No. 687,905. Patented Dec. 3, 1901.

R. C. & J. P. SEYMOUR.

ROTARY DIE PRESS.

(Application filed June 6, 1901.)

(No Model.) 5 Sheets—Sheet 1.

Fig. 5.

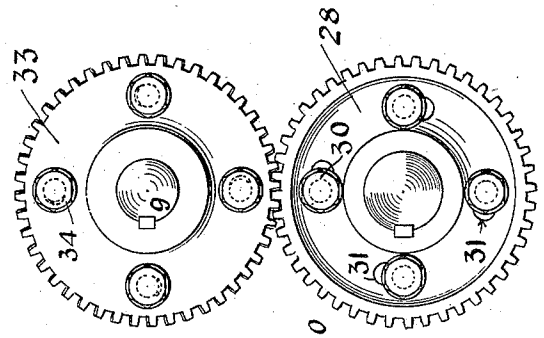
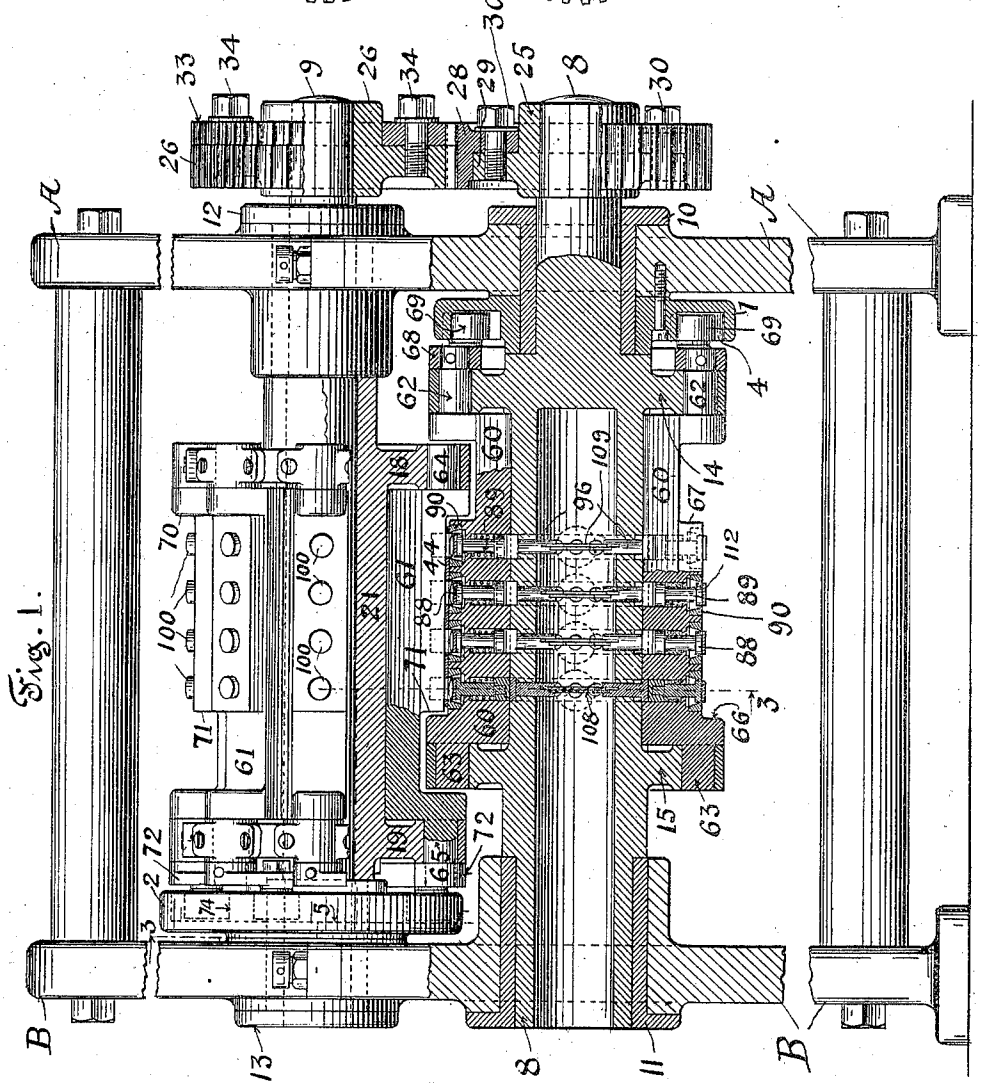


Fig. 1.



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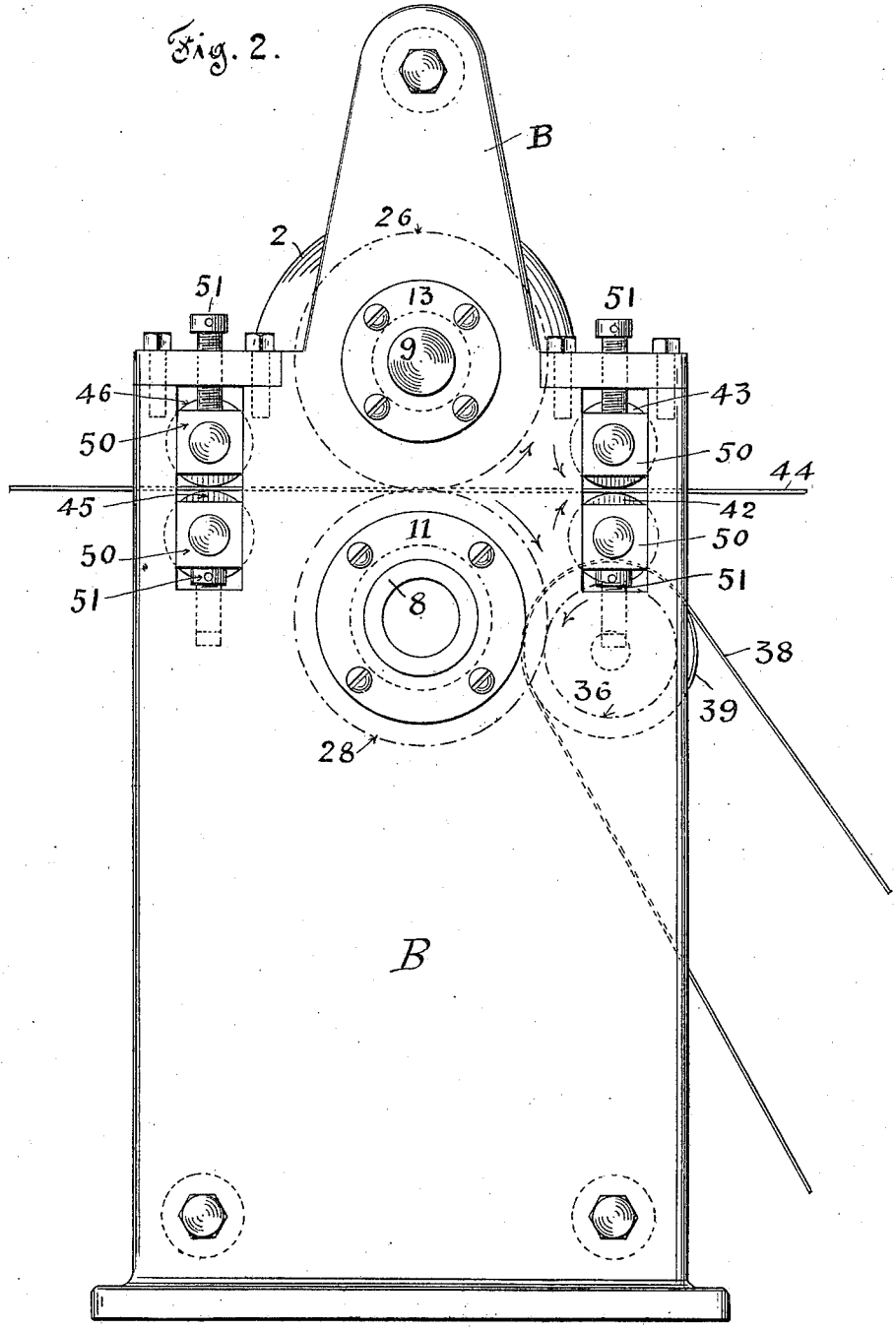
(No Model.) 5 Sheets—Sheet 2.

Fig. 2.



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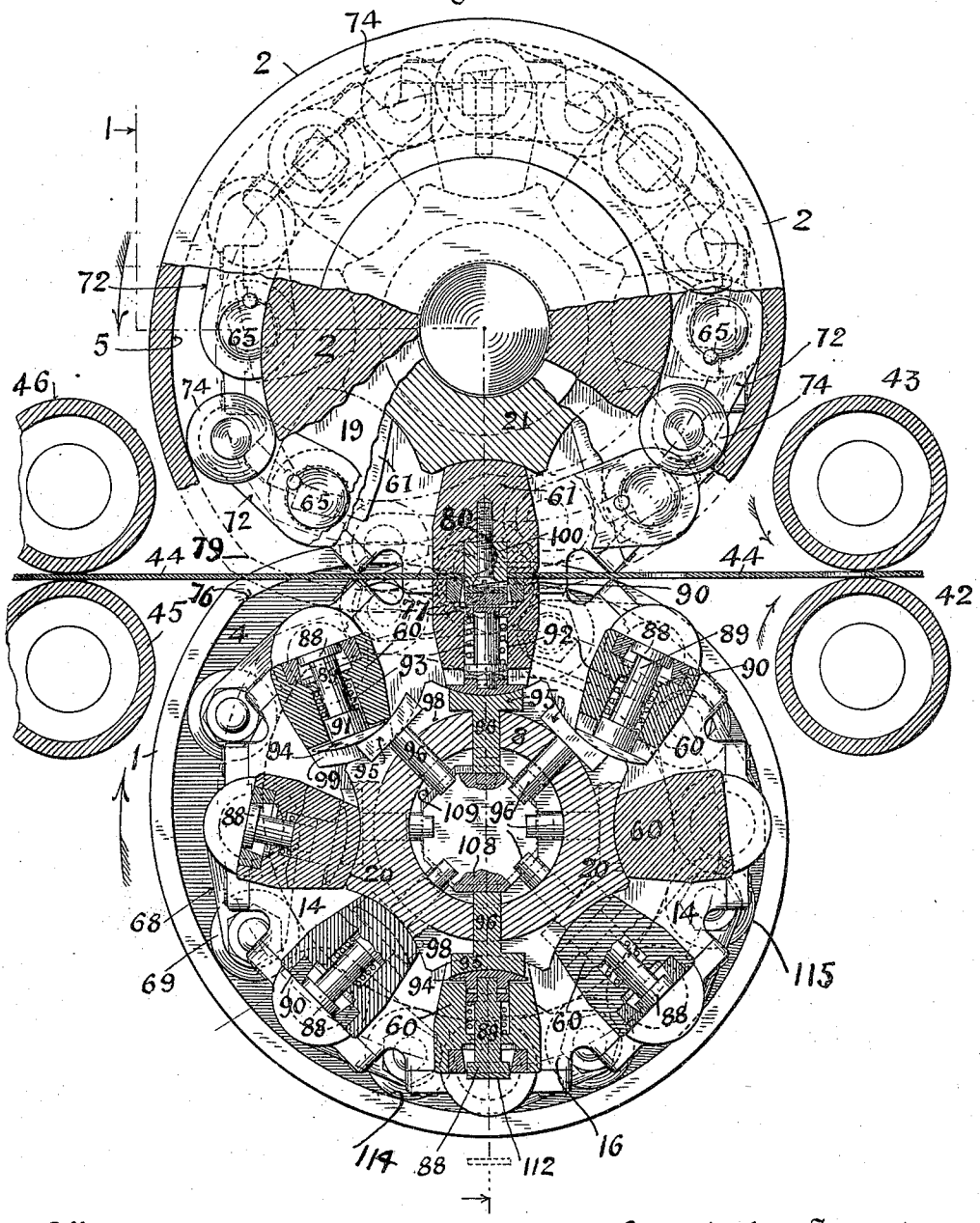
(No Model.) 5 Sheets—Sheet 3.

Fig. 3.



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(No Model.) 5 Sheets—Sheet 4.

Fig. 4.

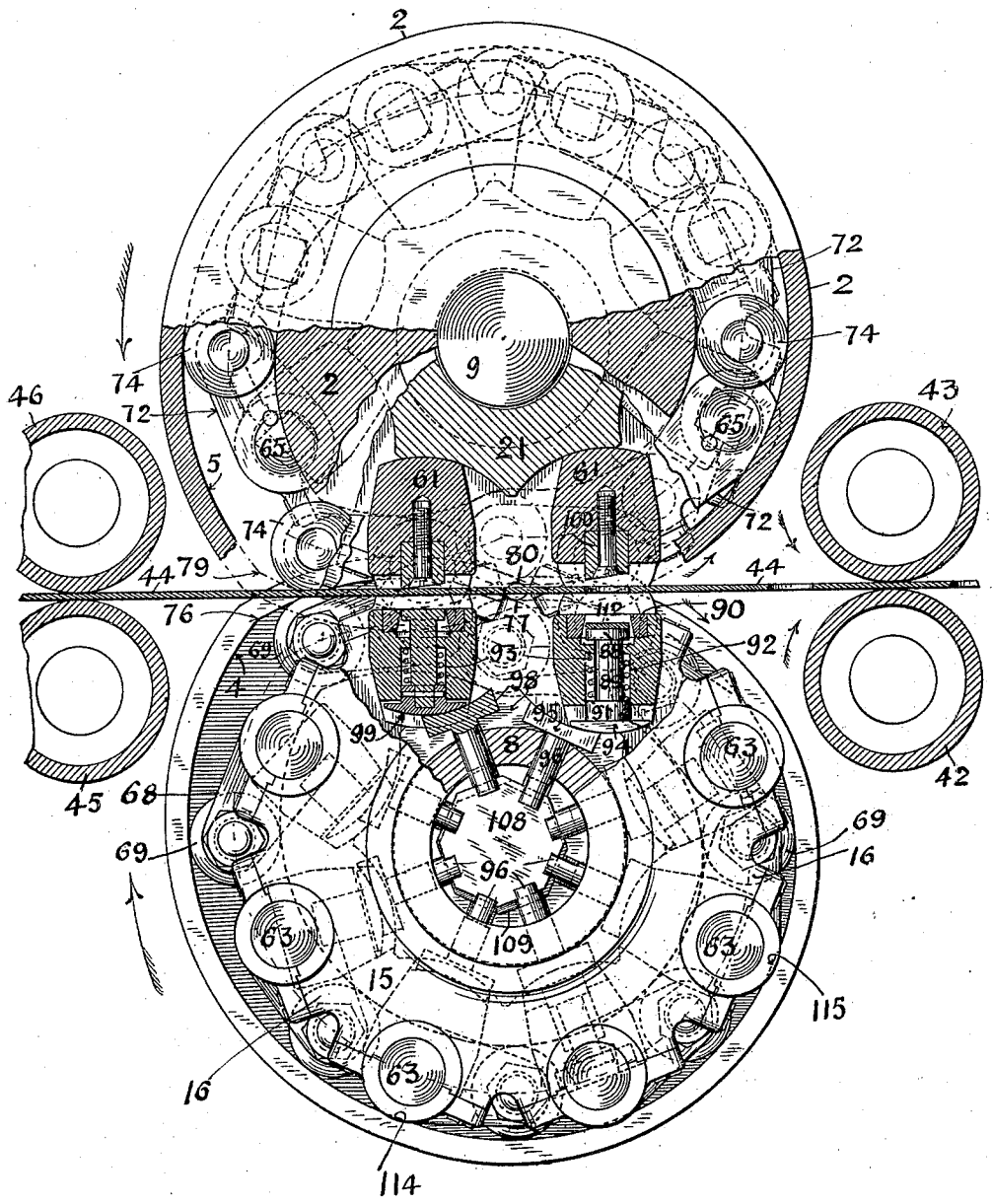

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Fig. 6.

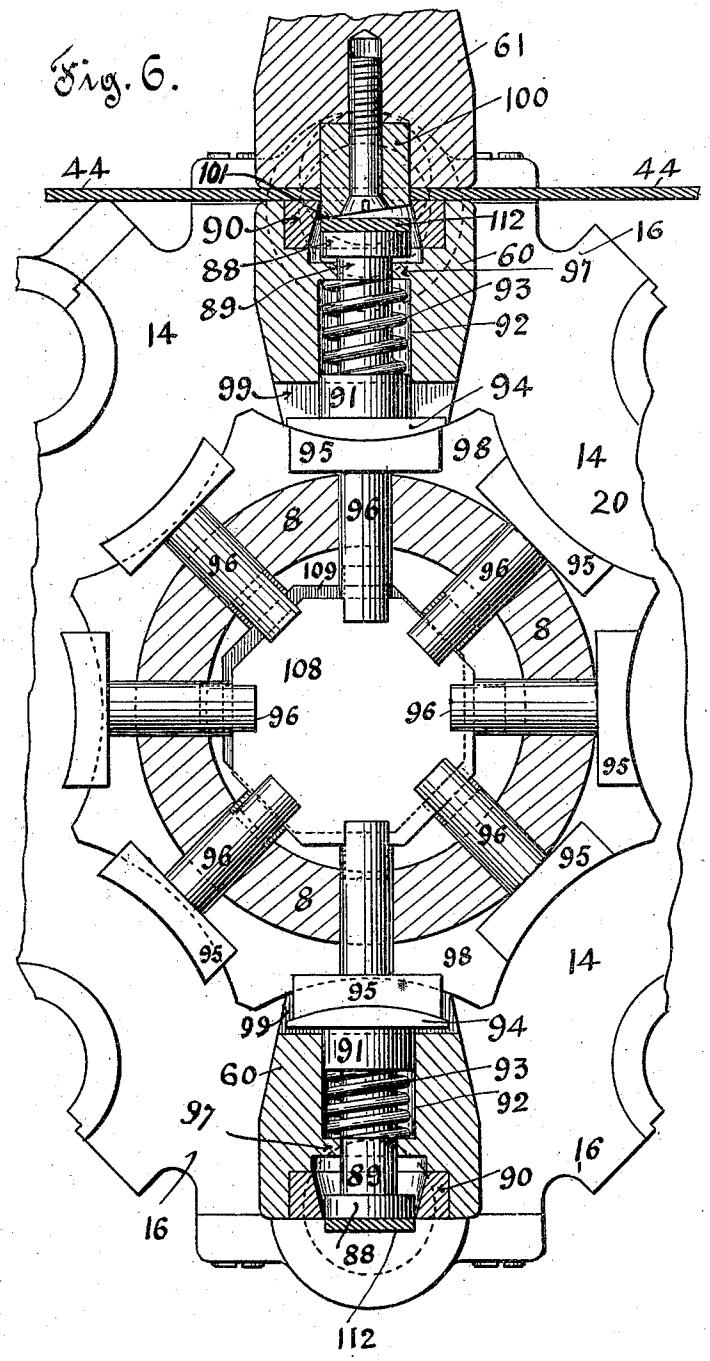
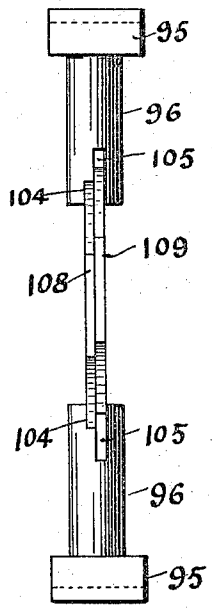


Fig. 7.



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UNITED STATES PATENT OFFICE.

RALPH C. SEYMOUR, OF SOUTH ORANGE, NEW JERSEY, AND JOHN P. SEYMOUR, OF NEW YORK, N. Y.

ROTARY DIE-PRESS.

SPECIFICATION forming part of Letters Patent No. 687,905, dated December 3, 1901.

Application filed June 6, 1901. Serial No. 63,409. (No model.)

To all whom it may concern:

Be it known that we, RALPH C. SEYMOUR, residing at South Orange, Essex county, New Jersey, and JOHN P. SEYMOUR, residing in the borough of Richmond, in the city of New York and State of New York, citizens of the United States, have invented certain new and useful Improvements in Rotary Die-Presses, of which the following is a specification.

This invention relates to improvements in rotary die-presses for punching, stamping, and similar purposes.

It is the purpose of the invention to provide a press for such purposes so designed and constructed that the punching or stamping operation may be continuous and very rapid, and we have found that the greatest rapidity can be obtained by placing the female and male dies, one or both, on rotary carriers and effecting the punching or stamping by the mere approach and recession of said dies, which is the result of the rotary motion. When both the male die or punch and the female die are on their respective rotary carrier, the dies will approach and recede from each other in a manner somewhat resembling the approach and recession of the teeth of intermeshing gear-wheels and the male die will enter to the greatest depth into the female and complete the punching or stamping operation at the instant when the axes of said dies are in the plane through the axes of rotation of the carriers. When one of the dies only is on a rotary carrier, the other will be on a reciprocating table or on a belt which will continuously travel in one direction. When the reciprocating table is employed, the rotary carrier will reverse its motion at the same instant that the table does. In all cases it will be evident that the female and the male die will have a twofold motion—first, a relative motion of approach to and recession from each other, which effects the stamping or punching and which we term the "interaction of the dies," and, second, a lateral motion, which we term "motion of translation," in a direction transverse to the first-named motion of interaction, and the rate of the motion of translation of both dies must be equal. In order that such a rotary motion of one or both dies can be practically utilized, it is necessary that from the instant the male die begins to enter the female (or to contact with the material which is punched or stamped) until the punching or stamping operation be completed the said dies shall remain in parallelism to themselves, notwithstanding their motions of interaction and translation, and we effect this parallelism by pivoting the die which is on the rotary carrier and oscillating said die on its pivots so that the die remains parallel with itself during the punching and stamping operation, and the position of the die during this operation is perpendicular to the surface of the material which is being operated upon. If both dies are on rotary carriers, then both will be pivoted and oscillated, so as to remain in parallelism and perpendicular to the material during their interaction.

Our invention provides as well for rapidly-repeating designs as for punching individual holes or cutting individual blanks, and we can manifestly arrange all the dies on a carrier to produce in the total a single design, or to repeat a single design, or to produce several designs in some determined succession.

Referring to the drawings which accompany the specification to aid the description, and which illustrate a press having both the male and female dies arranged on rotary carriers, Figure 1 is a front elevation of a machine partly sectioned and showing certain of the dies in the position assumed immediately after punching out blanks from a sheet of relatively flexible material. Fig. 2 is a side elevation on the same scale as Fig. 1 and showing devices for feeding the sheet of material. Fig. 3 is a view, partly in section and partly in elevation, taken chiefly on the line 3 3 of Fig. 1 and showing a male and a female die in the position wherein the punching operation is completed and a blank is ejected from the diametrically opposite female die. Fig. 4 is a view on the same scale as Fig. 3, partly in section and partly in elevation, and showing one pair of dies about to begin the punching operation and another pair which have just completed it. This figure indicates the parallelism of the dies from the beginning to

the end of their interaction. Fig. 5 is an elevation on the scale of Fig. 1 of the gearing of the carriers of the male and female dies and showing the means for accurately adjusting said dies and taking up wear and backlash. Fig. 6 is a broken sectional elevation, on large scale, of two diametrically opposite female dies and the ejector devices. Fig. 7 is a detail, on large scale and on a plane perpendicular to that of Fig. 6, of certain parts of the devices for ejecting blanks from a female die.

The frame, shafts, and driving-gear.—A B are the end frames. 1 and 2 are respectively the cam-plates of the female and the male die, which plates are respectively fixed to the said frames A B. In said cam-plates 1 and 2 are the respective cam-grooves 4 5, which will be hereinafter more particularly described.

8 and 9 are respectively the shafts of the female and the male dies. Said shafts 8 9 are eccentric to their respective cam-plates, and the arbors of said shafts have accurate working fit in the bushings 10 11 12 13, and said shafts are shouldered, as shown, to prevent endwise movement. 14 and 15 are flanges integral with or fixed on said shaft 8 and preferably shaped as shown in Figs. 3, 4, and 6, with journals 16 16, which carry the boxes for the pivots of the yokes 60 of the female dies, and 18 and 19 are flanges, similar in construction and purpose, on the hub 21 of said shaft 9. The said hub 21, which is keyed or otherwise secured on said shaft 9, and that part of said shaft 8 between the flanges 14 and 15, also termed a "hub," are polygonal in shape, but with the sides of the polygon somewhat concave, as shown in Figs. 3 and 6. Each hub has as many such concave sides as there are yokes 60 or 61, and said concave sides are each shaped on the arc of a circle having the axis of rotation of its corresponding yoke 60 or 61 as a center. The said hubs support the yokes at all their positions during the interaction of the dies.

25 and 26 are respectivelys pur-gears keyed on shafts 8 and 9. When the female and the male dies have the same angular speed, said gears 25 and 26 will be of equal diameters each to each. To provide for accurately adjusting the positions of said dies, the said gear 25 is provided with a spur-tooth annulus 28, which is secured to the web 29 of said gear 25 by bolts 30, slots 31 in the said annulus 28 permitting of adjusting said annulus, and to take up wear or backlash the said gear 26 is provided with the spur-tooth plate 33, which is secured to said gear 26 by bolts 34, slots in said plate 33 permitting of adjusting said plate. Said gears 25 and 26 may be driven in any suitable manner, as by the spur-gear 36, (indicated by dotted lines in Fig. 2,) which is driven by belt 38 and pulley 39, as indicated.

Rolls 42 43 feed the material 44 which is being punched, and the peripheral speed of said rolls should be the same as or a very little greater than the lateral motion of the dies during the operation of punching. Said roll 42 may be driven by meshing a pinion fixed on said roll with the said gear 36. Rolls 45 and 46 serve to guide the material 44, and the boxes 50 of all said rolls 42 43 45 46 are made adjustable in any suitable manner, as by the bolts 51.

The yokes and dies.—Yokes 60, pivoted in the flanges 14 15 of said shaft 8, contain the female dies 90, and yokes 61, pivoted in the flanges 18 19 of shaft 9, contain the male dies 100, and there may be one or more male and female dies in each respective yoke. The drawings show a press having an equal number of yokes for the male and female dies; but the number of said yokes may be unequal each to each. The arbors 62 63 of said yokes 60 have accurate working fit in the respective flanges 14 15, and the arbors 64 65 of said yokes 61 have similar fit in the respective flanges 18 19, Fig. 1. The inner sides of each yoke 60 61 are curved on arcs of circles struck from the axis of rotation of the respective yoke as a center. An arm 68 is fixed at one end on each of said arbors 62 and carries at its other end a roller 69, which works in the groove 4 of said cam-plate 1, and an arm 72 is fixed at one end on each of said arbors 65 and carries on its other end a roller 74, which works in the groove 5 of said cam-plate 2.

To facilitate the proper coöperation of the dies, the outer surface of each yoke 60 is depressed at 66 and 67, and the outer surface of each yoke 61 is depressed at 70 and 71, as shown in Fig. 1. These depressions allow of assembling the shafts 8 and 9 with their respective flanges 14 15 and 18 19 and respective yokes 60 and 61 in proper relation to each other, as shown in Fig. 1, and said depressions are also such that the adjacent faces of these yokes 60 61, which are in the working position, are as nearly as possible in the plane through the axis of rotation of the said yoke. This position of said adjacent faces is clearly shown in Fig. 1. From the points 76 to 77 of groove 4 in cam 1 and from points 79 to 80 of groove 5 in cam 2, Figs. 3 and 4, said grooves 4 and 5 are respectively so shaped that each pair of corresponding yokes 60 61 (and therefore the corresponding female and male die carried by said yokes) are brought perpendicular to the material 44 and remain in parallelism with themselves during the entire period of the interaction of each said pair of dies, notwithstanding the simultaneous motion of translation of the dies. From point 115 to point 114 said groove 4 is preferably circular and concentric to shaft 8, said groove 4 passing gradually out from point 77 to said point 115 and around in from said point 114 to said point 76. From said point 80 upward and around to point 79 said groove 5 in cam 2 may be of any shape which will permit of the free travel of said rollers 74. It results from the aforesaid shapes of the said cam-grooves 4 and 5

that as a given pair of male and female dies approach their working position they first come accurately into line with each other and perpendicular to the surface of the material 44 to be operated upon, and then the male die enters the female die to the proper depth with a rectilinear motion, finally withdrawing with a reverse rectilinear motion from the female, both dies and the material meanwhile moving transversely at the same rate. From the point where the interaction of the dies ceases the female gradually assumes a radial position to facilitate the ejection of the blanks 112, Figs. 3 and 6, and from this radial position again turns to its working position as it comes around to the point where its interaction with the male die will begin again, and so on as the shafts 8 and 9 continue to revolve. Said male and female dies will be secured in any suitable manner, and when the machine is used for punching blanks out of a sheet and for like purposes the walls of the female dies 90 are preferably flared, as indicated in Figs. 3 and 4, and the working face of each male die 100 is beveled to make a cutting edge 101, as shown in Fig. 6.

The ejecting devices.—When the female dies are on a rotary carrier and the machine is used for punching blanks from sheets and for like purposes, it is desirable to provide devices for ejecting the blanks from the female dies. Any suitable devices may be used for this purpose and among them those shown in the drawings and now to be described.

In each female die 90 is a plunger 88 on a stem 89, Fig. 6, and having about the same cross area and shape as the male dies. A plunger 91 on each said stem, working in a chamber 92, guides said stem 89, and a coil-spring 93 tends to always bring the stem and plungers 88 91 to the normal position—that is, the position in which all the plungers except those of the uppermost and lowermost female die are shown in Fig. 3. A shoe 94 on each plunger 91, curved on its inner surface approximately on an arc struck from the center of oscillation of its particular yoke 60 as a center, bears on the concave similarly-curved surface of a shoe 95, which has a stem 96, having an accurate working fit through a radial hole in the wall of said shaft 8, Fig. 6. Said shoes 95 work in circumferential grooves 98, cut in the aforesaid polygonal hub 20 of said shaft 8, as shown in Figs. 1, 3, and 6, and said shoes 94 work in transverse slots 99 in the inner sides of said yoke 60, said shoes 94 and 95 being of sufficient length to remain in contact in all positions of the yokes 60. In the inner end of each stem 96, which projects into the interior of shaft 8, is cut a relatively shallow slot 104 and a relatively deep slot 105. Now numbering the said yokes from the uppermost yoke around to the right from 1 to 8 for clearness of reference the said slots 104 105 will be similarly placed with respect to each other in all the stems 96 of the female dies 90 in the same yoke—that is, in all the stems of the same yoke the relatively shallow slot will be on the same side of the relatively deep slot; but the deep slot of the stems 96 of the female dies in yokes numbered 2, 4, 6, and 8 will be in the same vertical plane as the relatively shallow slot in the stem 96 of the female die of yoke numbered 1, and vice versa, and the relatively deep and relatively shallow slots of the stem 96 of the female dies of yokes numbered 3, 5, and 7 will be in the same vertical planes, respectively, as the relatively deep and shallow slots of the said stem 96 of the female die of yoke numbered 1. Alternate sides of a polygonal plate 108, which has as many sides as there are yokes 60, enter to the full depth into the said shallow slots 104 of the stems 96 of the female dies of the yokes numbered 1, 3, 5, and 7, while the intermediate sides of said plate 108 enter only part way into the deep slots 105 of the stems 96 of the corresponding female dies of the yokes numbered 2, 4, 6, and 8. The alternate sides of another similar polygonal plate 109 enter only part way into the deep slots 105 of the stems 96 of the female dies of the yokes numbered 1, 3, 5, and 7, and the intermediate sides of said plate 109 enter to the full depth into the shallow slots 104 of the stems 96 of the corresponding female dies of the yokes numbered 2, 4, 6, and 8, the yokes being multiples of four and the plates 108 109 being regular octagons.

With the aforesaid arrangement it results that when the plunger 88 of any female die is pressed in the plunger 88 of the female die which is diametrically opposite will be pressed out and will eject a blank 112 from said last-named die, and this without moving the plunger of any other female die.

The press operates as follows: A sheet of material 44 is fed in from the left of Fig. 3 by hand until its right end is caught by the rolls 42 43, which will thereafter move the said sheet at the proper rate. As the shafts 8 and 9, with their dies, rotate a pair of female dies and male dies (or a row of such pairs, if the dies are arranged in rows, as shown in the drawings) will come in line with each other. As they approach their position of interaction their respective rollers 69 74, being engaged by the said respective cam-grooves 4 5, will have turned the respective yokes 60 61 of the female and male dies (or of the row of such dies) so that the axis of each die will be perpendicular to the said sheet 44, and the said cam-grooves and rollers will keep the said respective yokes parallel to this position so long as the said dies are interacting, and therefore said dies will also remain parallel to their original position during their interaction. As the shafts 8 9 continue to rotate that male die 100 which has just arrived at its working position (as the one to the left in Fig. 4) will descend, advancing into the corresponding female die and cutting a blank out of sheet 44, which is meanwhile moving

laterally at the same rate as the interacting dies are. The male die will have advanced most deeply into the female die at the instant when the axes of both dies are in the plane through the centers of said shafts 8 9, at which instant the plunger 88 of the diametrically opposite female die will have moved to its outward limit, ejecting the blank 112 from said last-named die. As the shafts 8 9 continue their rotation the said male die gradually withdraws from the said female die until the dies reach the position of the shaded dies at the right of Fig. 4. Up to this position, which is the limit of the interaction of the dies, the said dies have remained parallel to their original interacting position; but from here on they (or at least the female dies) gradually turn, coming to a radial position a little before the female reaches the lowest and the male die the highest position in Figs. 3 and 4, although it is not necessary that the male die turn to such radial position, and so as the shafts 8 and 9 continue to rotate one pair of dies after another (or one row of pairs after another) is brought to the interacting position, through that position, wherein the blanks are punched, and around to the interacting position again.

When the material punched is somewhat flexible, the boxes of the rolls 42 43 44 45 may be arranged as shown and described; but with relatively rigid material the boxes of said rolls should be arranged to permit of automatic adjustment as the sheet of material feeds along. In such a case it will also be necessary to arrange the driving-pinion of roll 42 so as to remain in mesh with gear 36 in all positions of said roll 42.

Now, having described our improvements, we claim as our invention—

1. In a rotary die-press, the combination of a male and a female die each of which has a motion of translation in a direction transverse to that of their interaction in the operation of punching and is arranged to remain in parallelism during the period of said operation, substantially as described.

2. In a rotary die-press, the combination of a male and a female die, a rotary carrier for each of said dies, and means for keeping said dies in parallelism during their interaction, substantially as described.

3. In a rotary die-press, the combination of a rotatable shaft, a yoke pivoted thereon parallel to the axis of rotation, a die carried by said yoke, a cam, and devices operatively connecting said yoke with said cam, whereby said die is retained in parallelism with itself during the period of punching, substantially as described.

4. In a rotary die-press, the combination of parallel rotatable shafts, a yoke pivoted on each shaft parallel to the axis of rotation, a male die or dies on one and a female die or dies on the other yoke, cams, and devices operatively connecting each yoke with its respective cam, whereby said dies are retained in parallelism during the interaction of the dies, substantially as described.

5. In a rotary die-press, the combination of parallel rotatable carriers, a male die or dies on one and a female die or dies on the other carrier, an ejector in each female die adapted to be actuated by a male die, and means for maintaining a coöperating male and female die in parallelism during the operation of punching, substantially as described.

6. In a rotary die-press, the combination of a rotatable shaft, yokes for dies pivoted on said shaft parallel with the axis of rotation, a hub on said shaft adapted to offer support to said yokes during the interaction of the dies and the bearing-surfaces of said yokes and hub formed on arcs struck from the center of oscillation of said yokes, and means for holding each said yoke in parallelism with itself during the said interaction of the dies, substantially as described.

7. In a rotary die-press, the combination of a male and a female die each having a motion of translation in a direction transverse to their interaction, means for retaining said dies in parallelism during their interaction, and means for feeding the material operated upon at the same rate as that of the translation of the said dies, substantially as described.

8. In a rotary die-press, the combination of a rotatable shaft, female dies pivoted thereon parallel with the axis of rotation of said shaft and arranged diametrically opposite to each other, ejector devices in said female dies operatively connected through said shaft, whereby the punching at one die ejects the blank from the diametrically opposite die, substantially as described.

9. The combination in a rotary die-press, of rotatable parallel shafts, die-carrying yokes pivoted on said shafts parallel to the axis of rotation, and the exterior surfaces of said yokes shaped with depressions adapted to permit of the motion of a yoke on one shaft with reference to the corresponding yoke on the other shaft, substantially as described.

10. The combination in a rotary die-press, of a rotatable shaft, a cam, a die pivoted on said shaft, and an operative connection between said die and cam, whereby said die is retained in parallelism with itself during the operation of punching, substantially as described.

11. In a rotary die-press, the combination of a rotatable shaft, a yoke pivoted thereon parallel to the axis of rotation, and a die carried by said yoke and having its working face approximately in the plane through the axis of oscillation of said yoke, substantially as described.

12. The combination in a die-press, of a rotary shaft provided with a plurality of polygonal faces, a plurality of die-carrying yokes pivoted on said shaft and having a surface adapted to bear on one of said polygonal faces, whereby said yoke receives support during the interaction of the dies, and means for

retaining each yoke in parallelism with itself during said interaction, substantially as described.

13. The combination in a die-press, of rotary parallel shafts 8 and 9, a hub 20 on shaft 8 and a hub 21 on shaft 9 and each hub having the same number of concave faces, die-carrying yokes 60 pivoted on shaft 8 and having their inner sides bearing and working on the corresponding faces of said hub 20, die-carrying yokes 61 pivoted on said shaft 9 and having their inner sides bearing and working on the corresponding faces of said hub 21, and means for holding said yokes 60 and 61 in parallelism with themselves during the interaction of the dies, substantially as described.

14. In a die-press, the combination of a rotary shaft provided with flanges carrying journals and with a polygonal hub, die-carrying yokes pivoted in said journals and bearing on said hub, a cam and operative connections between said yokes and said cam whereby each of said yokes is retained in parallelism with itself during a determined range of movement, substantially as described.

15. The combination in a die-press, of rotary male and female dies, and a spring-actuated plunger in each female die operatively connected with the plunger of the diametrically opposite female die, whereby the action of the plunger in one female die in punching causes the ejection of a blank from the diametrically opposite female die, substantially as described.

16. The combination in a rotary die-press, of a hollow shaft, a plurality of female dies carried thereby and arranged in multiples of four, polygonal plates having as many sides as there are dies arranged in the hollow of said shaft and opposite sides of each plate operatively connected with mutually opposite dies, substantially as described.

17. The combination in a rotary die-press, of a hollow shaft, a plurality of female dies carried thereby and arranged in multiples of four, plungers in said dies, stems 96 operatively connected with said plungers, and polygonal plates 108, 109 operatively connected with said stems 96, substantially as described.

18. The combination in a rotary die-press, of a hollow shaft, a plurality of male and female dies carried thereby, spring-actuated plungers in said dies adapted to be operated by male dies, curved shoes on said plungers, stems 96 penetrating into the hollow of said shaft and curved shoes on said stems adapted to be engaged by the shoes on said plungers, and polygonal plates 108, 109 the sides of which polygons are in operative contact with alternate stems 96, substantially as described.

19. In a rotary die-press, the combination of female dies, a hollow shaft, stems 96 each having a shallow and a deep slot, and polygonal plates 108, 109 each having as many sides as there are stems 96, and alternate sides of one plate having working contact with the bottoms of the shallow slot in alternate stems 96 and the intermediate sides of the other plate having working contact with the bottoms of the shallow slots in the intermediate stems 96, substantially as described.

Signed at New York city this 14th day of May, 1901.

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