June 3, 1930. F. W. MACLENNAN 1,761,268

CRUSHING ROLL APPARATUS

Filed Aug. 8, 1927 2 Sheets-Sheet 1

Fig. 1

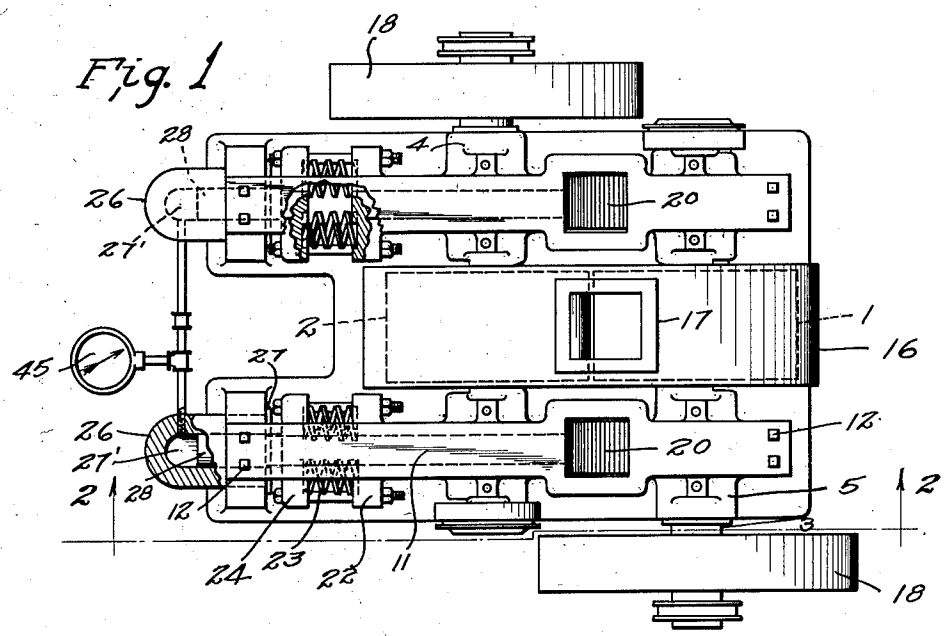
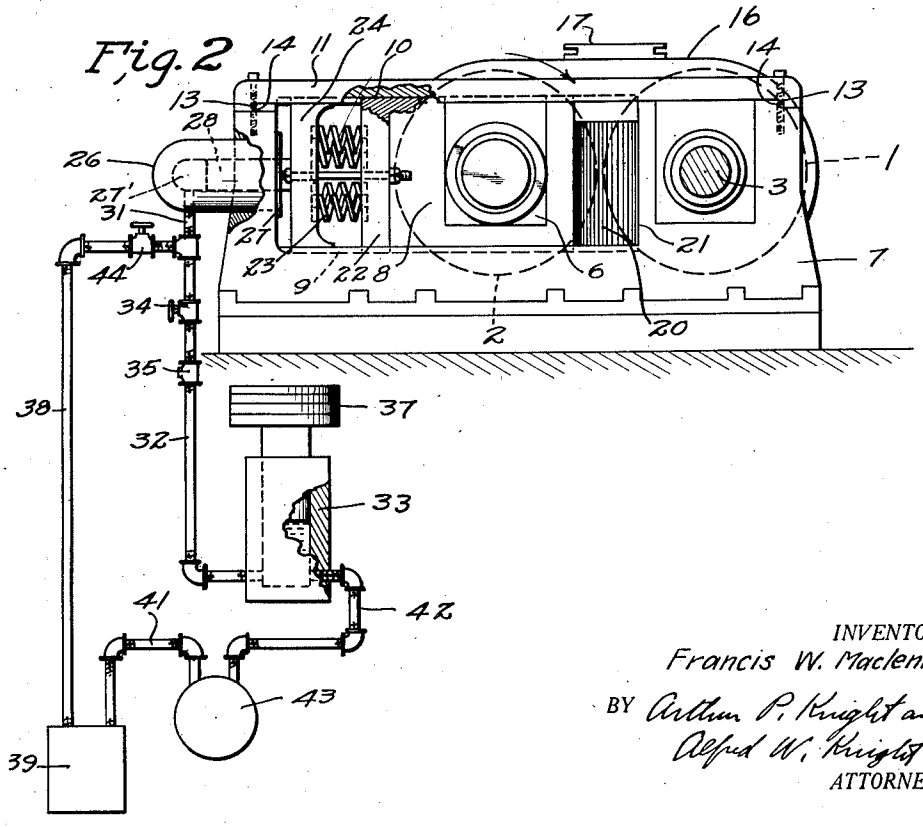


Fig. 2



INVENTOR.
Francis W. Maclennan
BY Arthur P. Knight and
Alfred W. Knight
ATTORNEYS

June 3, 1930. F. W. MACLENNAN 1,761,268

CRUSHING ROLL APPARATUS

Filed Aug. 8, 1927 2 Sheets-Sheet 2

Fig. 3

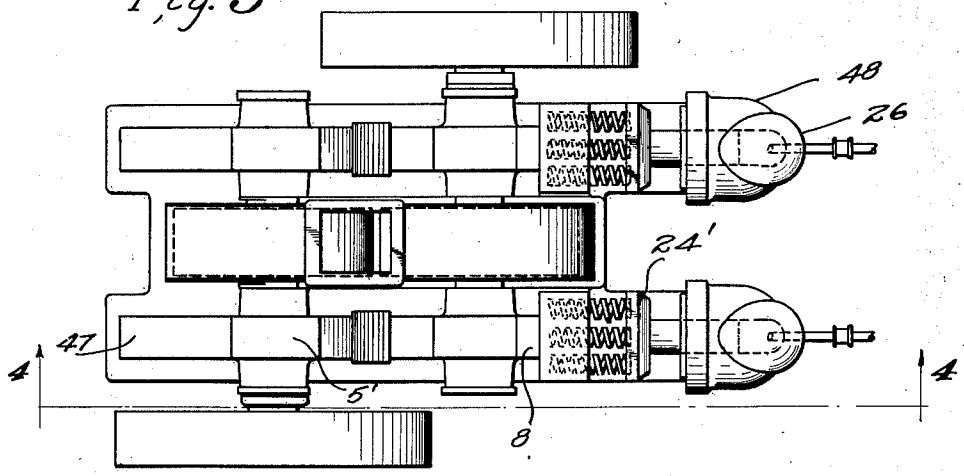
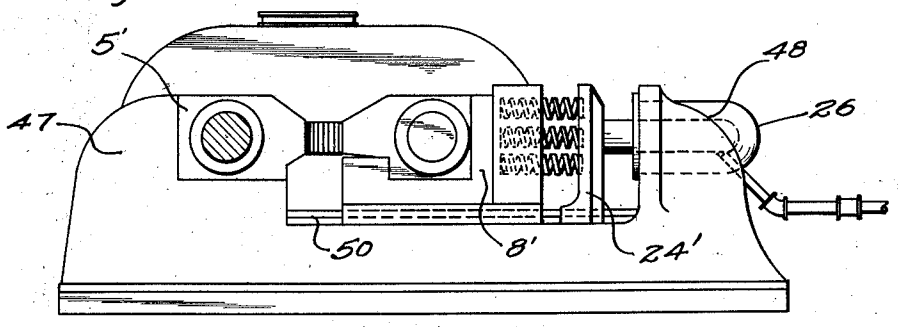


Fig. 4



INVENTOR.
Francis W. Maclennan
BY Arthur P. Knight and
Alfred W. Knight
ATTORNEYS

Patented June 3, 1930 1,761,268

UNITED STATES PATENT OFFICE

FRANCIS W. MACLENNAN, OF MIAMI, ARIZONA

CRUSHING-ROLL APPARATUS

Application filed August 8, 1927. Serial No. 211,341.

This invention relates to crushing rolls for use in crushing ores or other material and particularly to means for exerting pressure against the springs which serve to hold one of the rolls toward or against the other roll.

The principal objects of the invention are to reduce the time and labor required for adjusting or changing the rolls, to permit a constant and equal pressure to be maintained against the springs on each side and furnish a means for indicating such pressure, and to reduce the cost of maintenance of the crushing rolls.

The crushing rolls ordinarily used comprise two rotatably mounted rolls, one being mounted in fixed bearings and the other in slidably mounted bearings. Holding springs are provided for resiliently holding the slidably mounted roll toward the fixed roll, a plurality of shims of suitable thickness being provided between the fixed and sliding bearings so as to maintain the proper spacing between the rolls. The springs are supported or pressed inwardly by means of a spring block and the means which have heretofore been used for holding this spring block in proper position have comprised long bolts called tension rods which extend through a fixed part of the frame and through the spring block so that the necessary pressure could be applied by turning up nuts on one end of these rods. This arrangement has not proved satisfactory, partly on account of the great length of time required to turn up these heavy nuts, which in the larger sized rolls are from 6 to 8 inches in inside diameter. These nuts must be tightened by means of a power crane, and the operation is not only expensive, but also time-consuming. Furthermore, the nuts sometimes become frozen to the bolts or cross-threaded, so that they have to be burned off, involving even greater loss of time and additional expense. In operation as the roll shells wear down, it is necessary to move up the slidably mounted bearing in order to maintain the proper spacing between the grinding surfaces of the rolls and hence insure production of a uniformly sized product. During heavy operation this adjustment of the rolls must be done quite frequently, sometimes as often as once or twice during each shift. When the above described arrangement is used the heavy nuts on the tension rods must first be backed off sufficiently so that the necessary thickness of shim may be removed from between the bearings, and the nuts must then be again turned up against the spring block to move the same up to a new position and give the desired pressure against the spring block and springs.

According to my invention hydraulic ram means are provided for exerting the necessary pressure against the above described spring block and springs and for holding the same in the desired position, in place of the tension rods and nuts heretofore used. By the use of such hydraulic pressure means a substantially constant and equal pressure may be maintained against the holding springs on each side and furthermore this pressure may be indicated at all times by means of a pressure gauge connected to the pressure cylinder or to some other suitable point. Also the hydraulic pressure against the ram may be quickly and easily released to permit removal of the necessary shim when it is desired to adjust the slidably mounted roll, and may thereafter be quickly and easily raised to the desired value to move the slidably mounted bearing to its new position and exert the requisite pressure against the holding springs. This saving of time is especially brought about by using bolt means for maintaining the holding springs under initial stress. The whole operation will, therefore, require but a few minutes, for example from 2 to 5 minutes, as compared with a minimum of half an hour when the tension rods are used. The actual saving in time, however, is even greater than indicated by this comparison, for the chances of trouble with the hydraulic ram are practically negligible, while in the case of the equipment previously used, such things as freezing or cross-threading of the nuts, or trouble in the operation of the power crane utilized for loosening and tightening the nuts, have always been frequent occurrences, so that the average time required for the operation of adjusting the rolls has been considerably more than half an hour. Furthermore,

a great saving in labor is effected, as the adjustment has heretofore required a crew of men in addition to the power crane, while with the hydraulic pressure means the work can easily be done by one man in a very short time.

The hydraulic pressure means may comprise essentially a pressure cylinder having walls of sufficient strength to sustain the necessary hydraulic pressure to which it is to be subjected and of sufficient bore to carry a thrust member or plunger of such cross-sectional area as will safely withstand the total pressure or force required to be exerted against the slidably mounted bearing at each end of the shaft of the movable roll. The plunger is slidably mounted in the pressure cylinder, making a substantially liquid tight fit therein, and having its outer end bearing against the spring block. Suitable means are also provided for admitting a suitable liquid such as oil to the pressure cylinder under the required pressure and for permitting discharge of such liquid from the pressure cylinder. Means are also preferably provided for indicating the pressure within the cylinder.

The accompanying drawings illustrate embodiments of my invention and referring thereto:

Fig. 1 is a plan view of one form of crushing roll apparatus provided with hydraulic pressure means as above described.

Fig. 2 is a side elevation thereof taken on a line just inside the driving pulley on the fixed roll shaft.

Fig. 3 is a plan view showing the application of the hydraulic pressure means to a slightly different type of crushing roll apparatus.

Fig. 4 is a side elevation of the form of apparatus shown in Fig. 3, taken in the same manner as Fig. 2.

The crushing apparatus shown in Figs. 1 and 2 comprises a pair of crushing rolls 1 and 2, whose shafts 3 and 4 are respectively mounted for rotation in fixed bearing means 5 and movable bearing means 6. The fixed bearings 5 are rigidly secured to or mounted upon the frame 7 in any suitable manner, while the movable bearings 4 are mounted on sliding pedestals 8. Said sliding pedestals are mounted to slide horizontally in suitable guide means 9 and 10 on the frame 7 and on the cap plates 11 respectively. Said cap plates may be secured to the frame in any suitable manner as by means of bolts 12 and are also provided with shoulders 13 engaging shoulders 14 at the ends of the frame so as to tie together the ends of the frame and also hold down the bearings.

The crushing rolls 1 and 2 are shown as enclosed in the usual housing 16, the top of which is provided with feed means 17 through which the material to be crushed is supplied, and which is also provided with suitable means, not shown, beneath the rolls, for discharge of the crushed material. The shafts 3 and 4 are also provided with the usual driving pulleys 18 for rotating the crushing rolls in the directions indicated by the arrows in Fig. 2.

A plurality of shims 20 of varying thicknesses are provided between the movable bearings 6 or the sliding pedestals 8 and the fixed bearings 5 or any suitable rigid part of the frame as at 21. The sliding pedestals 8 may be provided at their outer ends with enlarged heads 22 and a plurality of holding springs 23 are mounted between said sliding pedestals and the spring blocks 24, which are also mounted to slide longitudinally in the guide means 9 and 10 aforesaid. Bolts connect heads 22 and spring blocks 24 to maintain the springs 23 under initial stress. Said springs, therefore, serve to resiliently hold the sliding pedestal and movable bearing inwardly against shims 20 as a stop.

According to my invention, hydraulic or liquid pressure means are provided for exerting the necessary pressure against the spring blocks 24 and for adjusting the position of said blocks, such means comprising pressure cylinders 26 mounted on the frame 7 and held against outward movement thereon as by means of flanges 27. Such pressure cylinders are formed, as shown, with walls of considerable thickness so as to withstand the necessary liquid pressure for exerting the desired force against the spring blocks. A thrust member, such as plunger or piston 28, is slidably mounted within the liquid chamber 27′ of each pressure cylinder and is provided with suitable means for maintaining a substantially liquid tight fit, as by means of rings or gaskets of suitable material. Said plungers project through the open ends of the pressure cylinders and bear against the spring blocks 24, and, as above stated, said plungers should be of sufficient cross-sectional area to safely withstand the force required to be exerted against the spring blocks.

Suitable means are provided for supplying liquid to the pressure chambers and for removing liquid therefrom. For this purpose the chambers 27′ of said pressure cylinders may be connected by pipes 31 and 32 to a suitable source of liquid under pressure, such as accumulator 33. Pipe 32 may be provided with a cut-off valve 34 and with a check valve 35 for permitting liquid flow only in a direction from the accumulator to the pressure cylinders. The accumulator may be of any ordinary construction and may be weighted as at 37 so as to maintain at all times a fixed pressure in the accumulator. Pipes 31 may also be connected to pipe 38 leading to sump 39, and pipes 41 and 42 and pump 43 may be provided for removing liquid from said sump and returning the same under the necessary pressure to the accumulator. Pipe 38 may also be provided with cut-off

valve 44. A pressure gauge 45 may be connected to one or both of the pressure cylinders, or to the pipe 31 connected to both cylinders, as shown, or said pressure gauge may, if preferred, be connected to the accumulator.

The operation of the above described apparatus will be readily understood from the above description. Any suitable liquid such as oil of proper density and viscosity may be used for supplying the pressure. A supply of such liquid is maintained at a fixed pressure in accumulator 33 and such liquid may be admitted to the pressure cylinders 27' until the desired pressure is reached, as indicated for example by the pressure gauge 45, and the cut-off valve 34 may then be closed. The movable roll will, therefore, be held toward the fixed roll and against the shims 20 with a constant equal pressure on each movable bearing, the spring blocks being moved inwardly by plungers 28 to such a position as to place the springs 23 under sufficient compression to exert the necessary equal pressure against each of the movable bearings, at the same time relieving the bolts from the initial stress of springs 23. This initial spring stress, if unequal on the two sides of the machine, is thereby automatically equalized by the hydraulic pressure substituted therefor. The crushing rolls are operated in the usual manner, springs 23 serving to permit roll 2 to yield slightly in case some hard object is delivered to the rolls, and thus prevent overstrain on any parts of the apparatus. When it becomes necessary to move the movable roll closer to the fixed roll to make up for wear on the grinding surfaces thereof, valve 44 may be opened to release a small portion of the liquid from the pressure cylinders, which allows the plungers 28 to move to the left, permitting the springs 23 to expand until prevented by the bolts maintaining them under initial stress, and then, by releasing only a very small additional portion of liquid from the pressure cylinders, allowing pedestals 8 to be moved outwardly and separate the rolls sufficiently to permit removal of the necessary thickness of shims 20. The liquid so released from the pressure cylinders flows to the sump 39 whence it is returned by pump 43 to the accumulator. After the shims have been removed, valve 44 may be closed and valve 34 opened, so as to again admit only the small portion of liquid to the cylinders released and thereby quickly move the roll 2 up to its new position and also automatically apply the proper equal pressures against the springs 23 on both sides of the machine.

The entire operation of moving up the roll requires but a few minutes, and furthermore there is practically no chance for anything to go wrong and cause any unusual delay. Since the operation is controlled entirely by manipulation of the valves controlling release of liquid from the pressure chamber and supply of liquid thereto, it is seen that it can easily be handled by one man and no additional equipment is required, such as the power crane heretofore used for loosening and tightening the nuts on the tension rods. Furthermore, there is substantially no wear on any parts of the pressure applying means and the cost of maintenance thereof is much less than that of the tension rods and nuts which must frequently be replaced due to freezing, cross-threading, etc.

In Figs. 3 and 4 I have illustrated the application of pressure applying means according to my invention in connection with a different form of crushing roll apparatus. In this form of apparatus there are no top tie plates to hold the ends of the frame together, and said frame is made sufficiently heavy at the ends, as at 47 back of the fixed bearings 5' and at 48 where the pressure cylinders 26' are supported, to sustain the crushing pressure of the rolls. In view of the absence of the top plate, other means must also be provided for holding down the sliding pedestal 8' and the spring block 24'. This may be accomplished for example by rabbeted guide means 50, which hold said members down on to the frame while permitting sliding movement thereof. The remainder of the construction is substantially the same throughout as in the form first described and corresponding parts are similarly numbered in the two cases. The operation of the hydraulic ram means is also substantially the same as in the first case.

In the above description it is assumed that the cut-off valve 34 is normally closed when the desired pressure is reached in the pressure cylinders. Under these circumstances, weight 37 may be such as to provide any desired pressure in the accumulator, in excess of the pressure desired in the pressure cylinders. In some cases, however, it may be preferable to so adjust the magnitude of weight 37 as to provide a pressure in the accumulator exactly equal to the pressure which it is desired to maintain in the pressure cylinders during operation. In such cases the check valve 35 should be omitted and the cut-off valve 34 should be normally open, and should be closed only while draining liquid from the pressure cylinders, so that during operation of the rolls the pressure in such cylinders is at all times equal to that in the accumulator, as determined by the magnitude of said weight. An advantage of this arrangement is that in the event of unusually high pressure against the rolls, as by passage of a large piece of tramp iron therethrough, if such pressure exceeds the pressure maintained in the accumulator the plungers 28 are permitted to yield slightly, by displacing liquid from the pressure cylinders into the accumulator.

Under normal conditions, however, in either case, the hydraulic pressure-exerting or ram means, while being adjustable, are substantially rigid, ordinary yielding of the movable roll being taken up entirely by the resiliency of the holding springs 23.

It may be pointed out as a particular advantage of my invention that since the pressure chambers 26' are in communication with one another during operation, the pressure in both chambers must be substantially equal at all times, thus automatically maintaining equal pressures against both bearings of the movable roll.

I claim:

1. In combination, a pair of cooperating rolls, a set of fixed and movable bearings at each end of said pair, one bearing of each set providing a support for one of said rolls and the other providing a support for the other roll, spring means for resiliently urging each movable bearing of a set toward the fixed bearing thereof, means for initially stressing said spring means, and hydraulic pressure means common to both of said sets for equalizing the resilient pressures exerted by the spring means of said sets.

2. In combination, a pair of cooperating rolls, fixed bearings rotatably supporting the opposite ends of one of said rolls, movable bearings rotatably supporting the opposite ends of the other of said rolls, spring means for resiliently urging each of said movable bearings toward the adjacent fixed bearing so as to permit limited separation of said rolls, means for initially stressing said spring means, and common means for equalizing the resilient pressure exerted by said spring means and for relieving said initially stressing means.

3. In combination, a pair of cooperating rolls, fixed bearings rotatably supporting the opposite ends of one of said rolls, movable bearings rotatably supporting the opposite ends of the other of said rolls, spring means for resiliently urging each of said movable bearings toward the adjacent fixed bearing so as to permit limited separation of said rolls, means for initially stressing said spring means, and hydraulic pressure means for simultaneously equalizing the resilient pressures exerted by said spring means.

4. In combination, a pair of cooperating rolls, a set of relatively movable bearings at each end of said pair, one pair of each set providing a support for one of said rolls and the other providing a support for the other roll, spring means for resiliently urging one bearing of each set toward the other bearing thereof, tension means for maintaining each of said spring means under initial stress, and hydraulic pressure means for simultaneously relieving all of said tension means from said initial stresses and for equalizing the resilient pressures exerted by the spring means of said sets.

5. In combination, a pair of cooperating rolls, fixed bearings rotatably supporting the opposite ends of one of said rolls, movable bearings rotatably supporting the opposite ends of the other of said rolls, spring means for resiliently urging each of said movable bearings toward the adjacent fixed bearing so as to permit limited separation of said rolls, tension means for maintaining said spring means under initial stress, and hydraulic pressure means for simultaneously relieving all of said tension means from said initial stresses and for equalizing resilient pressures exerted by said spring means.

6. In combination, a pair of cooperating rolls, a set of relatively movable bearings at each end of said pair, one bearing of each set providing a support for one of said rolls and the other providing a support for the other roll, means for resiliently urging one bearing of each set toward the other bearing thereof so as to permit limited separation of said rolls, means for initially stressing said resiliently urging means, and means coacting with said bearings so as to permit further separation of said rolls beyond the limits of separation established by said first mentioned means and for relieving said initially stressing means.

7. In combination, a pair of cooperating rolls, fixed bearings rotatably supporting one of said rolls, movable bearings rotatably supporting the other of said rolls, spring means for resiliently urging said movable bearings toward said fixed bearings so as to permit limited separation of said rolls, means for initially stressing said spring means, and means coacting with said movable bearings so as to permit further separation of said rolls beyond the limits of separation established by said spring means.

8. In combination, a pair of cooperating rolls, fixed bearings rotatably supporting one of said rolls, movable bearings rotatably supporting the other of said rolls, spring means for resiliently urging said movable bearings toward said fixed bearings so as to permit limited separation of said rolls, means for initially stressing said spring means, and hydraulic pressure means coacting with said spring means so as to permit further separation of said rolls beyond the limits of separation established by said spring means.

In testimony whereof I have hereunto subscribed my name this 14th day of July 1927.

FRANCIS W. MACLENNAN.