensate for each other, thereby eliminating the excessive bearing stresses inherent in prior art construction.

Another object of this invention is to provide a series of roller mills which is operable by one or two sources of motive power, in which each mill may have the spacing between the rolls thereof changed independently of the spacing adjustment in the other mills of the series, and wherein the rolls of each mill may be easily trammed.

Another object of this invention is to reduce the number of machinery guards required in a roller mill installation.

Other objects will be apparent as the description of the invention proceeds.

In the drawing appended hereto Fig. 1 is a diagrammatic plan view of a battery of roller mills, showing how the rolls are actuated.

Fig. 2 is a diagrammatic elevation of a battery system of roller mills.

Fig. 3 is a plan view of the slow roll driving means of an individual roller mill, with the top of the casing thereof removed.

Fig. 4 is a sectional view of the same taken along the lines IV—IV of Fig. 3.

Fig. 5 is a detail view of the roller chain tensioning means, partly in section.

Fig. 6 is an elevational view showing means for moving the outer rolls relatively to the inner rolls.

A battery system of double roller mills in accordance with this invention, as shown in Figs. 1 and 2, comprises a rigid unitary base 6, on which is mounted a series of double roller mills 7. Each roller mill is rigidly mounted on base 6, insuring constant alinement of the mills.

Each mill 7 comprises four rolls 8, 9, 10 and 11 mounted on suitable bearings. The inner rolls, which will be called the fast rolls, are mounted on fixed bearings, and the fast rolls of each machine are connected, by means of shafts 13 and flexible couplings 14, with the fast rolls of adjacent mills. Thus the rotation of one roll will effect rotation of all the rolls in that line. The two lines of rolls in each battery may be geared together, or each line of rolls may be driven by a separate motor 15, as shown in Fig. 2.

The outer or slow rolls of each mill are driven by flexible band connections from the first rolls. For example, slow roll 8 is connected to fast roll 10, and slow roll 11 is connected to fast roll 9. In this way the fast and slow rolls of each pair are caused to turn in opposite directions. It is obvious that the fast and slow rolls may be transposed, and that the outer lines of rolls may be coupled together, instead of the inner lines of rolls.

This drive from the fast rolls to the slow rolls is most conveniently effected by means of roller chains 17, 18 which are mounted on suitable sprocket gears fixed on the rolls. The roller chains 17, 18 are made slack, so as to permit of movement of slow rolls 8, 11 outward away from their cooperating fast rolls 9, 10. This slack in each roller chain is taken up by a biased tensioning means best illustrated in Fig. 5. This biased tensioning means comprises a sprocket gear idler 20 which meshes with each roller chain, and is carried by an arm 21 which is free to rotate on shaft 22. The sprocket idler is biased downward, as seen in Fig. 4, by one end of a spring 23, the other end of which is retained by a ratchet nut 24, which is prevented from rotating by pawl 25.

It will be noted that only the inner or fast rolls are coupled to corresponding rolls of adjacent mills, the slow or outer rolls being independent of the rolls of adjacent mills. This makes it possible to mount the fast rolls in fixed bearings as shown in Fig. 6, insuring continuous alinement of these coupled rolls, while the slow rolls are mounted in movable bearings so that each slow roll may be trammed to insure parallelism with its corresponding fast roll. Each slow roll may also be moved bodily toward or away from its corresponding fast rolls, as is required in starting the mill, without disturbing the coupled alinement of the fast rolls.

The means for changing the spacing between the outer and inner rolls forms no part of the present invention, and is indicated in Fig. 6 merely to complete the disclosure. The inner rolls 10 are mounted in stationary bearings 10', while outer rolls 11 are mounted in movable bearings 11' which are carried on arms 50 pivoted on the roller mill frame at 51. Each of the arms 50 carries an extension to which is connected one end of link 52, the other end of each link being connected to a pivoted eccentric 53. Movement of eccentrics 53 is effected by movement of arms 54, thus effecting movement of the bearings carrying rolls 11 away from rolls 10. A similar arm and eccentric arrangement (not shown) are provided for rolls 8. Because outer rolls 8 and 11 are driven independently of the rolls in axial alinement therewith, the spacing or setting of the outer rolls in any one roller mill may be effected without interfering with the rolls in any other roller mill in the same battery.

The entire roller chain drive is enclosed in a casing which comprises a bottom member 27, suitably attached to the roller mill frame, and a removable top member 28, suitably fastened to bottom member 27, and provided with an inner flange 29 to prevent oil from being thrown out of the casing during operation of the mill. It will be seen that any oil thrown on the upper part 28 of the casing will be prevented from running out by flange 29. The upper or cover member 28 carries the shafts 22 which carry the biased tensioning idlers 20. Pawls 25 are also carried by cover member 28, as shown in Fig. 5. It will be seen that when cover member 28 is removed, the tension idlers are removed together with the cover, and chain drives 17, 18 are easily accessible for repair or alteration, while ratchet nut 24 in cover member 28 can easily be adjusted to change the tension of springs 23.

To provide proper lubrication for roller chains 17, 18 each shaft 13 of slow rolls 8 and 11 is provided with circular grooves 30, loosely carrying oil chains 31, which dip into a pool of oil 32 in lower casing 27. A trough or other container 34 is attached to one wall of lower casing 27, and is arranged adjacent oil chain 31 so that as chain 31 is carried up on the left of roll 8 in Fig. 4 and starts its downward path, the oil carried by the chain is thrown out by centrifugal force into container 34. An oil conduit 35 carries the lubricating oil from container 34 and permits it to drip on the inside of roller chains 17 or 18. Gravity and centrifugal force combine to make this oil permeate the entire chain. It will be noted that this means for oiling the roller chains is very simple and highly reliable.

Reverting now to the battery drive diagrammatically illustrated in Fig. 1, it will be seen that a simple flexible coupling connecting adjacent fast rolls and a double roller chain drive on each mill replace the complicated shafting and belting of the prior art. Not only does this mean a reduction in the number of parts required, but it also provides a simple means for eliminating air friction losses which invariably accompany rotating pulleys and traveling belting. This saving in power, added to the saving effected by elimination of the tortuous drive of the prior art effects a saving in power estimated at twenty-five percent. It will further be noted that the only moving parts which are in the open are shafts 13 and couplings 14. These couplings are of simple construction, and are so made that, when released, each of the fast rolls can be moved in a lateral direction out of engagement with its adjacent rolls without altering the position of such adjacent rolls. This makes it possible to change any roll without moving any other rolls in line therewith.

A further advantage of the drive shown herein is that the reactive forces on the rolls due to the material being treated are substantially in the plane of the forces on the rolls due to the chain or belt drive between the driving and driven rolls. In certain instances, it will be seen that these forces are directed in opposite directions, thereby tending to cancel each other. This results in re-

duced bearing pressures, with the result that mills constructed in accordance with this invention run with greatly reduced bearing temperatures, as compared to those of the prior art. This is another indication of power saving in the battery system of mills disclosed herein. In the prior art construction, on the other hand, the forces on the rolls due to the drive were not only greater in magnitude, but were directed at a considerable angle to the direction of the reactive forces on the rolls exerted by the material being treated. The resultant forces on the rolls and therefore on the bearings were so great that difficulty was experienced in maintaining the bearings cool. The high temperatures of the bearings during operation of the prior art mills also made it difficult to maintain the rolls of each pair in uniform alinement, because the end portions of the rolls, being nearer the hot bearings, expanded more than did the central portions of the rolls. This difficulty is obviated by the construction of this invention.

It will be noted that when the fast rolls are driven by a direct connected motor, a balanced couple is applied to the rolls, which exerts no lateral bearing pressure. ("Motor", as used in the specification and claims, refers to any rotary motive means which may be connected directly to a roller shaft.) If the roller is driven by means of the belting or gearing of the prior art, however lateral pressures, which may be of great magnitude, are necessarily exerted on the bearings of the roller.

The roller chain drive and biased idler shown in Figs. 3 and 4 are particularly useful in the flour mill drive. Not only do they permit of the movable roller being moved relatively to its complementary roll, but they also provide for substitution of driving and driven members which occurs in use. This may be illustrated as follows: when the mill is first started, with complementary rolls spaced from each other, fast roll **10** drives slow roll **8** through chain **17**, so that the upper run of chain **17** is taut while the lower run is slack. When slow roll **8** is moved into operative relation with fast roll **9**, rolls **8** and **9** are in engagement with each other through a film of the grain being treated. This tends to expedite the slow roll, which now is driven largely by roll **9**, and tends to feed power back to roll **10**. This regeneration of power also occurs in mills of the prior art, but is much more efficient in the present construction because the regenerated power is transmitted directly instead of being dissipated in the tortuous drive and greater bearing pressures of the prior art. Under these circumstances, the lower run of chain **17** becomes taut, while the upper run becomes slack. It is therefore very important to have a biased idler, such as **20**, to maintain comparatively uniform tension on the chain and to permit of this substitution of driving and driven members.

The elimination of the driving belts of the prior art also eliminates holes in the floor through which the belts passed from the main shaft under the floor to the rolls. This makes it possible to install an efficient system of air conditioning in the plant, which was made difficult previously by the belt holes in the floor. It should also be noted that instead of having a complicated system of belts and pulleys to be housed on each side of the machine, a single casing is sufficient to cover the chain drives to the slow rolls.

This invention is not limited to the specific construction shown and described, as various changes within the scope of the appended claim will occur to those skilled in the art.

It is claimed and desired to secure by Letters Patent:

A series of similar double roller mills, each mill comprising two pairs of cooperating rolls, one roll of one pair in each mill being mounted in fixed bearings and being coupled to the corresponding rolls of the other mills, a series of rolls comprising the other rolls of said pairs, each roll in said series being rotatable independently of the remaining rolls in said series and being mounted in bearings movable relative to said fixed bearings, and driving means in each mill for connecting each roll of said series with a roll of the other pair in said mill.

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