May 15, 1928. 1,669,905

J. F. KELLER

STRAIGHT LINE REDUCING MACHINE

Filed Sept. 15, 1923 6 Sheets-Sheet 1

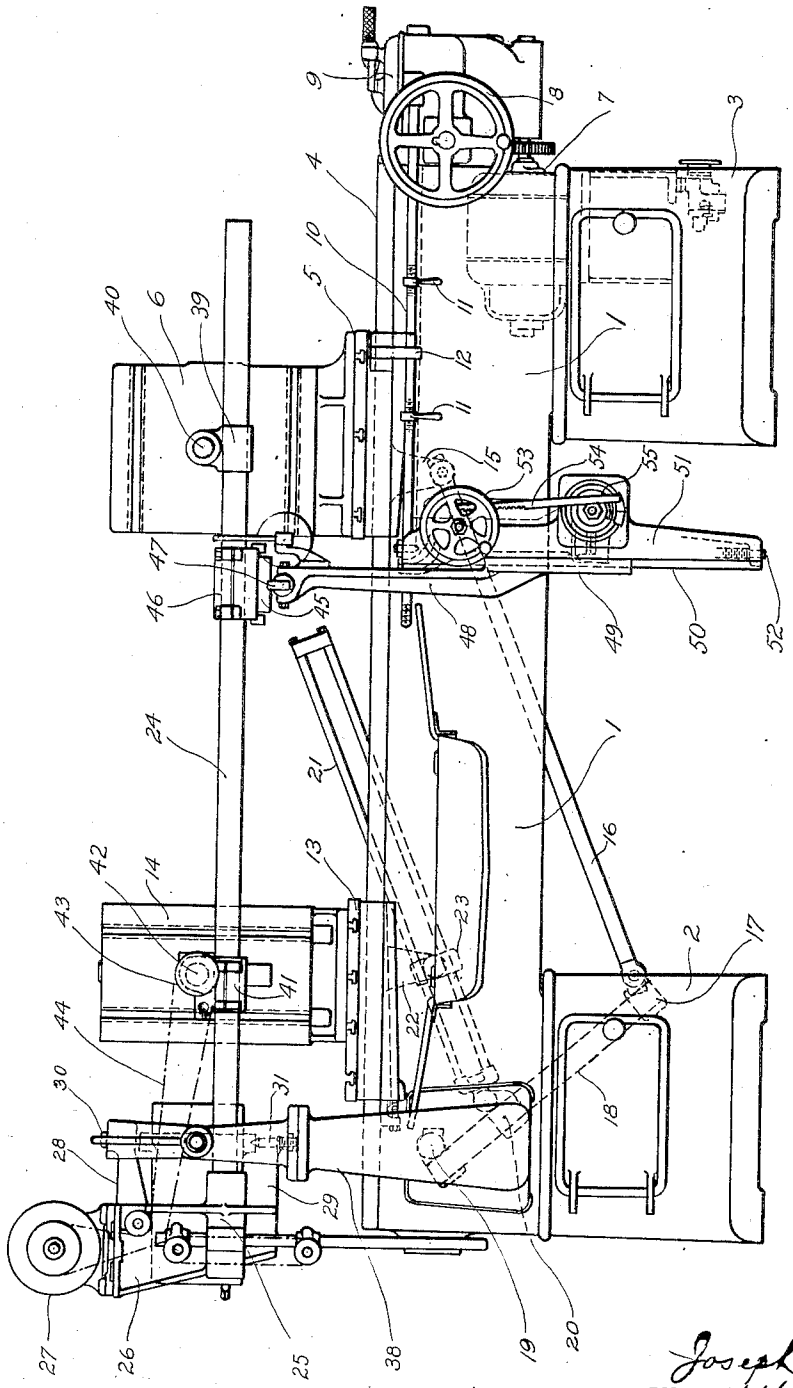

FIG. 1.

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6 Sheets-Sheet 2

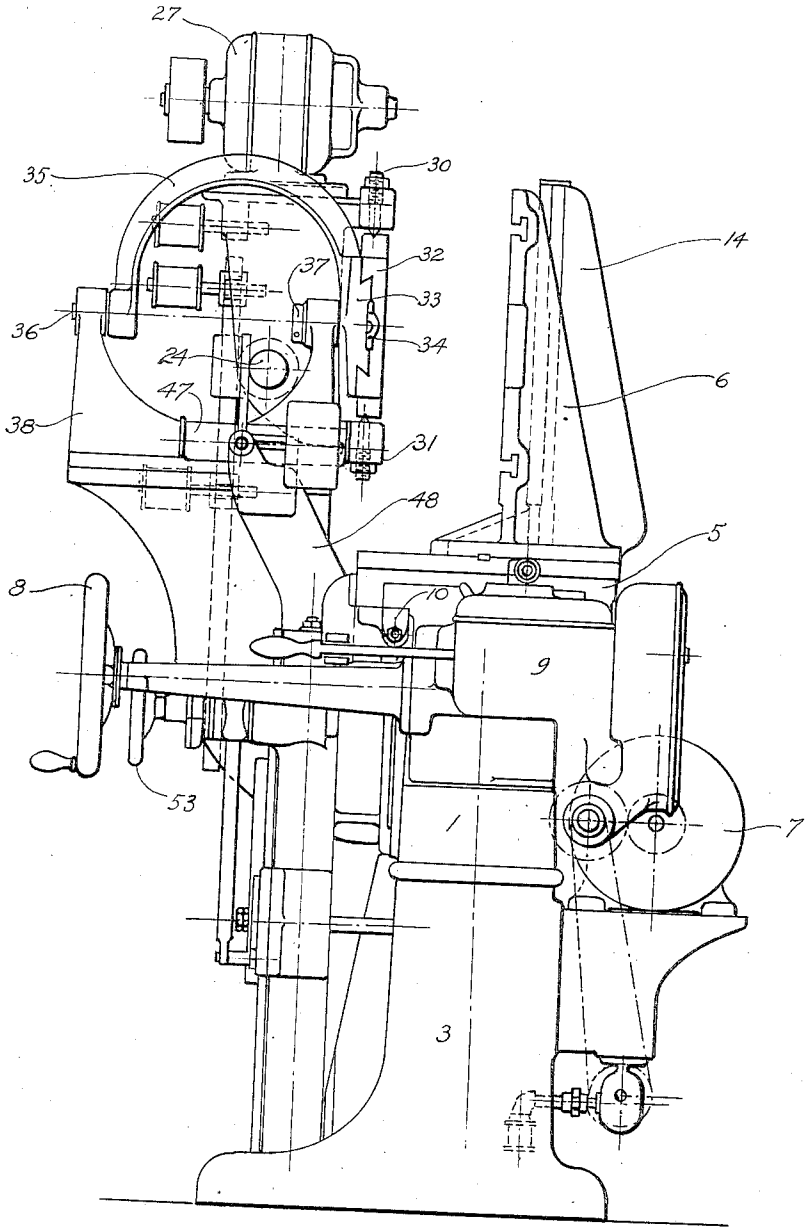

FIG. 2.

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6 Sheets-Sheet 3

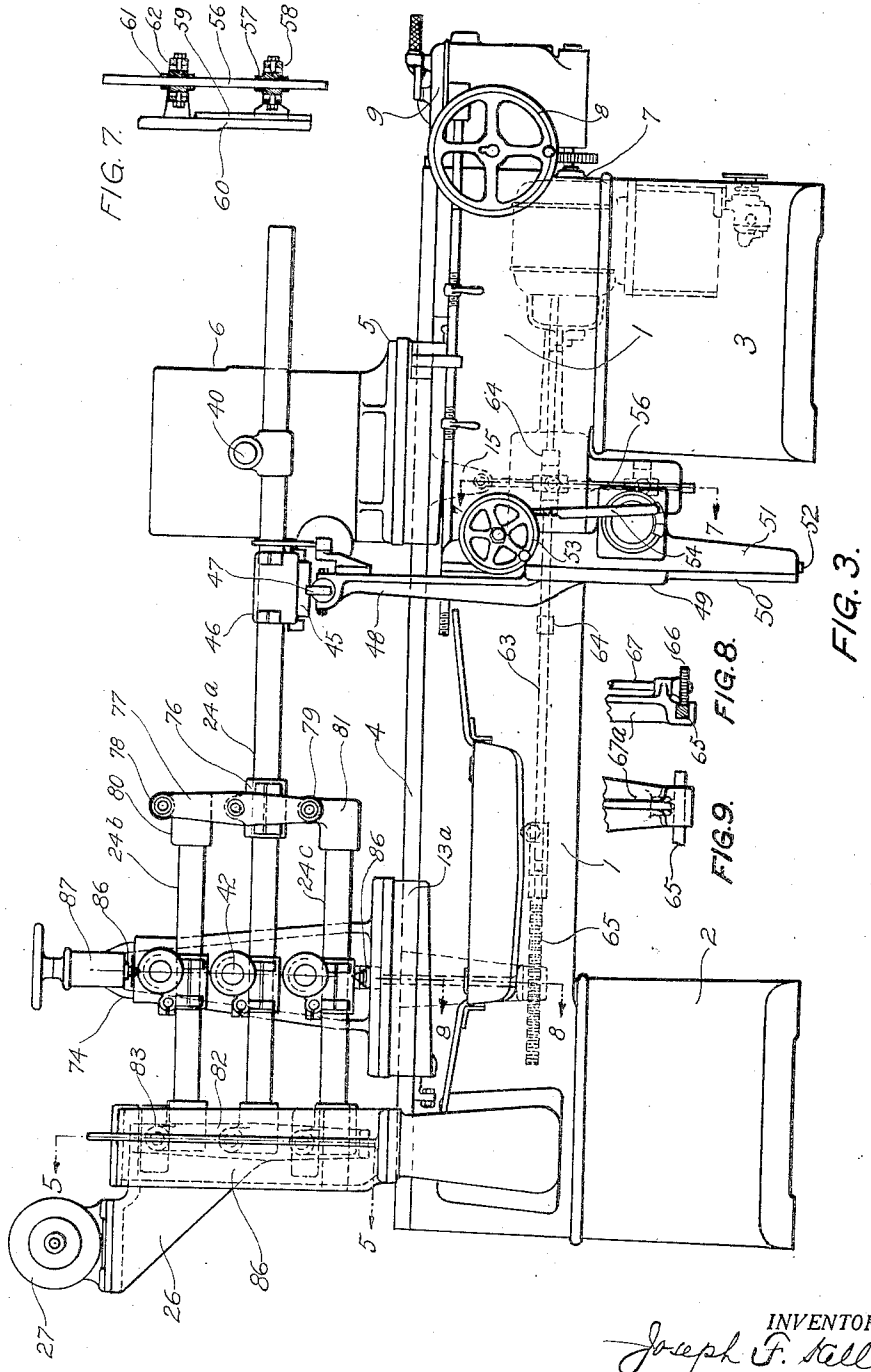

FIG. 7.

FIG. 3.

FIG. 8.

FIG. 9.

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STRAIGHT LINE REDUCING MACHINE

Filed Sept. 15, 1923 6 Sheets-Sheet 4

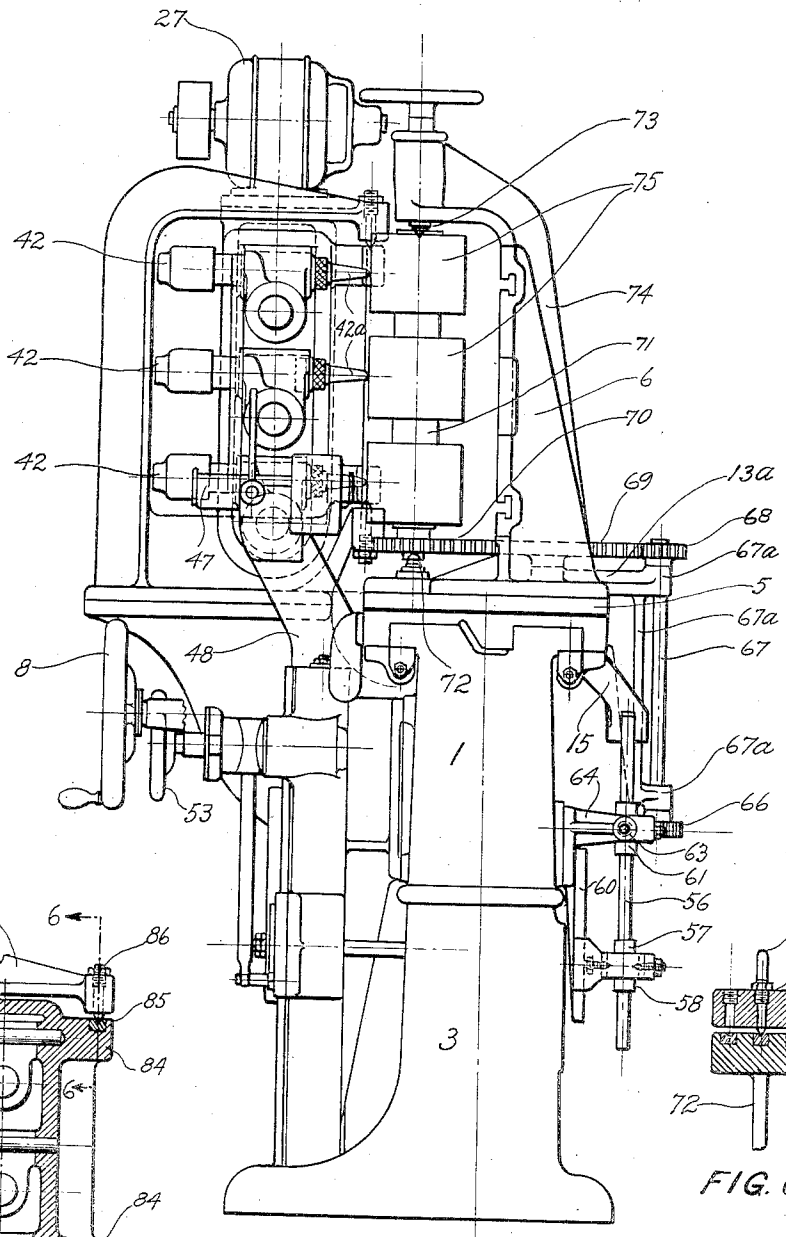

FIG. 4.

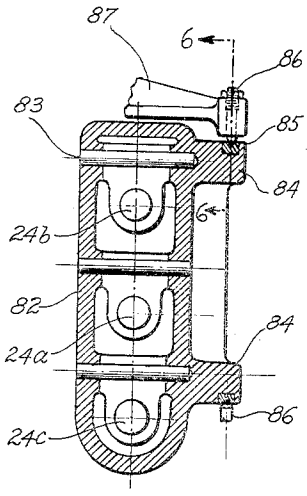

FIG. 5.

FIG. 6.

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STRAIGHT LINE REDUCING MACHINE

Filed Sept. 15, 1923 6 Sheets-Sheet 5

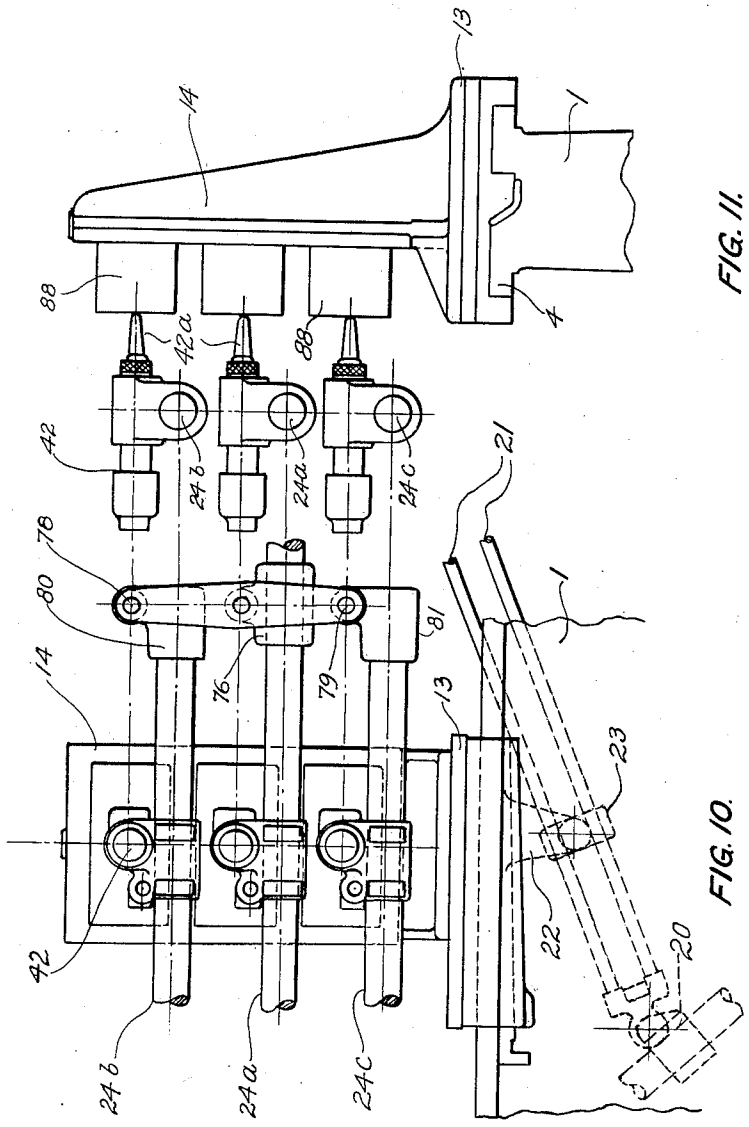

FIG. 11.

FIG. 10.

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May 15, 1928. 1,669,905

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STRAIGHT LINE REDUCING MACHINE

Filed Sept. 15, 1923 6 Sheets-Sheet 6

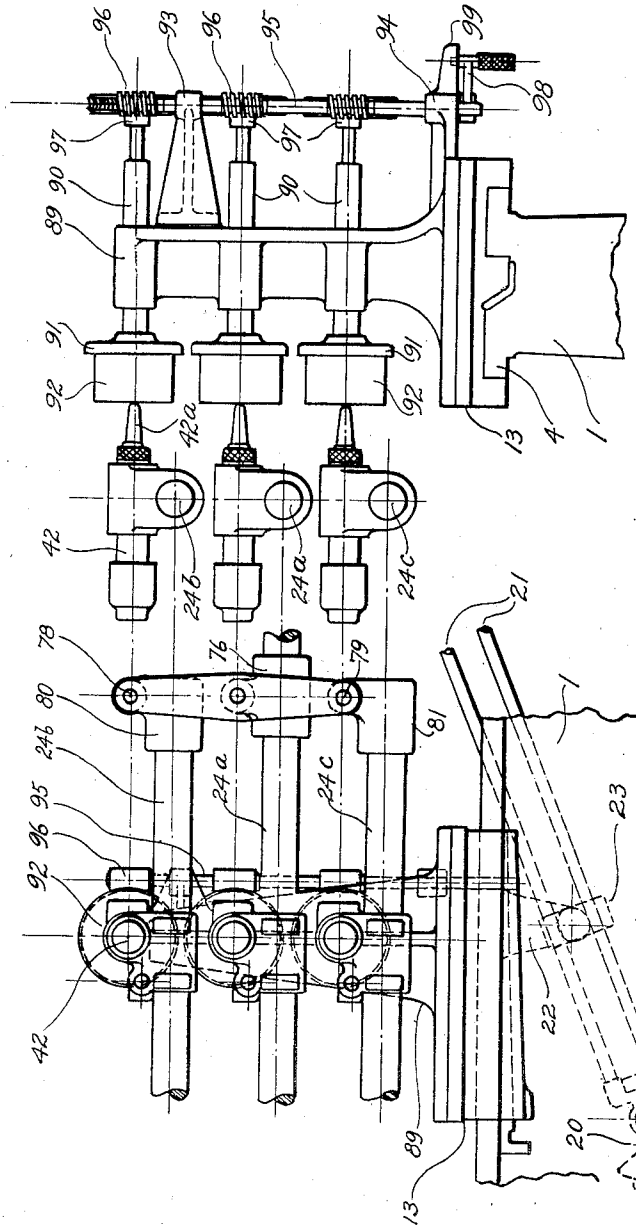

FIG. 13.

FIG. 12.

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UNITED STATES PATENT OFFICE.

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STRAIGHT-LINE-REDUCING MACHINE.

Application filed September 15, 1923. Serial No. 662,854.

My invention relates more particularly to engraving or die cutting machines, by means of which replicas of any desired design may be reproduced from a pattern of larger size than the reproduction.

Many different types of machines have been devised for this purpose, in which for reproducing designs of a die or other device, which has three dimensions, it is necessary to provide for relative movement between the tracer and pattern and cutter and die in the three dimensional directions. This has usually been done by connecting the tracer and cutter in such a manner that any motion of the former will be transmitted to the latter in reduced ratio in each of the three rectilinear dimensional directions. It will be understood that in reproducing many designs, its is preferable to work from a large pattern, where the details of the design can be better worked out, and reproduce the design in reduced size, thereby obtaining greater accuracy.

For some classes of work, the movement of the tracer and cutter in the three dimensional directions is not desirable and, therefore, one object of my improvement is to provide a reducing machine, in which the movement in one dimensional direction is effected by a straight line movement of the pattern and work, the two being connected together so that the latter is reproduced in reduced ratio. In this improved form of my machine, the other two dimensional movements are effected by movements of the tracer and cutter.

It is sometimes desirable to have the ratio of reduction different in one dimensional direction from that in the others, and another object of my improved machine is to provide means whereby the ratio of reduction may be varied in one or more of the dimensions, such as width, length or depth of the design as reproduced may be different.

It is frequently desirable to reproduce a plurality of replicas from the same pattern and a further object of my improved machine is to provide for doing this simultaneously from a single pattern. For this purpose, a plurality of cutter bars are provided, all operating for the same ratios of reduction and connected together to be operated in connection with a single tracer cooperating with the pattern to be reproduced. In this multiple reproducing machine, it will be evident that the work may be arranged in various ways for straight line reproductions from a single pattern.

In work of this character, it is often necessary to reproduce a design upon rollers or cylindrical surfaces and a further object of my improvement is to provide means whereby rollers or cylinders may be engraved in straight line reduction from a pattern, movable in a straight line. In my improved machine, this may be accomplished with a single work piece, but preferably a plurality of similar cylindrical work pieces are mounted for simultaneous execution of a plurality of reproductions of the design from a single pattern moving in a straight line. In this case, the movement of the cylindrical surface, at the point of contact of the cutter may be considered as corresponding to straight line movement.

In the accompanying drawings, I have shown several improved forms of straight line reducing machines, embodying the various objects referred to, together with certain modifications adapted for obtaining specific results. Referring to the drawings, Fig. 1 shows a side elevation of my improved straight line reducing machine, with a single cutter bar, the pattern and work supports being in the form of slides, movable in straight lines; Fig. 2 is an end elevation of the straight line reducing machine shown in Fig. 1; Fig. 3 is a side elevation of my improved straight line reducing machine with a plurality of cutter bars operating upon a plurality of work pieces in the form of cylinders or rolls; Fig. 4 is an end elevation of the roll cutting straight line reducing machine shown in Fig. 3; Fig. 5 is a sectional view on the line 5—5 of Fig. 3, illustrating the pivotal mounting of the cutter bars; Fig. 6 is a detail sectional view on the line 6—6 of Fig. 5 of the multiple pivot bearing for the horizontal movement of the cutter bars; Fig. 7 is a sectional detail on the line 7—7 of Fig. 3; Fig. 8 is a sectional detail on the line 8—8 of Fig. 3; Fig. 9 is a side view of the parts shown in Fig. 8; Fig. 10 is a broken away side elevation of a straight line reducing machine, such as shown in Fig. 1, provided with a plurality of cutter bars, operating on a corresponding plurality of

work pieces supported on the work slide; Fig. 11 is a side elevation of the modified construction shown in Fig. 10; Fig. 12 represents another modification of the straight line reducing machine, with a plurality of cutter bars, operating upon a plurality of work pieces, the latter in this case being mounted for rotation on horizontal axes, so that the design of the pattern may be reproduced on a circular face of the work piece in a plurality of quadrants or sectors, and Fig. 13 is a side elevation of the modified machine as shown in Fig. 12.

My improved straight line reducing machine, in its single cutter bar form, is more particularly shown in Figs. 1 and 2, and comprises a bed 1, supported upon piers 2 and 3, the upper surface of the bed at 4 being planed off and formed as slide ways, upon which the slides for supporting the pattern and work are mounted. The pattern slide 5 may be mounted upon the ways 4 for longitudinal movement thereon in any preferred manner and is provided with a vertically extending bracket 6, upon which the pattern may be suitably mounted. The pattern slide 5 is adapted to be moved longitudinally of the bed 4 by means of a screw in the usual manner, the screw being actuated either by a motor 7 or by means of the hand wheel 8, as may be preferred. Obviously, the pattern slide 5 may be moved in either direction and the usual reversing means is provided in the box 9 and adapted to be actuated by a rod 10, extending parallel to the slide way 4. The rod 10 is provided with the usual adjustable stops 11 adapted to cooperate with a finger 12, attached to and moved with the pattern slide 5, substantially as shown in Fig. 1 of the drawings.

On the slide way 4 to the left, as shown in Fig. 1 of the drawings, there is mounted another slide 13, upon which a bracket 14 is mounted for supporting the work piece or pieces, upon which the design of the pattern is to be reproduced. The replica, however, is preferably of reduced size and, therefore, the ratio of movement between the pattern slide and the work slide is reduced accordingly. In order that this reduction may be accurate, and adjustable according to the requirements, the pattern slide is provided with a depending ear or lug 15 connected by means of a link or rod 16, with the outer end 17 of a lever 18 pivoted at 19 to suitable brackets on the bed 1 of the machine, substantially as indicated in Fig. 1 of the drawings. An adjustable collar 20 is slidably mounted upon the lever 18 and is connected by a double rod link 21 with a depending ear or lug 22 on the work slide 13. The link 21 is connected with the ear 22 on the work side 13, by means of an adjustable pivot bracket 23, which is slidably mounted on the double rod link 21, as indicated in Fig. 1 of the drawings. From this construction, it will be seen that any movement of the pattern slide 5 will be transmitted in reduced ratio to the work slide 13, through the links 16 and 21 and the lever 18. In order that the design may be reproduced accurately with the necessary reduction, it is preferable that the two links 16 and 21 are maintained in parallel relation. When it is desired to change the ratio of reduction, the adjustable collar 20 may be adjusted longitudinally of the lever 18 and the adjustable pivot bracket 23 adjusted lengthwise of the rods of link 21, until the latter is again parallel with the link 16. By this means, it will be seen that as the pattern slide 5 moves in a horizontal straight line, the work piece will be proportionately moved in a reduced ratio, which may be predetermined by suitable adjustment of the linkage.

Obviously, the ratio of reduction between the pattern slide 5 and the work slide 13 may be the same or different from the ratio of reduction between the tracer and cutter, which, in the machine shown in Figs. 1 and 2, are mounted upon the cutter bar 24, the latter being pivotally mounted at one end for swinging movement horizontally and vertically. The left end of the cutter bar 24, as shown in Fig. 1 of the drawings, is secured in a socket 25, cast integral with a platform bracket 26, upon which the motor 27 is mounted; the latter being provided for driving the cutter in the usual manner. The bracket 26 is provided with laterally extending arms 28 and 29, provided with cone bearings 30 and 31, which cooperate with sockets in a side plate 32, (see Fig. 2) mounted on a dove-tail slide 33, for adjustment parallel to the cutter bar. Any suitable means, such as a screw 34 may be provided for adjusting the slide block 32 on the dove-tail slide 33. The dove-tail slide 33 is formed as part of a casting 35, which, in the present instance, is substantially semi-circular and extends over the cutter bar and is suitably pivoted at 36 and 37 on a Y-bracket 38, secured to and extending upward from the bed 1 of the machine, as will be seen in Figs. 1 and 2. This construction, it will be seen, provides for swinging movement of the free end of the cutter bar 24 in horizontal planes on the cone bearings 30 and 31, and swinging movement in vertical planes on the horizontal pivots 36 and 37.

Near the outer free end of the cutter bar 24, or opposite the pattern supporting bracket 6, there is mounted a split collar 39, adapted for carrying the tracer 40 for cooperation with the pattern, which, in operation, is mounted on the bracket 6. A suitable split collar 41 is mounted upon the cutter bar 24 opposite the bracket 14, upon

which the work piece is mounted, and this split collar 41 is adapted to support the cutter 42ª, which is rotatably mounted on a shaft 42 having bearings in the collar 41. A pulley 43, driven by a belt 44 from the motor 27 is secured on the cutter shaft 42, as indicated in Fig. 1 of the drawings. The split collar 41, carrying the cutter, is adapted to be adjusted longitudinally of the cutter bar 24 to change the ratio of reduction to correspond with any change in the position of the work slide by the adjustment of the linkage 16—18—21. It will be understood that ordinarily the axis of horizontal swinging movement of the cutter bar 24 about the pivots 30 and 31, lies in a plane passing through the axis of vertical swinging movement of the bar about the pivots 36 and 37. Thus, ordinarily, the ratio of reduction will be the same in the two dimensional directions taken care of by the swinging movement of the cutter bar 24. If, however, it is desired that the ratio of reduction shall be different in one direction of movement of the bar as compared with the other, the position of the pivots 30 and 31, relative to the axis of the pivots 36 and 37, may be changed by moving the slide block 32 on the dove-tail slide 34, thus adjusting the vertical axis of the cutter bar to obtain any desired ratio of reduction greater or less than the ratio of reduction given by the bar swinging on the horizontal axis of the pivots 36 and 37.

In order to operate the machine systematically and cover all portions of the design, it is preferable to move the cutter bar in the vertical plane by increments controlled by a hand screw or automatic feed devices of well known construction, such as are used on machine tools of this character. For this purpose, a roller 45, mounted in a split collar bracket 46 upon the cutter bar 24 (see Fig. 1) is adapted to roll upon a track rail 47 extending transversely of the cutter bar and supported in a bracket arm 48, as will be seen in Figs. 1 and 2 of the drawings. The bracket arm 48 extends upward from a slide 49 sliding on vertical tracks 50; the latter being formed on a depending bracket 51 secured to the bed of the machine. A suitable screw 52 (indicated by dotted lines in Fig. 1) is provided for feeding the slide 49 and bracket 48 vertically. A suitable hand wheel 53 is provided for operating the screw 52 for manual adjustment of the position of the cutter bar 24, and the usual automatic feed may be provided, such as the rack 54 and friction drive 55.

In the operation of the straight line reducing machine, the pattern is mounted upon the face of the bracket 6 in position to cooperate with the tracer 40. The work piece, upon which the replica is to be reproduced, is mounted on the face of the upright bracket 14 on the work slide 13 in position to cooperate with the cutter 42ª on the end of the shaft 42. The tracer may be positioned to contact with the pattern at the desired starting point by raising the cutter bar 24 by moving the rail 47. Then by moving the pattern slide 5 on its bed, the tracer will follow a horizontal line across the pattern. The pattern slide 5 is reciprocated back and forth by means of the motor 7 and the straight line movements of the pattern slide are communicated to the work slide 13 in reduced ratio through the linkage 16—18—21 and the cutter, being rotated by the motor 27, is adapted to reproduce the design of the pattern on the work piece. At each reciprocation of the pattern slide 5, the cutter bar 24 is given an increment of feed movement to raise or lower the cutter bar and place the tracer and cutter in position to follow lines in a different plane and this is continued until the entire surface of the pattern has been covered by the tracer. During the straight line reciprocation of the pattern, the tracer is caused to follow the elevations and depressions of the pattern by suitable pressure applied to the cutter bar 24 in the usual or any well known manner and the latter will swing in a horizontal plane, rolling on the track 47.

My improved straight line reducing machine is adaptable for engraving rolls or cylindrical surfaces, and for this purpose the machine may be modified, substantially as shown in Figs. 3 and 4 of the drawings. This improved machine also is provided with a plurality of cutters bars, so that a plurality of replicas may be simultaneously reproduced from a single pattern.

In the improved straight line roll cutting machine, shown in Figs. 3 and 4, the straight line reciprocating movement of the pattern slide 5 is converted into rotary or circumferential movement of the work piece by suitable rack and gear connections. In this modification, the depending ear or lug 15 on the pattern slide 5 is connected with a lever 56, which is fulcrumed at its lower end in a collar or bushing 57, the latter being pivotally mounted in a bearing bracket 58 projecting outwardly from a slide block 59, slidably and adjustably mounted upon a depending bracket arm 60 secured to the bed 1 of the machine, substantially as indicated in Figs. 3 and 7 of the drawings. By this arrangement, it will be seen that the position of the fulcrum and hence the length of the lever arm 56 may be varied by adjusting the bushing 57 up or down on the rod 56. Between the fulcrum bushing 57 and the ear 15, the lever rod 56 passes through a bushing 61, which is pivotally connected to a bracket 62 formed as part of or inserted in a bar 63 slidably mounted longitudinally of the bed 1, and supported in suitable

brackets 64. The bar 63 at its left end, as seen in Figs. 3 of the drawings, is provided with a rack 65 engaging a pinion 66 (see Fig. 8) secured to the lower end of a shaft 67, rotatably mounted in a bearing bracket 67^a, secured to and depending from the slide block 13^a. The upper end of the shaft 67, as will be seen in Fig. 4 of the drawings, is provided with a pinion or gear 68 engaging suitable intermediate gears 69 and 70, for rotating a vertical shaft or arbor 71, which is preferably mounted upon cone bearings 72 and 73 in an overhanging bracket 74, secured to the slide block 13^a mounted upon the slide 4 of the bed 1 of the machine. The slide 13^a corresponds, in some respects, to the slide 13 of Fig. 1, but, in the present instance, it is fixed in position on the bed of the machine when the machine is in operation, but may be adjusted to line up the work pieces with the respective cutters.

As will be seen in Figs. 3 and 4, the roll cutting machine, here shown, is adapted for cutting three rolls at a time, and hence the arbor 71 is shown as carrying three rolls or work pieces 75.

Cutters 42^a on shafts 42 are provided for cooperation with the respective cylindrical roll work pieces 75 and all of the cutters are rotated simultaneously by means of the motor 27 in the usual manner or substantially as previously described for the machine shown in Fig. 1. The cutter shafts and cutters 42—42^a are mounted on a plurality of cutter bars, the main cutter bar 24^a corresponds with the cutter bar 24 of the machine shown in Fig. 1. As will be seen in Fig. 3 of the drawings, the cutter bars 24^b and 24^c are not as long as the bar 24^a, for they support only the respective cutters. A split collar 76 is mounted on the cutter bar 24^a and carries parallel links 77 pivotally mounted thereon and pivotally connected with the cutter bars 24^b and 24^c at 78 and 79 in suitable thimbles 80 and 81 carried on the ends of the short cutter bars. In this manner means is provided for simultaneous movement of the three cutter bars, when the cutter bar 24^a, which carries the tracer 40, is moved. The three cutter bars 24^a, 24^b, 24^c are each individually pivoted in a bearing block 82 on horizontal pivot rods 83, substantially as shown in Fig. 5 of the drawings. The pivots 78, 79 and 83, with the links 77, therefore, provide for parallel movement of the cutters in the bars 24^a, 24^b and 24^c. The bearing block 82, in the present instance, is provided with laterally extending lugs 84, preferably provided with a plurality of cone bearing blocks 85, adapted to cooperate with cone bearing points 86, screw-threaded into holes in the double armed bracket 87, which corresponds to the bracket 38 of the machine shown in Fig. 1, and is similarly mounted on the bed 1 of the machine. As will be seen in Fig. 6 of the drawings, the bracket arms 87 and the bearing lugs 84 are provided with three positions for the pivotal bearing between the two members, the central position being in the plane of the pivotal rods 83 of the cutter bars, thus providing means for changing the vertical axis of swinging movement of the cutter bars to vary the ratio of reduction.

In the roll cutting machine just described and shown in Figs. 3 and 4, the pattern slide 5 will be reciprocated in the same manner as described for the machine shown in Figs. 1 and 2, and the motion thereof transmitted in reduced ratio to the cylindrical work pieces 75, by means of the lever 56, rack bar 63—65, pinions and gears 66—68—69 and 70, so that the work pieces will be rotated in circumferentially, so as to pass the respective cutters 42^a and reproduce the design of the pattern on each of the work pieces. Any movement of the tracer 40 on the cutter bar 24^a will be simultaneously communicated to the cutter bars 24^b and 24^c, so that three replicas of the pattern will be produced at the same time. If it is desired to vary the ratio of reduction, in the straight line movement, this may be done by moving the slide 59 up or down to change the position of the fulcrum of the lever 56. If the same ratio of reduction is desired for both the horizontal and vertical movements of the cutter bars, the cone bearing pivots 86 will be inserted in position to engage the central cone sockets 85 in the bearing lugs 84, which is the position shown in Figs. 5 and 6 of the drawings. On the contrary if the ratio of reduction for the movement of the cutter bars in horizontal planes is to be different from that in vertical planes, the cone bearings 86 may be shifted to the cone sockets 85 at one side or the other of the central position.

In the modification shown in Figs. 10 and 11, there is a combination of the multiple cutter bar arrangement of Figs. 3 and 4, with the reciprocating work supporting slide and straight line reducing mechanism of Fig. 1. In this modification, vertically disposed bracket 14 on the slide 13 carries three work pieces 88 adapted to be operated upon respectively by cutters 42^a on shafts 42, supported on the cutter bars 24^a, 24^b and 24^c, corresponding to and operating in the same manner as the three cutter bars shown in Figs. 3 and 4 of the drawings. With this type of machine, the operation is the same as described for the straight line reducing machine of Figs. 1 and 2, except that three work pieces are operated upon at the same time to reproduce three replicas of the pattern.

In Figs. 12 and 13, another modification of the straight line reducing machine of Figs. 1 and 2 is represented in combination

with three cutter bars, for operation upon three work pieces. It is frequently required to engrave a plurality of replicas of the pattern upon the face of a disc in different arcs or quadrants thereof, and the work supporting slide shown in Figs. 12 and 13 is adapted for this purpose. In this form the work slide 13 carries a special vertically disposed bearing bracket 89 having bearings for three horizontally disposed shafts 90 rotatable in the bearing block 89 and provided with face plates 91 upon which the respective work pieces 92 may be mounted. Brackets 93 and 94 extending outward from the bearing block 89 are provided for supporting a screw rod 95 provided at suitable intervals with worm screws 96 cooperating with work gears 97 on the ends of the respective shafts 90. By this arrangement, it will be seen that when the screw rod 95 is rotated, the face plates 91, carrying the work pieces 92, are rotated in synchronism. The screw rod 95 may be provided with a crank 98 for rotating the same and a suitable indexing plate 99 may be provided for uniformly dividing or spacing the surface of the work piece 92, to be operated upon by the respective cutters. This form of machine will be operated substantially as described for the straight line reducing machine shown in Figs. 1 and 2, with the three cutter bars and cutters, as described for the machine shown in Figs. 3 and 4, and 10 and 11. However, this machine has the advantage that when replicas of the pattern have been reproduced in one sector or quadrant of the work pieces, the latter may all be simultaneously rotated to the next sector or quadrant to be operated upon, by means of the crank 98 and properly located by the index plate 99. The operation may be repeated until the required number of replicas has been engraved upon the face of the work piece.

It will be understood that while I have shown and described the preferred forms and certain modifications thereof of my improved straight line reducing machine, I do not wish to be limited to the specific details of construction shown for obviously, various modifications in the details of construction and the combinations or arrangement of the elements for operating the work piece or pieces from the pattern slide may be made without departing from the spirit and scope of the invention.

I claim:

1. In a straight line reducing machine, the combination of a pattern supporting slide movable in a straight line, means for supporting the work for movement corresponding with the movement of said pattern slide, connections whereby movement of the work is reduced compared with movement of the pattern, a bar for supporting the tracer and cutter, means for pivoting said bar for swinging movement in planes at right angles to and parallel with the plane of the pattern and means for supporting said bar during its movement in a plane at right angles to the plane of the pattern.

2. The straight line reducing machine as claimed in claim 1, in which said means for supporting said bar comprises a transverse horizontal rail which is mounted for vertical adjustment to vary the horizontal plane of movement of said bar.

3. The straight line reducing machine as claimed in claim 1, in which means for pivoting said bar for swinging movement in one plane may be varied, whereby the ratio of reduction in one plane may be different from that in the other.

4. In a straight line reducing machine the combination of a pattern supporting member movable in a straight line, a work supporting member carrying a plurality of work pieces, means connecting said members so that movement of the pattern member is transmitted to the work member in reduced ratio, a plurality of cutter bars individually pivoted for movement in a plane parallel to the plane of the pattern, a single pivot supporting all of said bars for movement in planes at right angles to the pattern, and means connecting said bars for simultaneous movement.

5. The straight line reducing machine as claimed in claim 4, in which one of said cutter bars is made longer than the others and provided with a tracer bar for cooperation with a pattern on said pattern supporting member, whereby a plurality of replicas may be made simultaneously from a single pattern.

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