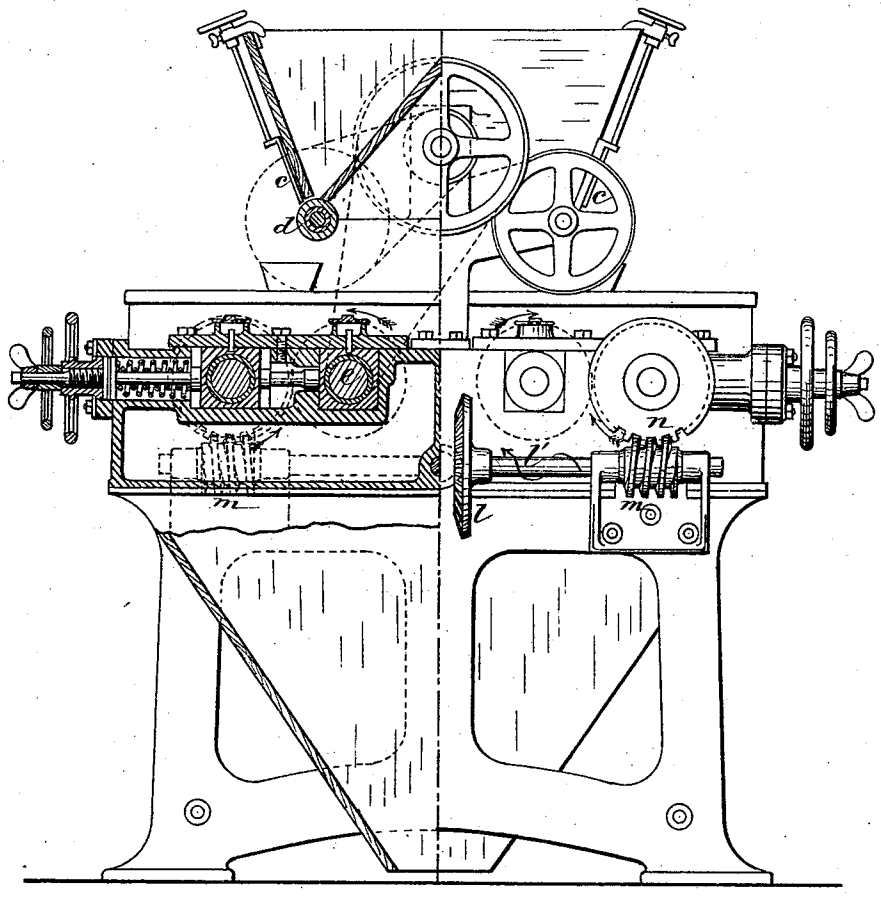
(No Model.) 3 Sheets—Sheet 1.

O. OEXLE.

Roller Mill for Grinding Grain, &c.

No. 240,453. **Patented April 19, 1881.**

Fig. 1.



Witnesses:
Floyd Norris
Howell Bartle

Inventor:
Oscar Oexle
by Johnson and Johnson
Attys

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

(No Model.) 3 Sheets—Sheet 2.

O. OEXLE.

Roller Mill for Grinding Grain, &c.

No. 240,453. **Patented April 19, 1881.**

Fig. 2.

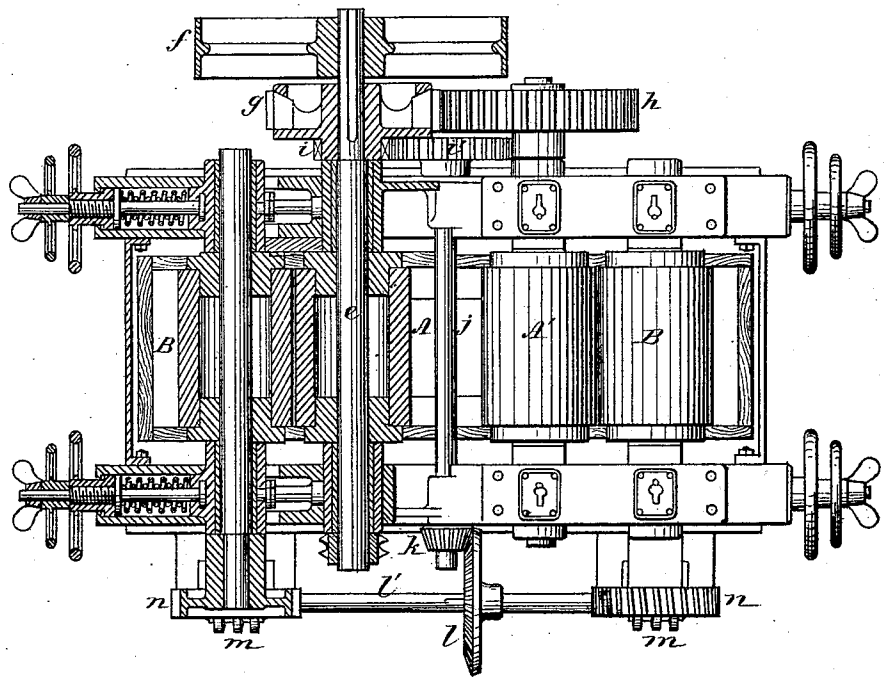


Fig. 3.

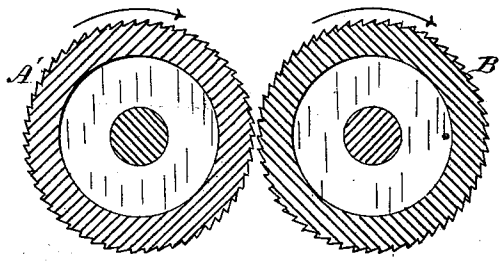
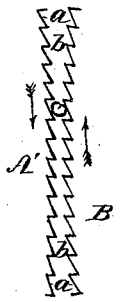


Fig. 4.



Witnesses:

Floyd Norris

Howell Battle

Inventor:

Oscar Oexle

by Johnson and Johnson

Attys

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

(No Model.) 3 Sheets—Sheet 3.

O. OEXLE.

Roller Mill for Grinding Grain, &c.

No. 240,453. **Patented April 19, 1881.**

Fig. 5.

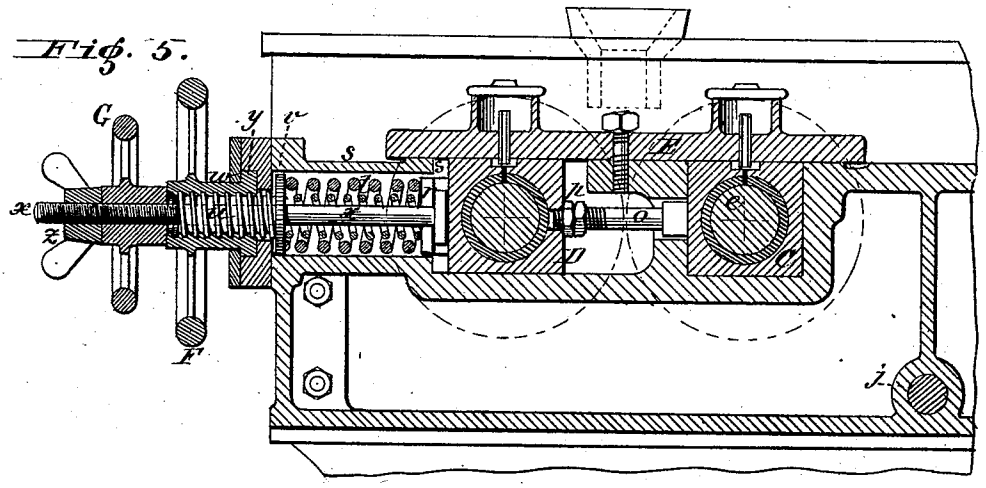
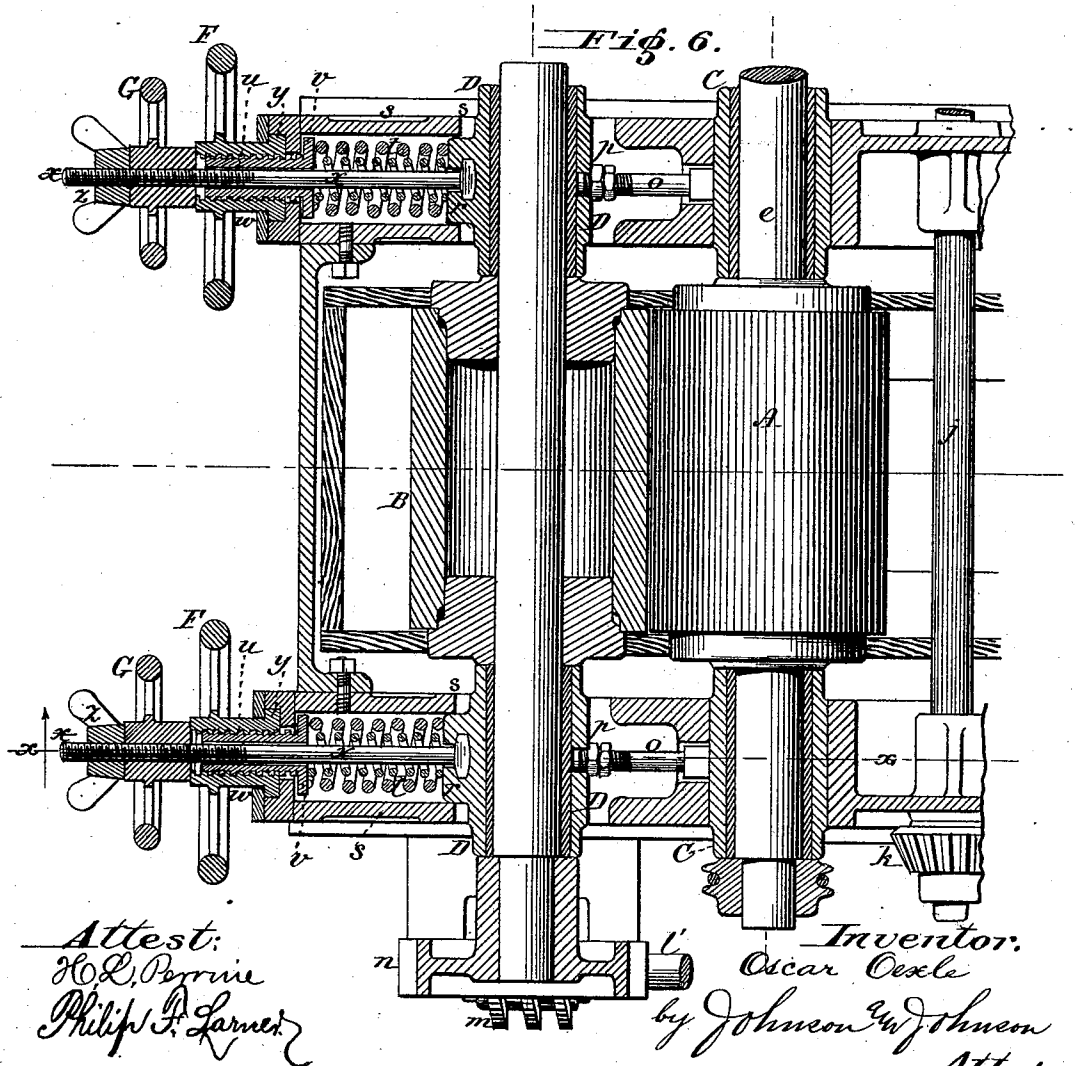


Fig. 6.



Attest:
H. L. Perrie
Philip F. Larner

Inventor:
Oscar Oexle
by Johnson & Johnson
Atty's

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

OSCAR OEXLE, OF AUGSBURG, BAVARIA, GERMANY.

ROLLER-MILL FOR GRINDING GRAIN, &c.

SPECIFICATION forming part of Letters Patent No. 240,453, dated April 19, 1881.

Application filed July 29, 1880. (No model.) Patented in Germany April 2, 1880.

To all whom it may concern:

Be it known that I, OSCAR OEXLE, civil engineer, of Augsburg, in the Kingdom of Bavaria, Germany, have invented certain new and useful Improvements in Roll-Mills for Grain and other Substances, of which the following is a specification.

My invention relates to improvements in roll-mills for disintegrating wheat-kernels preparatory to the manufacture of flour; and the objects of my improvements are to break or cut the kernels of wheat in their longitudinal axis to open the crease or groove in their first reduction, for the purpose of freeing or detaching as complete as possible the dark dust and the germ from the crease and produce large coarse-sized middlings, whereby to facilitate the separation of the crease-dust and the germ from the broken particles, to effect such crease cleaning with the least possible production of flour, to reduce middlings, and to clean the bran. I attain these objects by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 represents a roll-mill, partly in vertical section and partly in side elevation, embracing my invention; Fig. 2, a view partly in horizontal section and in top view; Fig. 3, the rolls, in cross-section, on an enlarged scale, showing the manner in which their cutting or reducing surfaces are formed and operate; and Fig. 4, an enlarged diagram, showing the relation of the operating or cutting surfaces to the wheat-kernels in the operation of opening the crease in the first reduction. Fig. 5 is a vertical section through the bearings of a pair of rolls and their housings, taken on the line *x x* of Fig. 6, showing the means for adjusting one of the rolls to determine the distance between them, the means for regulating the pressing-force of such roll toward the other independently of the adjustment of the roll, means for limiting the minimum distance between the rolls, and means for determining the distance the adjustable roll may yield from the other independently of the means by which said roll is adjusted and pressed forward; and Fig. 6, a horizontal section of the same, these views being on enlarged scales.

The rolls are formed with sharp ridges or scores, extending from end to end parallel to their axis, of ratchet, or approximately ratchet, form, and in which the interdental spaces present in one roll the apices of the ridges moving upward and those of the other roll moving downward at the point of operation or reduction, so that the shortest or radial sides of the ridges of the rolls must travel facing upward in one roll and downward in the other roll at the point of operation upon the grain, or at which the grain is delivered upon them, while the rolls themselves travel in the same direction. The roll in which the apices of the ridges travel downward, as stated, is geared to run at a high speed, while the roll in which the apices of the ridges travel upward is geared to revolve at a very slow speed. The travel of the rolls in the same direction at unequal speed, and formed with sharp ridges or scores parallel with the axis of the rolls, and having the operative relation described, constitutes an entirety, by which grain, having a regulated feed into the rolls, is broken in the line of its axis or split open at the crease by the action of the sharp ridges, so as to expose and free the dark dust and germ, that it may be separated by bolting the broken mass. This separation can only be effectively obtained by splitting and breaking the kernels in comparatively few pieces in the first reduction, and in which there is little loss in the reduction of the flour-producing substance. The desired fineness is obtained by passing the cleaned product of the first reduction through the rolls and successively bolting and reducing the middlings produced by each separate operation.

The rolls may be of any suitable material, and of the size of crushing-rolls used for milling purposes.

The form of the ridges or scores is shown in Figs. 3 and 4, in which the faces *a*, which form the interdental spaces, are tangential to a circle of sufficiently less diameter than the roll to give the proper depth to the scores; and the short sides *b* are radial, or approximately so, and with the sharp apices form the breaking and cutting parts, which extend parallel with the axis of the cylinder, which causes the kernels to assume horizontal positions within the interdental spaces as they descend between the upward and downward moving sur-

faces of the rolls. The roll which presents the short or radial sides of the ridges moving upward has a motion from one-half to about five revolutions per minute, and the roll which presents the short or radial sides of the ridges moving downward has a motion of from eighty to three hundred revolutions per minute, according to the work required. The rolls are set so that the apices of their ridges cannot lap or touch, but work free of each other. The differential speed increases the reducing action and equally distributes the grain between the rolling-surfaces, and the oppositely moving operating-surfaces retard the speed of the material passing through the rolls, while the ridges act in a cutting way and with little pressure, more scraping than squeezing and tearing, and consequently a larger and cleaner bran is produced, so that its separation from the flour-producing substance is more easily effected by the bolting and cleaning operations. In the first reduction the middlings are large and the kernels are mostly split along their crease and cut into pieces, so that the damaging matter in the crease is, to a large extent, separated from the skin as a preliminary operation, while in the subsequent operations the bran is scraped, giving the most important advantages in the manufacture of flour, in which it is of the highest importance to prevent the reduction of the bran.

The rolls are suitably mounted in pairs in a cast-iron frame, one roll being carried by adjustable bearings and held to the proper operating relation by springs and set-screws, as shown, or by other suitable means. Two or more pairs of rolls may be arranged for use in one frame, and with a double feeding apparatus provided with regulating-slides *c c* and feed-rolls *d d*, arranged to deliver the material into the disintegrating-rolls in quantities suited to the work and to the speed of the rolls, suitable supply and conducting hoppers being arranged upon the machine for this purpose. A hopper below receives the product from the rolls. In these particulars the arrangement of the rolls, hoppers, and the supporting framework may be as shown, or in any suitable way that will give the same compactness and capacity for work.

In the arrangement of the two pairs of rolls the outer ones of each pair revolve slowly and the inner ones revolve rapidly, and the rolls of each pair in the same direction, and this arrangement I prefer, and will now describe the manner in which the rolls are so operated.

Upon the shaft *e* of the inner roll, A, of one pair a pulley, *f*, is secured, from which a band leads to the driving power. A gear-wheel, *g*, on the shaft of this roll engages with a similar gear, *h*, on the inner roll, A′, of the other pair, so that these rolls are thus revolved in opposite directions at the same fast speed. The shaft *e*, first stated, also carries a pinion, *i*, which engages with a similar pinion, *i′*, upon a shaft, *j*, crossing the frame at a point between the inner rolls, and carrying a bevel-pinion, *k*, at the opposite side of the frame, and which matches with a bevel-wheel, *l*, on a shaft, *l′*, carried in bearings at the side of the frame. This side shaft, *l′*, is provided at each end with a worm, *m*, Fig. 1, one being right and the other left hand, and each engaging with a worm-wheel, *n*, on the shaft of the outer roll, B, of each pair, so that these rolls are thus revolved in the same direction as the inner rolls and at slow speed. This gives a very compact and effective arrangement for operating the two pairs of rolls, as described, from a single driving-pulley, and in which the cross and side shaft connections equally distribute the strain upon the machine. It is obvious, however, that only one pair of rolls may be used to carry out my invention. As the sharp ridges of the rolls must not be pressed one into the other, the arrangement for setting the adjusting-roll must be such as to allow it to yield against the pressure of double springs, but prevent it from pressing against the ridges of the non-adjusting roll. In Figs. 5 and 6 I have shown the means by which this is effected more clearly, and will now specifically describe them.

The fixed blocks or bearings C C of the inner roll, A, are preferably set between walls in depressed parts of the top plates of the side frames, while the sliding blocks or bearings D D of the adjustable roll B are seated in said depressed parts, and both are secured upon their seats by a top binder, E, provided with oil-cups for the roll-journals. The adjustable roll has a yielding pressure given to it by coiled springs *t*, arranged within tubular parts *s*, extending inward from the front corners of the side frames on a line with the sliding blocks against which they press; and the means for regulating such pressure consists of a screw-sleeve, *u*, provided with a follower, *v*, at its inner end bearing against the outer end of said springs, and a surrounding screw-sleeve, *w*, provided with a hand-wheel, F, on its outer end and a collar, *y*, on its inner end, the screw of the surrounding sleeve fitting the external screw of the inner sleeve. The outer screw-sleeve, *w*, is secured to the outer end of the tubular frame part *s* by the collar *y*, so as to be free to be turned by the hand-wheel F, which is at the front of the frame; but being prevented from endwise movement when so turned to the right, it will screw the inner sleeve inward, and, by its follower *v*, compress the springs and increase their pressing force upon the roll. The reverse movement of said hand-wheels will diminish the pressure of said roll.

I prefer to use double springs, one within the other, and of right and left pitch, to obtain a uniform pressure. To prevent the contact of the roll-ridges under such pressure, and which would cause them to become locked together, stop-studs *o* are arranged between the bearings C and D and are supported thereby, said studs being provided with screw-nuts *p*, which are set so as to receive and support the sliding bearings, so that the roll-ridges cannot

meet. This is independent of the means by which the distance between the rolls is adjusted, and therefore such adjusting means can never cause the rolls to come in contact. These stop-studs have no fixed connection with either bearing-block, and, in fact, the sliding blocks can move freely over them. When the roll B is properly set the nuts *p* are secured by jam-nuts.

The distance which the adjustable roll can yield from the non-adjustable roll is determined by stops formed by the inner ends of the tubular parts *s*, and against which the sliding blocks will act to prevent the separation of the rolls beyond a proper limit, so that whether the roll B be adjusted toward or from the roll A such adjustment is limited between the stops *o* on one side of the sliding blocks and by the tubular parts *s* on the other side. It is, however, important in reducing different kinds of grain to set the rolls at different distances apart; and for this purpose I provide screw-stems *x*, locked by T-heads to extensions *r* from the sliding bearings and passing centrally through the springs *t*, and their pressure-regulating sleeves are fitted on their outer ends with hand-nuts G, just outside of the hand-wheels F, there being jam-nuts *z* on the ends of said screw-stems to lock these outer hand-nuts thereon. The hub of the outer hand-nut has a screw fitting the screw-stem *x*, and it also bears against the outer end of the outer sleeve, *w*, and this bearing is necessary to render the follower-sleeve independent of the outer hand-nut, so that these hand wheels and nuts bear one upon the other in the line of their axis and maintain such relation both in the adjustment of the springs and of the roll by the action of the springs. These screw-stems do not turn in their connections with the sliding blocks, but the outer hand-nuts are turned upon them, and if so turned to the right the screw-stems and their connected bearing-blocks will be drawn outward against the pressure of the springs. The turning of these hand-nuts to the left will allow the bearing-blocks to be forced inward by the springs, and the distance between the rolls is in this way regulated to suit the work; and when so regulated the jam-nuts *z* serve to make the set secure. This adjustment of the roll, while being independent of that of the springs, yet the devices for effecting both are combined in a single device and independent of the means by which the minimum distance between the rolls is effected.

The arrangement for operating the sleeve-followers *u* and for forming bearings for the outer hand-nuts independent of said sleeve-followers are the means by which I obtain the combined device for each sliding block.

The tubular parts *s s* of the frame serve to inclose the springs.

It is important to notice that the means for operating the rolls not only equalize the strain upon both sides of the frame, but the worm-gear connections allow the outer roll to slide toward and from the inner roll without effecting such connections; and, besides, the worm-gear gives a much slower motion to the outer roll than could be obtained by spur-gear, which is very important.

I am aware that prior to my invention rolls in pairs for milling purposes have been run at an unequal speed, in opposite directions, and that rolls have been made having ribs or surface-corrugations inclined to the axis, so as to act like shears at the grinding-point, and at which point the surface of one roll descends and that of the other ascends with the same speed for grinding bone to flour, and therefore I do not claim these things broadly. Nor do I claim rolls provided with sharp ridges or corrugations of ratchet form parallel to their axes and revolving in the same direction with unequal speed.

I claim—

1. In a roll-mill for reducing grain to middlings, the combination of rolls having sharp ridges formed and operating substantially as described, with means for operating the rolls in pairs in the same direction at unequal speed, and for equalizing the strain upon both sides of the frame, the said means consisting of the cross-shaft *j*, uniting the gear-wheels *g h* and the pinions *i i'* at one side of the frame with the inner roll and the bevel-gear *k l*, connecting, by the side shaft, *l'*, the worm *m* thereon with the gear *n* on the adjustable roll, at the other side of the frame, as specified.

2. The means herein described for adjusting the distance between the rolls, and for regulating the pressure of the adjustable roll, consisting of the screw-stems *x x*, having non-revolving connections with the sliding bearings of said adjustable roll, and provided with the hand-nuts G, which turn thereon, the pressure-springs *t*, and the intermatching screw-sleeves *u w*, the inner one, *u*, provided with a bearing-follower for said springs, and the outer one, *w*, having the hand-wheel F, and turning upon said inner screw-sleeve, and secured to the frame by a collar, *y*, which revolves with it, the said hand-nuts G having a face bearing upon the sleeves of the hand-wheels F, so that while the hand-nuts adjust the rolls, and the sleeves *u* and *w* co-operate to adjust the pressure of the springs, the hand-nuts and the hand-wheel sleeves neither move toward or from the roll-bearings in effecting such adjustment and pressure, substantially as described.

3. The combination of the roll B, mounted in sliding bearings, the screw-stems *x x*, having non-revolving connections with the sliding bearings of said adjustable roll, the hand-nuts G G, turning upon said screw-stems, the pressure-springs *t*, and the intermatching screw-sleeves *u* and *w*, constructed and having the relation to each other substantially as described, and for the purpose specified, with the jam-nuts *z*, on the outer ends of said screw-stems for locking the latter when the rolls are set the required distance apart, substantially as described.

4. The tubular frame parts *s*, in combination with the roll B, mounted in sliding bearings, and the cap-binders E therefor, the said sliding bearings provided with the side extensions, *r*, projecting within said tubular parts of the frame, which serve as guides for said sliding bearings and as stops to limit their maximum yielding distance, substantially as described.

5. The combination, with means having a fixed connection with the boxes of the roll B for adjusting the distance between the rolls and for locking such adjustment when made, means for regulating the pressure of the adjustable roll, and fixed means for determining the maximum yielding distance of said adjustable roll, substantially as described, of means placed between the rolls and having no fixed connection with the adjustable roll for determining the minimum distance between the rolls, the said last-stated means consisting of the screw-studs *o*, provided with bearing-nuts *p* and lock-nuts, substantially as described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

OSCAR OEXLE.

Witnesses:
PAUL STETTER,
FRANZ MAYER.