(No Model.)

L. D. HARDING.

DIFFERENTIAL IN ROLLER MILLS.

No. 463,049. Patented Nov. 10, 1891.

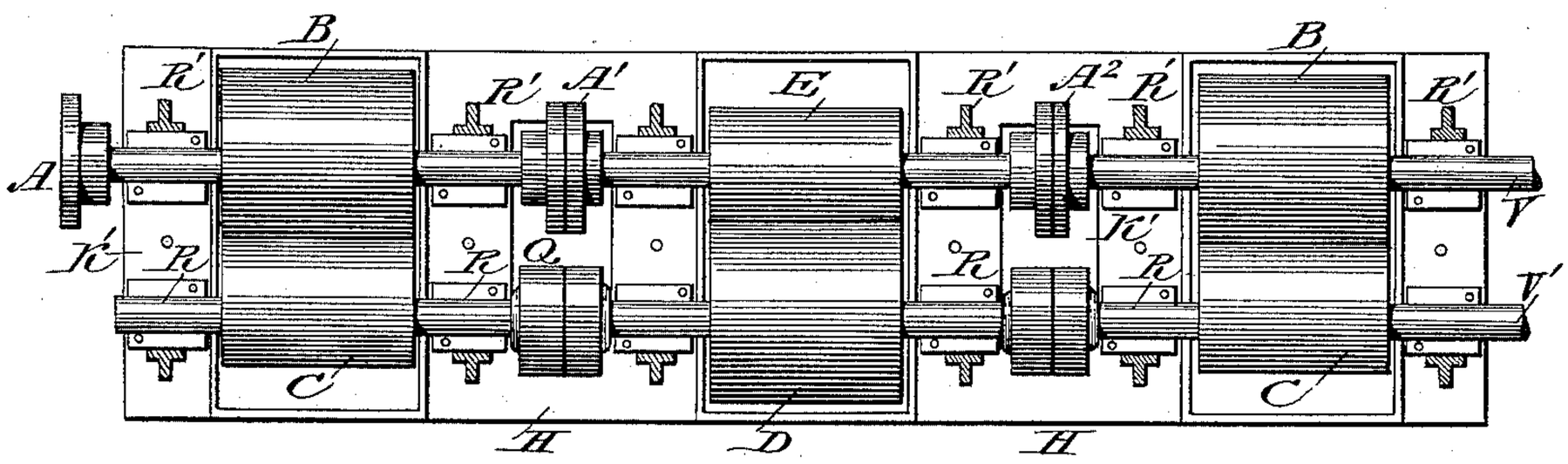
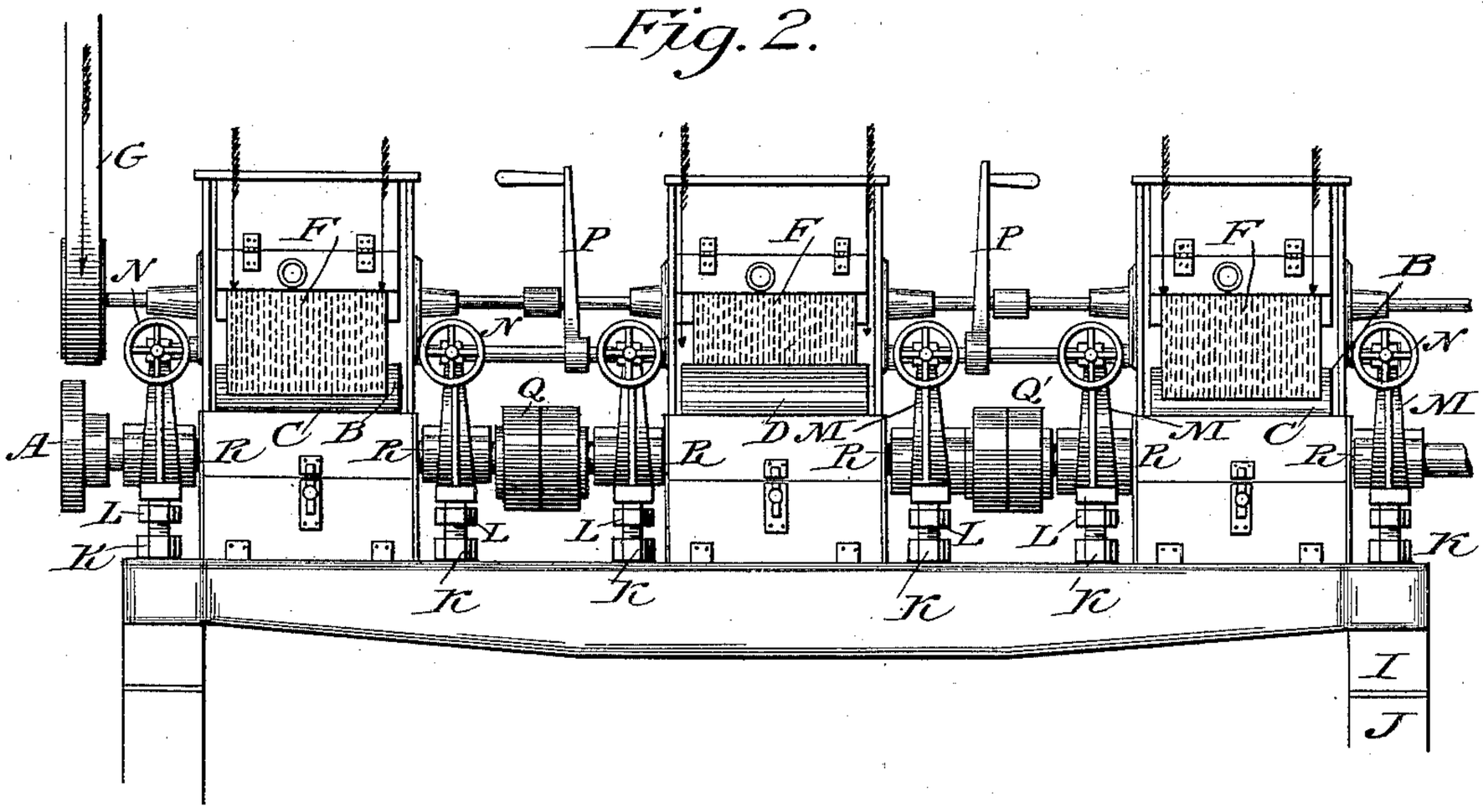


Fig. 1.

Fig. 2.



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LEGRAND D. HARDING, OF COLFAX, WASHINGTON.

DIFFERENTIAL IN ROLLER-MILLS.

SPECIFICATION forming part of Letters Patent No. 463,049, dated November 10, 1891.

Application filed March 16, 1891. Serial No. 385,321. (No model.)

To all whom it may concern:

Be it known that I, LEGRAND D. HARDING, a citizen of the United States, residing at Colfax, in the county of Whitman and State of Washington, have invented certain new and useful Improvements for Producing the Desired Differential in Roller-Mills without the Use of Counter-Shafts, Pulleys, Belts, Gears, or Tighteners; and I do hereby declare that the following is a full, clear, and exact description of the same, which will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, which form a part of this specification, in which—

Figure 1 is a plan view of a roller-mill adapted to work under my process, showing the rolls in position with the upper parts above the shafts removed. Fig. 2 is a front elevation of the same with part of the front casing removed.

Heretofore the differential has been acquired by driving one of a pair of rolls at the desired speed and placing a gear on the shaft thereof or on a shaft connected therewith, the teeth of which connect with a gear of different diameter on or connected with the shaft of the other roll; or by belting from the shaft of one roll to the shaft of the other roll, using pulleys in any of the well-known ways; or by driving both fast and slow rolls from a line of shafting by the use of pulleys and belts; or by using a roll with a suitable annular recess near the middle, in combination with a roll with a suitable annular enlargement, as is shown in my patent, No. 450,014, dated April 7, 1891; or by using a roll provided with a suitable annular offset at one end, in combination with a roll with a suitable annular enlargement, as shown in my application for Letters Patent, Serial No. 388,083, dated April 8, 1891. When the gearing is used, a great deal of noise is made thereby, which is the source of great annoyance, and there is also considerable loss of power by the frictional contact of the teeth of the gears. When belting is used, there must be idlers and tighteners or cross-belts or counter-shafts, which make the process complicated and expensive and result in great loss of power by friction on the journals, arising from the pressure of the belts, which also cause the bearings and journals to heat at times and to wear more rapidly than they otherwise would. When the rolls are made with the recesses and offsets, they are not so easily constructed and repaired as the ordinary straight rolls are.

The object of my invention is to produce the differential required in roller-mills for the manufacture of feed and flour without the use of belts, gears, pulleys, or counter-shafting and without the loss of power arising from their use, and also without providing the rolls with offsets or recesses.

To this end my invention consists of a certain combination of rolls, and in using the stock passing between the rolls and the same power required to disintegrate the particles of stock to produce any differential motion that may be required between their faces or at their peripheries.

To carry my invention into effect I place four or more rolls in position, as shown in Figs. 1 and 2, and couple them together by any suitable means of coupling. These rolls must vary in diameter sufficient to produce whatever differential may be required between them and their opposing rolls when each is making an equal number of revolutions in the same time. In all cases a roll B of large diameter must be opposed by a roll C of small diameter, and each small roll E must have a large one D opposite.

As before stated, I place four or more rolls in position, in which I prefer to have about two-thirds of the entire length of those rolls that are placed in the primary line V (to which power is to be applied) of larger diameter and the remaining one-third of said line V of smaller diameter. I then revolve the primary line of rolls by any of the well-known means, preferably by coupling A to a revolving shaft extending directly from the water-wheel, an engine, or any suitable motor. I then feed a portion of the stock F to be reduced between the large parts B and B of the primary line of rolls V and the small parts C and C of the secondary line of rolls V′, using about two-thirds of the stock F, which I distribute throughout the length of all the parts B and and C and B and C so far in use. I then adjust the rolls so far in use by means of hand-wheels N, so as to reduce the different streams of stock passing between them (each) to the

desired degree of fineness. At this point in the process the small parts C and C of the secondary line of rolls V′ are driven by their contact with the stock passed between them and the large parts B and B of the primary line V (or the prime movers) and move at about the same peripheral speed, the differential so far acquired being insufficient and beyond the control of the operator.

From the foregoing it may be readily seen that the entire secondary line of rolls V′ is now revolving rapidly, and that the differential between the parts D and E, so far unemployed, is very great, and at this point in the process the large parts D of the secondary line V′ will be revolving at a high rate of speed at their peripheries and the small parts E of the first line of rolls V will be moving relatively very slow, their differential being almost double that required at each point in the operation and about one-third of the roll-surface running yet unemployed. I now feed a stream of the remaining stock F between the unemployed rolls D and E to retard the motion of the secondary line V′ sufficiently to cause it to revolve at the same speed as the primary line V, which gives the required differential at all points in the operation, by reason of the difference of the diameters of the different opposing rolls being such as to produce in each pair such difference in their peripheral movement as may be required for reducing the kind of stock fed thereto, so long as uniform revolutions are maintained between their respective shafts by the proper distribution of the stock.

It is evident that it may not be necessary to introduce the stock between the rolls in the exact order hereinbefore described, but that an approximate apportionment may be made between all the large and the small rolls from the onset, for the purpose of more evenly guiding the secondary line of rolls while making the adjustment.

A striking advantage of my process is that one-half of the rolls are properly differentially driven by contact with the stock, the same power being used to actuate and govern their movements that is used to reduce the particles, thus saving the expense of all machinery heretofore used and all annular offsets and recesses heretofore used to guide the movements of one-half the rolls without detriment to the work. I am aware that rolls have heretofore been driven at random by the stock passing between them and other rolls.

I am also aware that the movement of the secondary roll has been so controlled by means of suitable annular offsets and recesses, as shown in my patent, No. 450,014, dated April 7, 1891; but I am not aware that the method of arranging ordinary straight rolls (each of which is of uniform diameter throughout its length) so as to control the movements of all the rolls in the secondary line of such rolls by the relative size and position of the rolls by the use of the stock operated upon, so as to produce the differentials so essential for granulation in flour-milling, has ever been practiced.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination of a primary line of rolls (to which power is applied) comprising two rolls of larger diameter and one roll of smaller diameter, each mounted on an independent shaft and each supported in independent bearings, with the proximate ends of their respective shafts coupled together and forming a direct line of a secondary line of rolls comprising two rolls of smaller diameter placed opposite the said two rolls of larger diameter in the said primary line of rolls and one roll of larger diameter placed opposite the said roll of smaller diameter of the said primary line of rolls and each mounted on an independent shaft and each supported in independent bearings and having the proximate ends of their respective shafts coupled together and forming a direct line, lying in the same horizontal plane and having their axes parallel with the axes of the rolls of the said primary line of rolls and each held in frictional contact with the stream of stock passing between it and its opposing roll (or mate) in the said primary line of rolls, substantially as herein described, and for the uses and purposes herein set forth.

2. The herein-described arrangement of rolls of larger diameter and rolls of smaller diameter in two parallel lines, comprising a primary line of rolls to which power is to be applied, in which approximately two-thirds of the aggregate length of the rolls in said primary line are of larger diameter and the remainder of smaller diameter and each mounted on an independent shaft and each supported in independent bearings, with the proximate ends of their respective shafts coupled together and forming a direct line, and a secondary line of rolls in which approximately two-thirds of the aggregate length of the rolls in said secondary line are of smaller diameter and are placed opposite the rolls of larger diameter in the aforesaid primary line of rolls and the remainder in said secondary line are of larger diameter and are placed opposite the rolls of smaller diameter in the aforesaid primary line of rolls and each of the rolls of the said secondary line is mounted on an independent shaft and each supported in independent bearings with the proximate ends of their respective shafts coupled together and forming a direct line of rolls, the rolls of smaller diameter of the secondary line being held in frictional contact with the stock passing between them and the rolls of larger diameter of the primary line and the rolls of larger diameter in the secondary line being held in frictional contact with the stock passing between them and the rolls of smaller diameter in the said primary line of rolls, whereby by the relative size and position of the several rolls in the

series or system the required differential is produced between the periphery of each roll and its mate by the contact of the faces of the rolls with the intervening stock.

3. The combination of two rolls of large diameter with one roll of small diameter to form a primary line of rolls, as and for the uses and purposes herein set forth.

4. The combination of two rolls of small diameter with one roll of large diameter, as shown, to form a secondary line of rolls, for the uses and purposes herein set forth.

5. The combination of a primary line of rolls, as shown, with a secondary line of rolls, as shown, for the uses and purposes herein set forth.

6. The combination of rolls of large diameter with rolls of small diameter, as shown, to form a series or system of rolls, whereby certain differentials may be produced by the relative proportion and position of the rolls in conjunction with the use of the stock, as herein described and set forth.

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