H. SACK, DEC'D.

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ROLLING MILL PLANT.

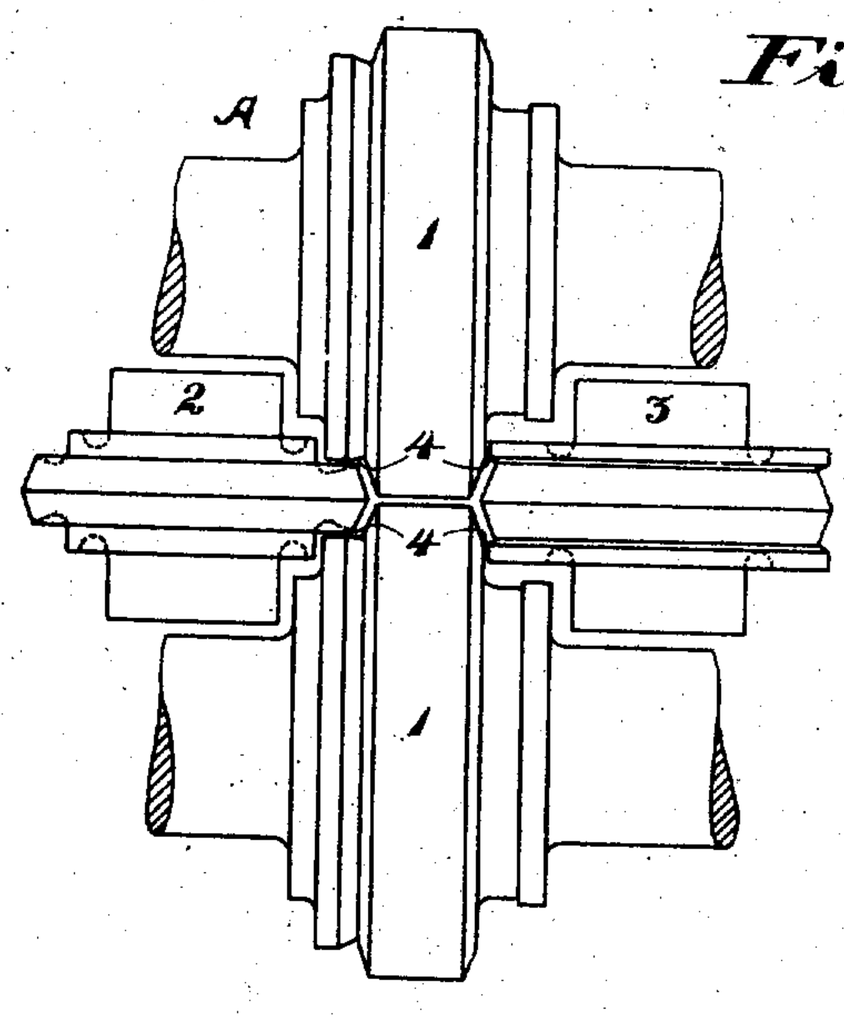
APPLICATION FILED NOV. 30, 1908.

970,559.

Patented Sept. 20, 1910.

5 SHEETS—SHEET 1.

Fig. 1.



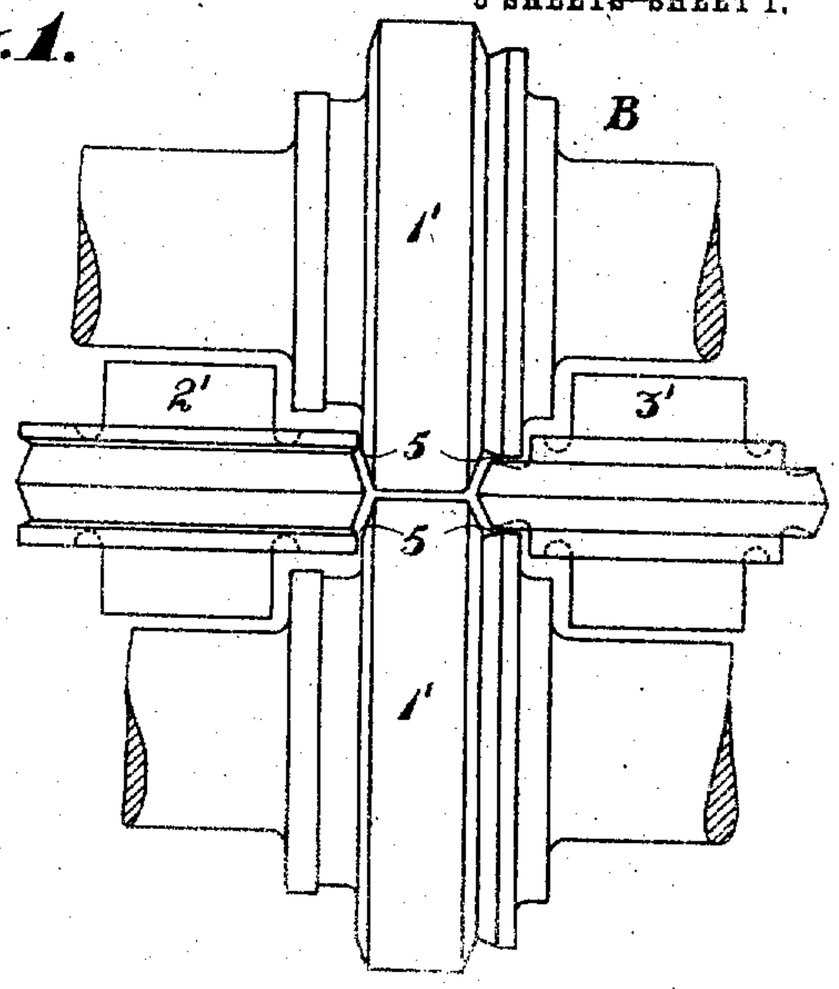
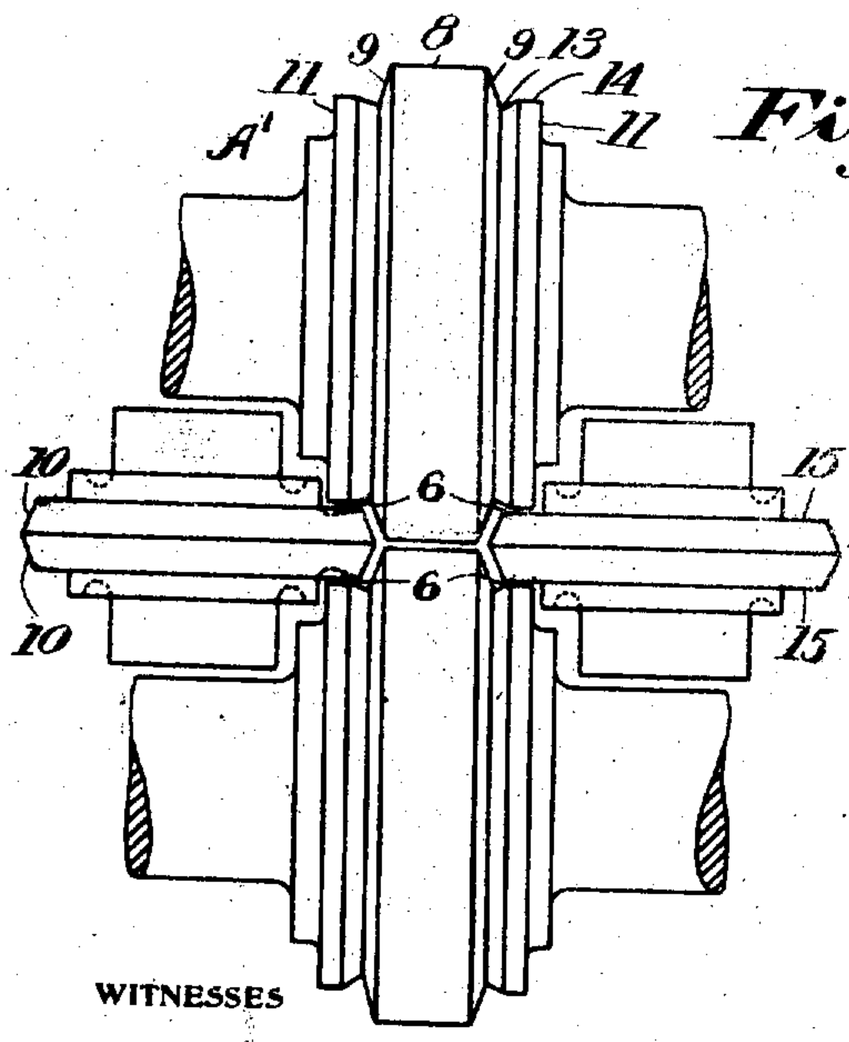
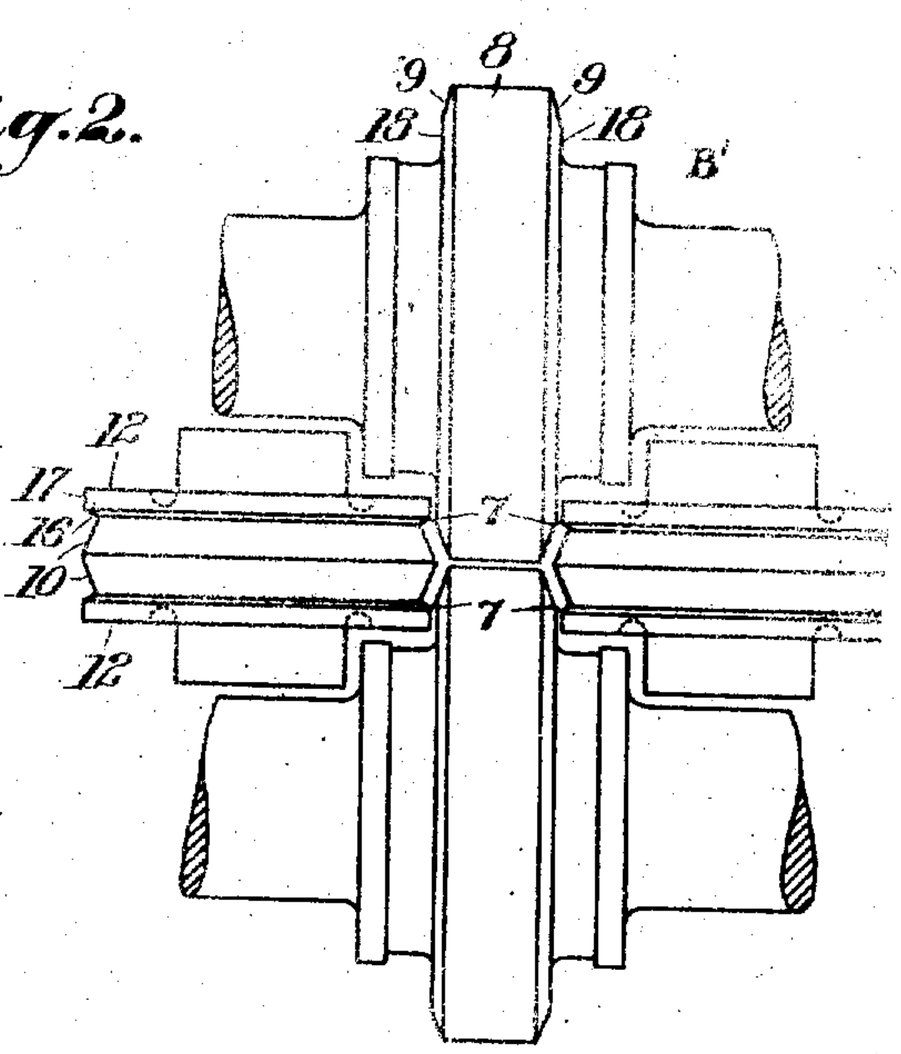


Fig. 2.





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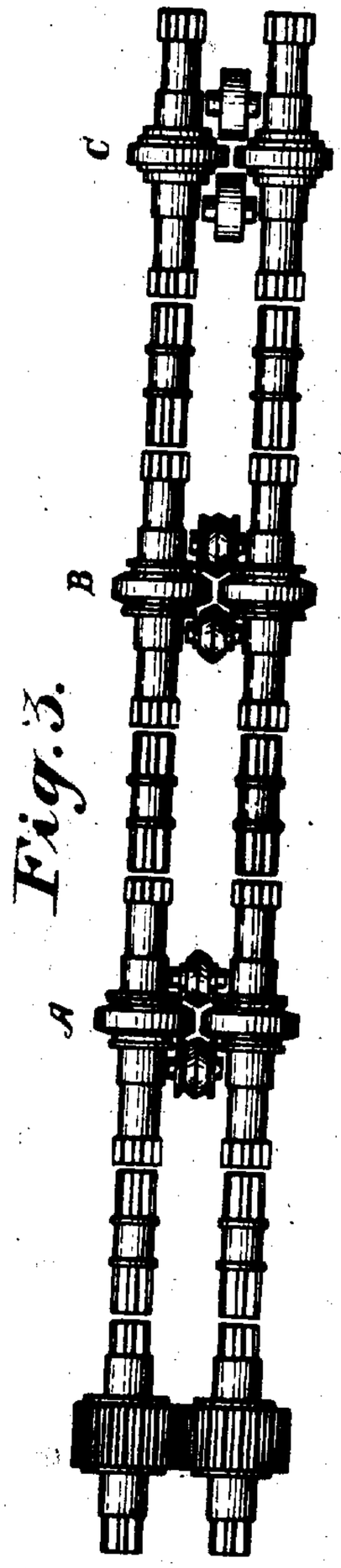

Fig. 3.

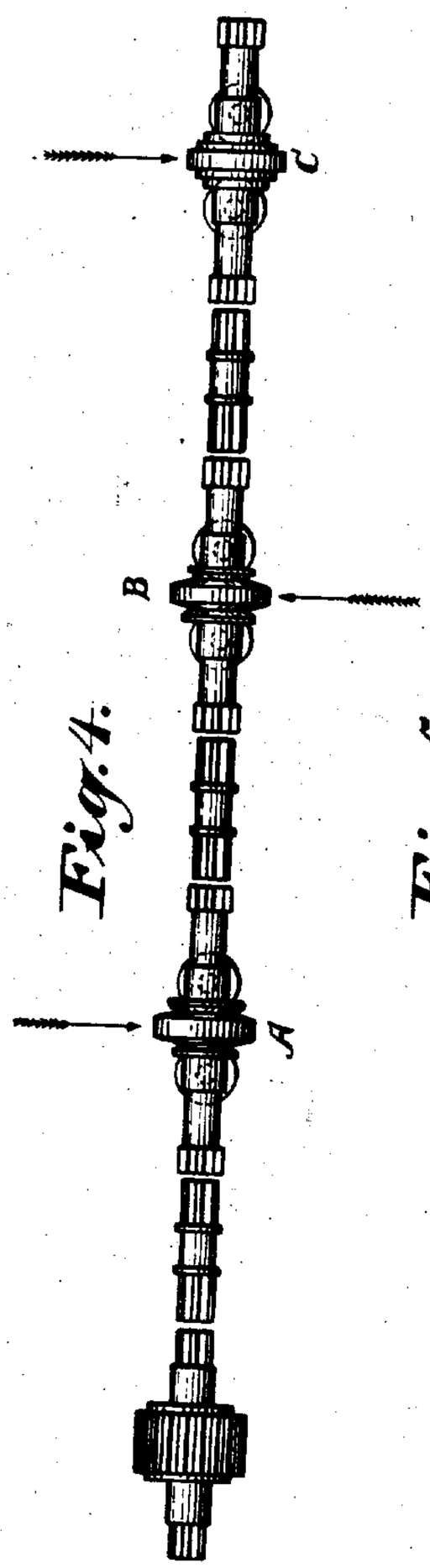

Fig. 4.

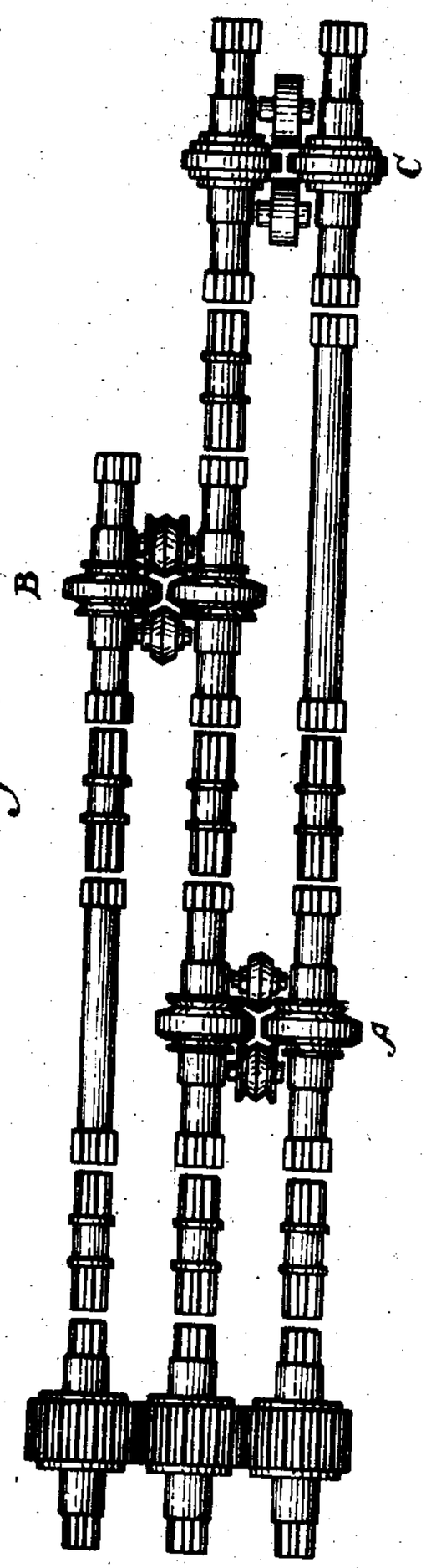

Fig. 5.

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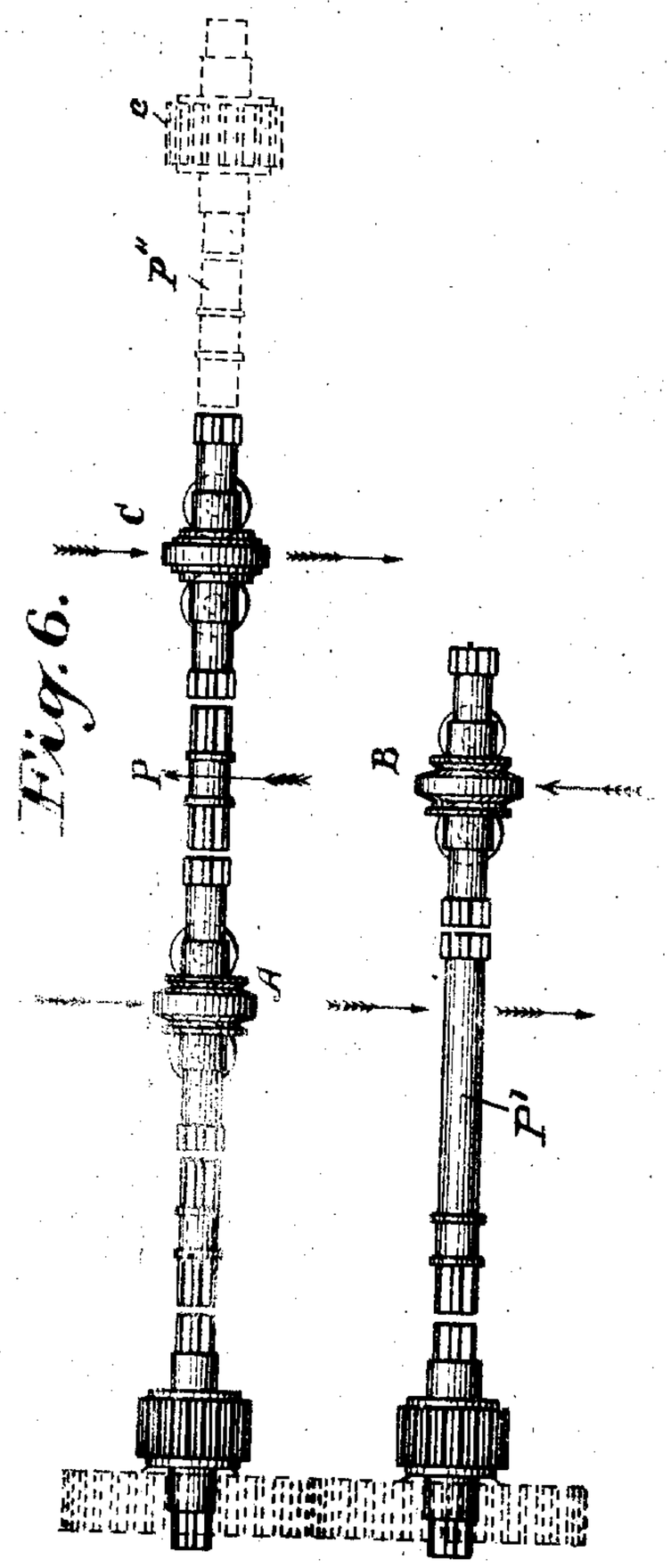

Fig. 6.

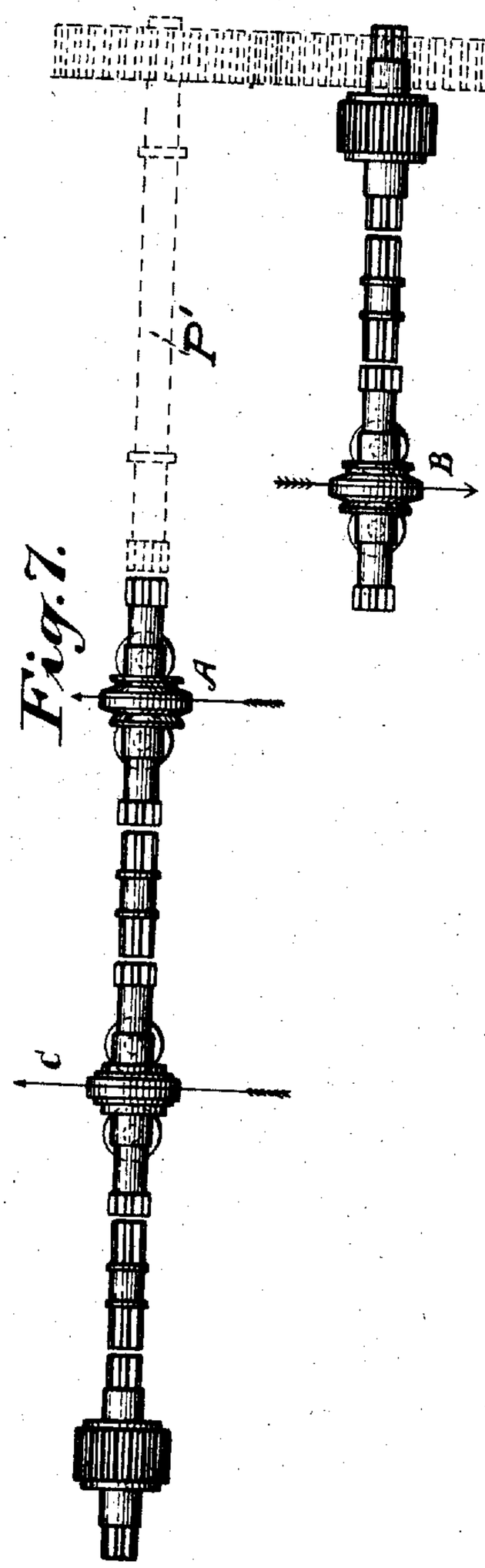

Fig. 7.

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6 SHEETS—SHEET 4.

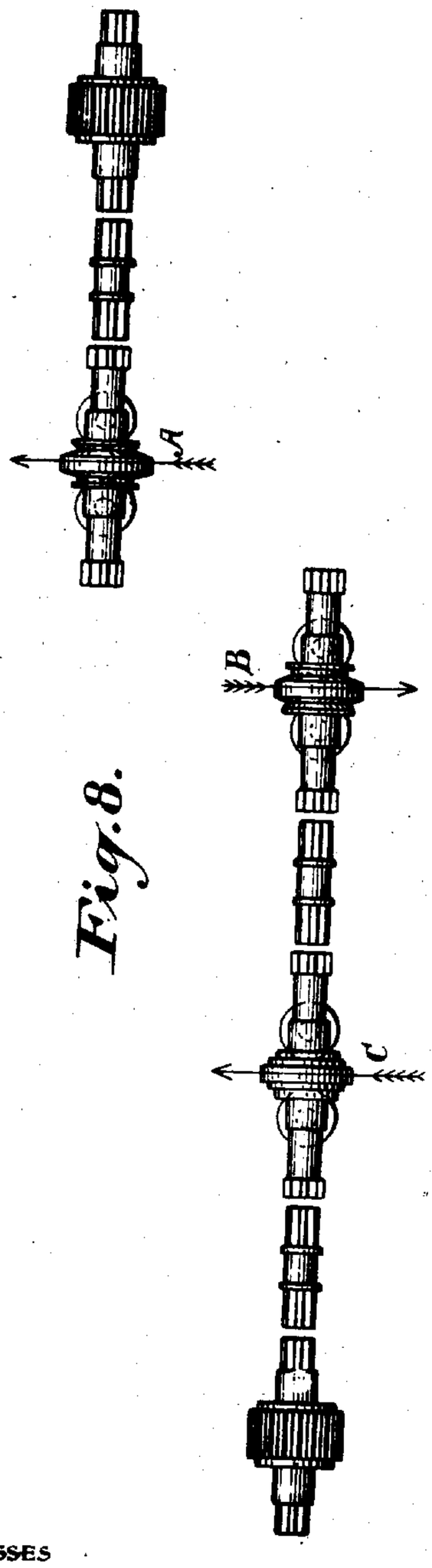

Fig. 8.

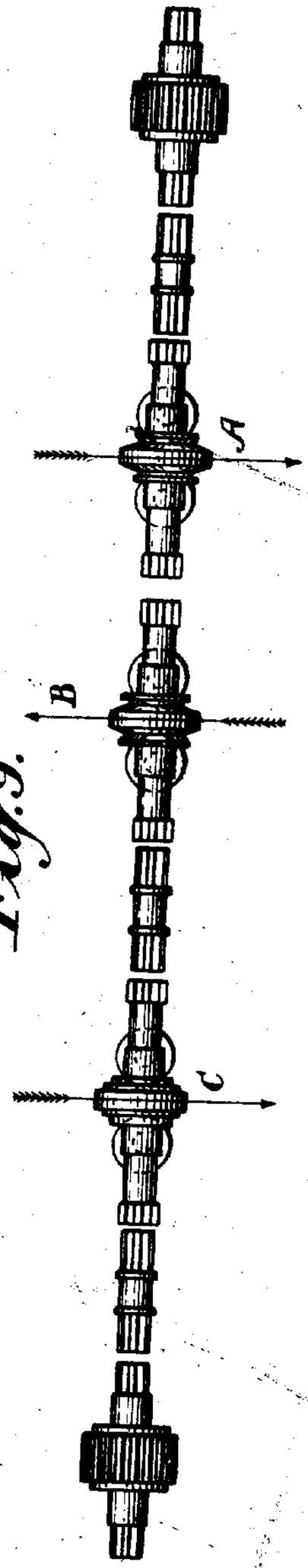

Fig. 9.

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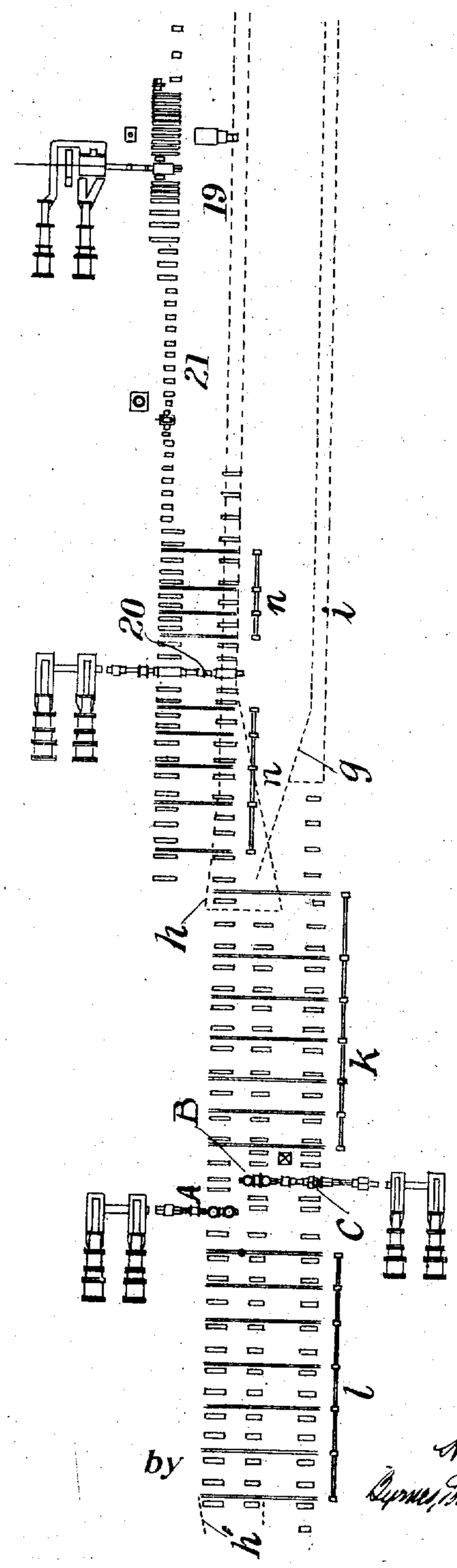
Fig. 10.



Attest:
C. H. Potter.
M. C. Brawner.

by

Inventor:
Henry Sack,
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Attys

UNITED STATES PATENT OFFICE.

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ROLLING-MILL PLANT.

970,559. Specification of Letters Patent. Patented Sept. 20, 1910.

Application filed November 30, 1908. Serial No. 465,412.

To all whom it may concern:

Be it known that I, HUGO SACK, a subject of the Emperor of Germany, residing at Dusseldorf, Rhenish Prussia, Germany, have invented certain new and useful Improvements in Rolling-Mill Plants, of which the following is a specification.

In my United States Patents, Nos. 365,100, and 431,623, there were disclosed universal rolling mills for rolling I-beams, having two horizontal and two vertical rolls, all situated in the same vertical plane. In these mills the rolling contours of the rolls were made different on opposite sides of a vertical central plane lying in the line of rolling. The reason for so making them different was, that when a bar is passed through such universal rolls, a fin is formed at any point of the section where the rolls have no close fit at their junction, but, by thus making the rolls asymmetrical, and turning the bar through half a turn before passing it again through the rolls, such a fin can then be passed through a part of the rolls where they form a closed round corner, and can thus be suppressed or removed in said next pass through the rolls.

According to the present invention, the turning-over of the bar is avoided, by employing two separate sets of universal rolls and by passing the bar successively through the two sets, these sets being so related in form that, in each passage of the rolls, any fin formed in the last previous passage through the other set is removed or suppressed.

In the accompanying drawings, Figure 1 is a front elevation of two complementary sets of asymmetrical rolls; Fig. 2 is a front elevation of two complementary sets of symmetrical rolls; Fig. 3 is a diagrammatic front elevation showing two such sets of rolls with their couplers; also the finishing rolls; Fig. 4 is a diagrammatic plan view of the rolls shown in Fig. 3, the arrows indicating the direction of rolling; Fig. 5 is a diagrammatic front view of a modified arrangement of rolls, employing the three-high system to avoid reversing the engine; Fig. 6 is a diagrammatic plan view of an arrangement of two-high rolls which also dispenses with the reversing of the engines; Fig. 7 is a plan view showing a modified form of mill to enable the bar to be rolled without interfering with the opposite coupling-spindle, as is the case in Fig. 6; Fig. 8 is a plan view of a further modification; Fig. 9 is a plan view of a further modification; Fig. 10 is a diagrammatic plan view of complete rolling-mill plant.

The asymmetric set of rolls A shown at the left of Fig. 1 comprises a pair of horizontal roughing rolls 1, substantially alike in form, and a pair of vertical roughing rolls 2, 3. It will be seen that, in passing a bar through a set of rolls A, fins may be formed at the left-hand corners 4 of each of the angular flanges of the bar. The complementary asymmetric rolls B shown at the right of the same figure are, in general, similar to the rolls A at the left, but with the pass reversed, and the several parts thereof are distinguished by corresponding numerals having affixed thereto a prime. It will be seen that these rolls B are so arranged that fins are formed only at the right-hand corners 5 of two angular flanges of the bar. It follows that if a bar is passed through the rolls A and then, without tilting, is passed through the rolls B, the fins formed in the first passage are removed or suppressed in the second passage. In like manner, a fin which is formed by a passage through the set of rolls B is removed or suppressed when the bar, without tilting, is passed through the set of rolls A.

In the arrangement shown in Fig. 2, the rolls of each set are symmetrical with respect to a vertical plane lying in the line of rolling, but they are so arranged that fins are formed by the set of rolls A′ on the left, on the outer corners 6, only, of the two flanges, while fins are formed by the set of rolls B′, on the right, at the inner corners 7 only of the flanges. Therefore, in this arrangement also, by passing the bar in succession through both sets of rolls, fins previously formed are suppressed or removed.

The horizontal rolls of the complementary mills A′, B′, shown in Fig. 2 have symmetrical working faces comprising intermediate cylindrical surfaces 8 for shaping the web and frusto-conical end surfaces 9 for shaping the inner sides of the flanges. The vertical rolls of these mills have symmetrical working faces comprising frusto-conical surfaces 10, parallel to the end surfaces 9 of the horizontal rolls, for shaping the outer sides of the flanges. One of these mills, as illustrated, mill A′, has collars 11 on the

ends of the horizontal rolls for shaping the edges of the flanges, while the other mill, B′, has collars 12 on the ends of the vertical rolls for shaping the edges of the flanges and suppressing the fins produced in the first mill. The collars 11 have frusto-conical surfaces 13 extending at right angles from the surfaces 9, and cylindrical surfaces 14, parallel to the roll-axes and to the horizontal ends 15 of the vertical rolls. The collars 12 have frusto-conical surfaces 16, extending at right angles from the surfaces 10, and cylindrical surfaces 17, parallel to the roll-axes and to the vertical ends 18 of the horizontal rolls. As the working faces of the rolls wear, in use, the rolls may be returned to maintain the accurate shape of the pass.

It will be seen that, in a mill of the type shown in Figs. 1 and 2, the bar is shifted laterally after each pass, from a position in front of one set of rolls to a position in front of the other set, in order to effect a change in the place of formation of the fins, and that this shifting takes the place of the tilting of the bar necessary in the rolling mills described in my former patents already referred to. However, even with the new arrangement, it may be desired to tilt the bar under certain conditions, as, for instance, if the skid gear is out of order, or if it is desired to remove the scale which accumulates on the sections in the rolling process, or for other reasons. It is to be remembered that it is generally advantageous to tilt the bar from time to time, in order to remove scale by means of the shock or jar caused by the tilting. In this respect the arrangement of Fig. 1 is preferable to that of Fig. 2, for, with the former, it is always possible to obtain the desired result of removing the fins not only by passing through the two sets of rolls in succession, but also by tilting the bar and then passing it back again in the opposite direction through the same set of rolls, reversed in direction of rolling. This is not possible with the arrangement shown in Fig. 2, but, with that arrangement, it is necessary, even after tilting, to shift the bar from the first to the second set of rolls.

While the expense of providing a double arrangement of rolls is greater, yet, when there is a very large production, this is compensated for by the fact that the rolls last much longer. The reason why, with the present arrangement, a much larger quantity can be rolled in the same rolls before they are worn out, is that the rolls become very hot if the material is passed always through the same groove, as when a single set of universal rolls is used, instead of being transferred from one set of rolls to another between the passes, as now proposed.

Figs. 3 to 9 illustrate the various modes of arranging the rolls, the bar being shifted from one pair of rolls to another, or, still better, not only shifted but tilted, in order to change the place where the fins are formed on the bar.

Figs. 3 and 4 are, respectively, a front elevation and a plan of a reversing mill furnished either with the two sets of asymmetric universal rolls, A, B, shown in Fig. 1, or with the symmetric rolls A′, B′, shown in Fig. 2, and also with a third set of finishing rolls C, for bending each pair of outwardly-diverging flanges into the same vertical plane, such rolls being shown for example in my copending application, Ser. No. 353,380, filed June 2, 1908. The arrows show the direction of rolling.

Fig. 5 is an elevation of a three-high mill employing the sets of universal rolls A B, shown in Fig. 1 (although those shown in Fig. 2 may also be used) and the finishing rolls C, and in which the directions of the rolling movements are the same as in the plan view, Fig. 4. In the arrangement shown in Fig. 5, the engine for driving the mill may be a reversing engine without a fly wheel, although it is not necessary in ordinary rolling to reverse the mill. It may however, in some cases, be useful to be able to reduce the speed, as for instance, to facilitate the biting of the bar by the rolls, or to stop or reverse the rolls in case of accident. However, in this arrangement, as is the case in all three-high mills, a lifting table, not shown, is required to lift the bar to the second set of rolls.

Fig. 6 shows a mill which dispenses with the lifting table, the second set of rolls B not being in the same vertical plane, transversely of the line of rolling, as the first set A, but behind it. This arrangement not only avoids the use of a table to elevate the bar but also reduces the distance through which the bar must be shifted laterally from the first set of rolls to a position in front of the second set. The rolls are arranged in two different vertical planes, at from 10 to 20 feet distance from each other, so that they really constitute two mills. Each set may have its own fly-wheel engine or electric motor, or the two sets may be geared together and driven by a single engine or motor as indicated in dotted lines at the left hand of Fig. 6, or better still, for the reasons already mentioned, there may be used a reversing engine or engines without fly-wheel. In this arrangement the stands of the second mill, which has only a single set of rolls, are so placed behind the first mill, which has two sets of rolls, that the rolls B and roller racks of the second stand are exactly behind the zone of the couplings P of the rolls A and C. Suitable provision is also made to insure that the bars, as they become very long, pass between the coupling spindles.

The coupling spindle P of the upper rolls may be dispensed with, if desired, by adopting the arrangement indicated by dotted lines at the right hand of Fig. 6, the upper roll of the set C being then directly driven by the pinion *c* and coupling spindle P'' instead of through the upper spindle P.

The arrangement shown in Fig. 7 is very similar to that shown in Fig. 6, but has for its object to avoid interference of the bar with the couplings P and P'. The short distance between the center lines of the rolls A and B is maintained, in order that the frequent shifting from rolls A to B and B to A can be performed very quickly, but for the last pass the bar must be shifted from rolls B to C over the track of the rolls A. This mill may be driven by a single non-reversing engine and the gearing for so doing is indicated in dotted lines. The long coupling shaft P' drives the bottom roll and does not interfere with the rolls B.

The arrangement shown in Fig. 8 has for its object to avoid, in the last pass, the shifting of the blank over the track of other rolls, thus presenting an advantage over the arrangement of Fig. 7, but requiring the mill having the rolls B and C to be reversed for the last pass.

Fig. 9 shows an arrangement of rolls similar to that of Fig. 8 but placed in one line. The rolls A are connected to one engine, while the rolls B and C are connected to another engine, and the latter must be reversed for making the last pass through rolls C. If mills with shiftable housings are employed, the rolls A and B should be spaced farther apart than those shown in this figure.

Fig. 10 shows a complete universal girder-rolling-mill plant with rolls for preparing the blank and other accessories. This plant is designed to roll very long bars and to give a large output. For this reason a cogging mill 19 and shaping mill 20 are provided for preparing a blank of an appropriate shape to go into the universal mills. The rolling work to be performed is so distributed that each engine is employed simultaneously with the others. The cogging mill deals with comparatively heavy blooms which, after being cogged down to the desired width and thickness, are rolled down to the desired shape in the grooved rolls of mill 20. The bad ends are cropped off by the shears 21. However, by rolling the bar in the grooved rolls of the mill 20, I get a projecting tongue which first comes in contact with the driven horizontal rolls, which then pull it through the mill. The shaping mill 20 is preferably a reversing mill, and has skid gears *m n* for shifting the bar from groove to groove and from stand to stand. The last groove, which delivers the desired blank, is preferably situated opposite the first set of universal rolls A. The shaped blank is thus rolled straight on to the universal rolls A. When the blank is passing underneath the mouth of the chute *h* shown in dotted lines, the latter is lifted to allow the blank to advance. In the subsequent rolling the length of the bar increases rapidly and in order not to necessitate very long roller racks or runout tables, the chutes *h* and *h'* are provided to deflect the bar laterally and upward. The bar after passing the first set of rolls is shifted by the skid gears *l* in front of the second set of universal rolls B, and after passing these rolls is shifted back again to the first set of universal rolls A by means of the skid gear *k*. It will be seen that, with a very long bar, the end runs onto the chute *h*, whereby it is deflected laterally and upward above the mill 20, and only a comparatively short end has to be shifted sidewise to reënter the rolls A. When the bar is traversing the last pass through the universal rolls B, the end of chute *h* is lifted up and a new rolled blank is rolled onto the first set of universal rolls A, and a bar emerging from the rolls B is deflected by the guide plates *g* and runs up the chute *i* in front of the finishing rolls C. Again only a comparatively short end requires to be shifted from set B to set C while the longer end is on the chute *i*. A hot-bed and saws are arranged behind the set of universal roughing rolls C. While the last pass is performed, the engine driving rolls B and C has to be reversed, as stated, and it can happen that the new blank in the mill A has to wait before it can be shifted to the set B. In this case, also, the mill A is reversed, and for this reason the shape of the rolls must allow several successive passes without danger of forming fins. In any case even the second set of universal rolls B should be so formed that two successive passes may be given without formation of fins, so that it is not essential that the bar be shifted from one set of universal rolls to the other after each pass. It is a matter of practice to determine which is the most economical system.

I claim:

1. A universal mill for rolling double-flanged beams, consisting of a pair of identical symmetrical horizontal rolls and a pair of identical symmetrical vertical rolls, the pass between said rolls consisting of a web portion and outwardly-diverging flange portions, one of said pairs of rolls having pressure-surfaces arranged to substantially close the outer ends of said flange portions.

2. A universal mill for rolling double-flanged beams, consisting of a pair of identical symmetrical horizontal rolls and a pair of identical symmetrical vertical rolls, the pass between said rolls consisting of a web portion and outwardly-diverging flange

portions, one of said pairs of rolls having pressure-surfaces arranged to substantially close the outer ends of said flange portions and cylindrical surfaces extending outward from said pressure-surfaces.

3. A plant for rolling I-bars comprising complementary sets of universal rolls, arranged side by side, the upper and lower rolls of adjacent mills being driven from a common shaft, the first two sets of rolls having passes of substantially identical shape, said passes consisting of a web portion and outwardly-diverging flange portions, the first set of rolls having spaces between the horizontal and vertical rolls to permit the extrusion of surplus blank metal as fins, the second set of rolls having pressure surfaces in position to roll down said fins, and the third set of rolls having passes arranged to finish and square up the bar.

4. A plant for rolling I-bars comprising sets of universal rolls, arranged side by side, the first two sets of rolls having passes of substantially identical shape, said passes consisting of a web portion and outwardly-diverging flange portions, the first set of rolls having spaces between the horizontal and vertical rolls to permit extrusion of surplus blank metal as fins, the second set of rolls having pressure surfaces in position to roll down said fins, and a third set of rolls having passes arranged to finish and square up the bar.

5. A plant for rolling I-bars comprising complementary sets of rolls adapted to operate on the bar to form a web portion and outwardly diverging flange portions, and a set of universal finishing rolls having passes arranged to support the web and to apply pressure to the flanges to bring them to a right angle with the web.

In testimony whereof, I affix my signature in presence of two witnesses.

HUGO SACK.

Witnesses:
EUGENE A. BYRNES,
G. E. MOORE.