

E. E. CLAUSSEN & E. A. CLAUS.

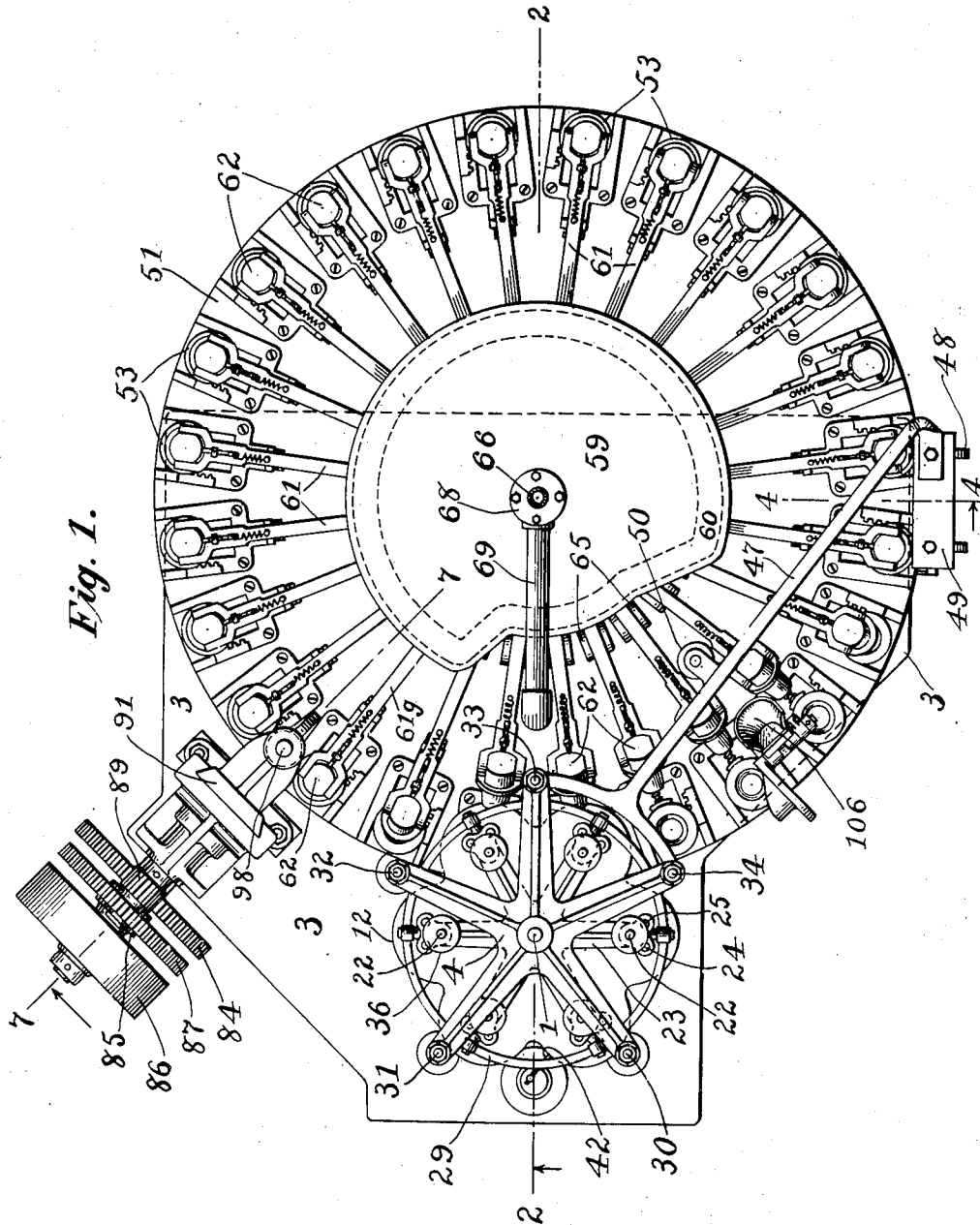
PAPER CUP MACHINE.

APPLICATION FILED JAN. 9, 1912.

1,047,173.

Patented Dec. 17, 1912.

7 SHEETS—SHEET 1.



WITNESSES:

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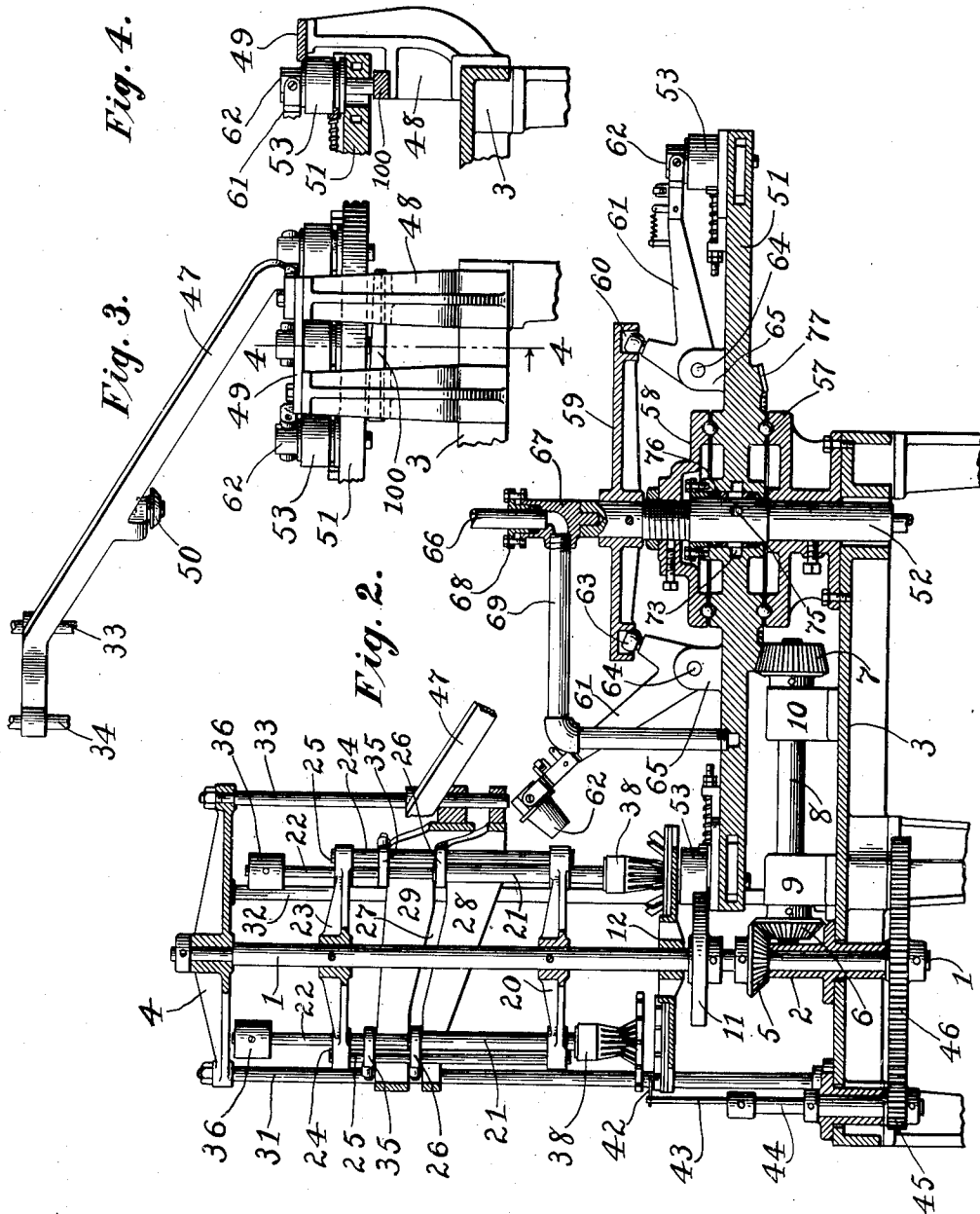
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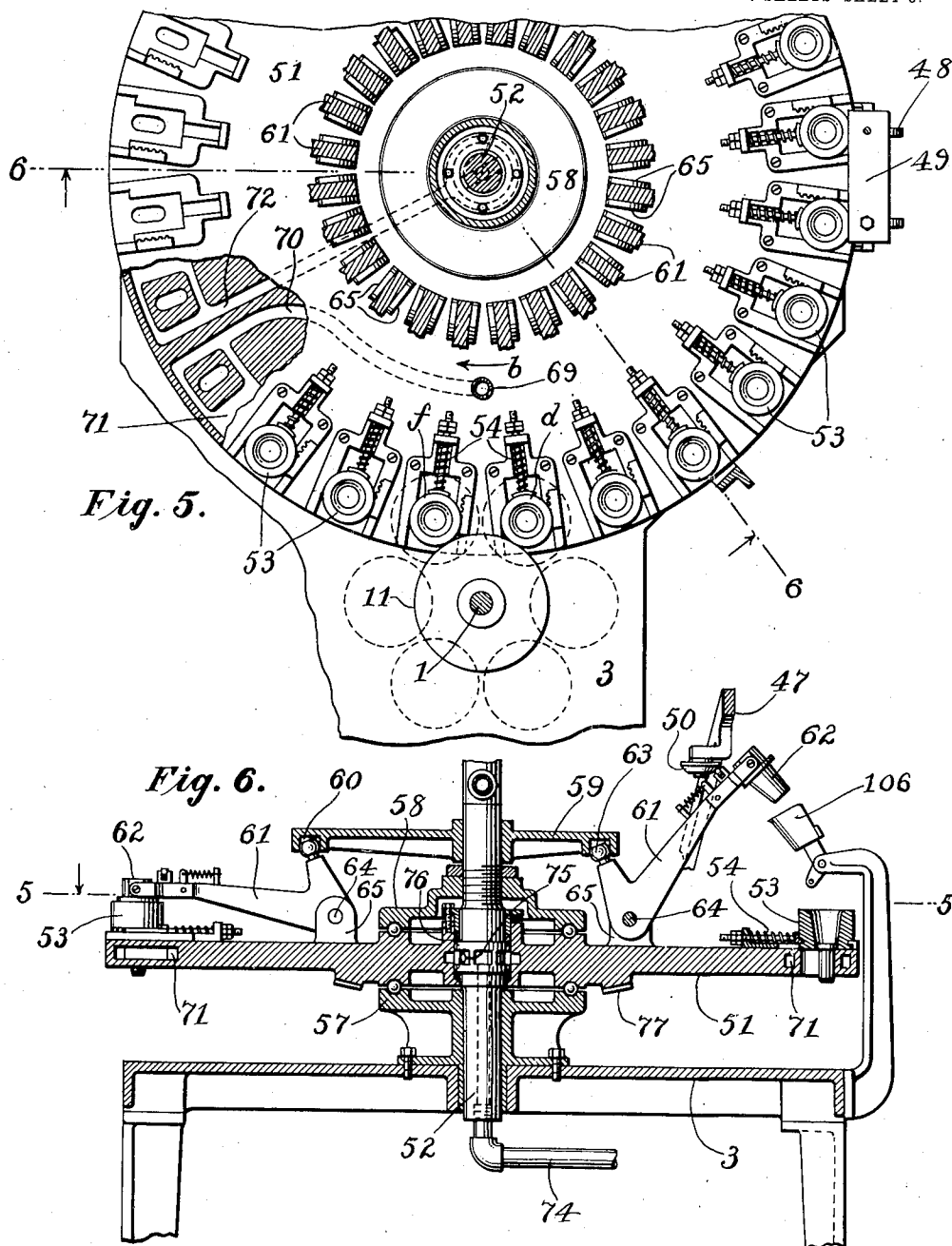
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7 SHEETS—SHEET 4.

Fig. 9.

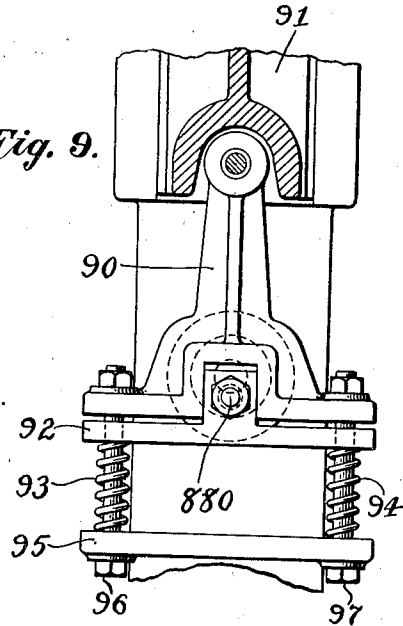


Fig. 7.

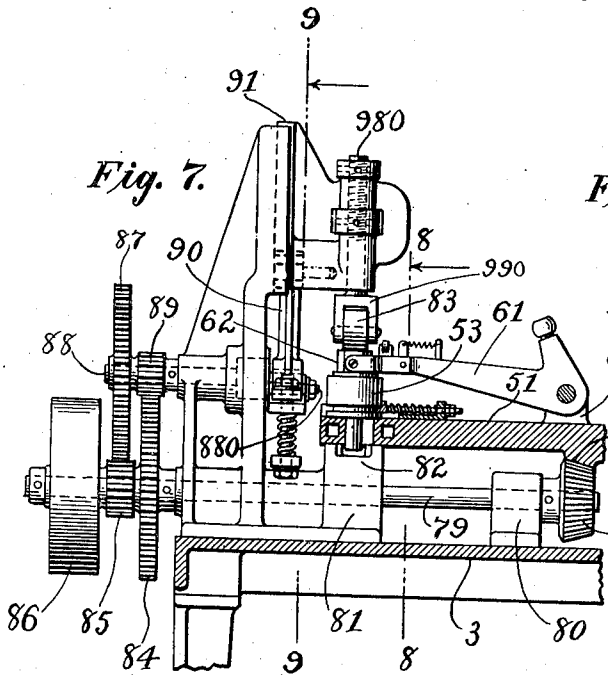
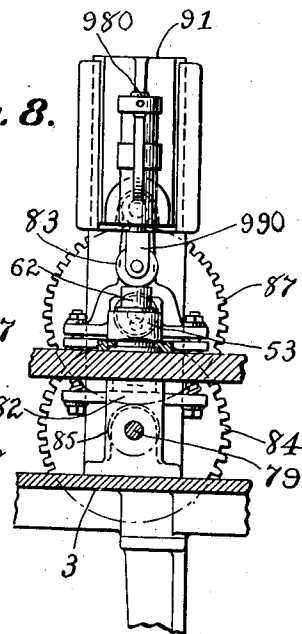


Fig. 8.



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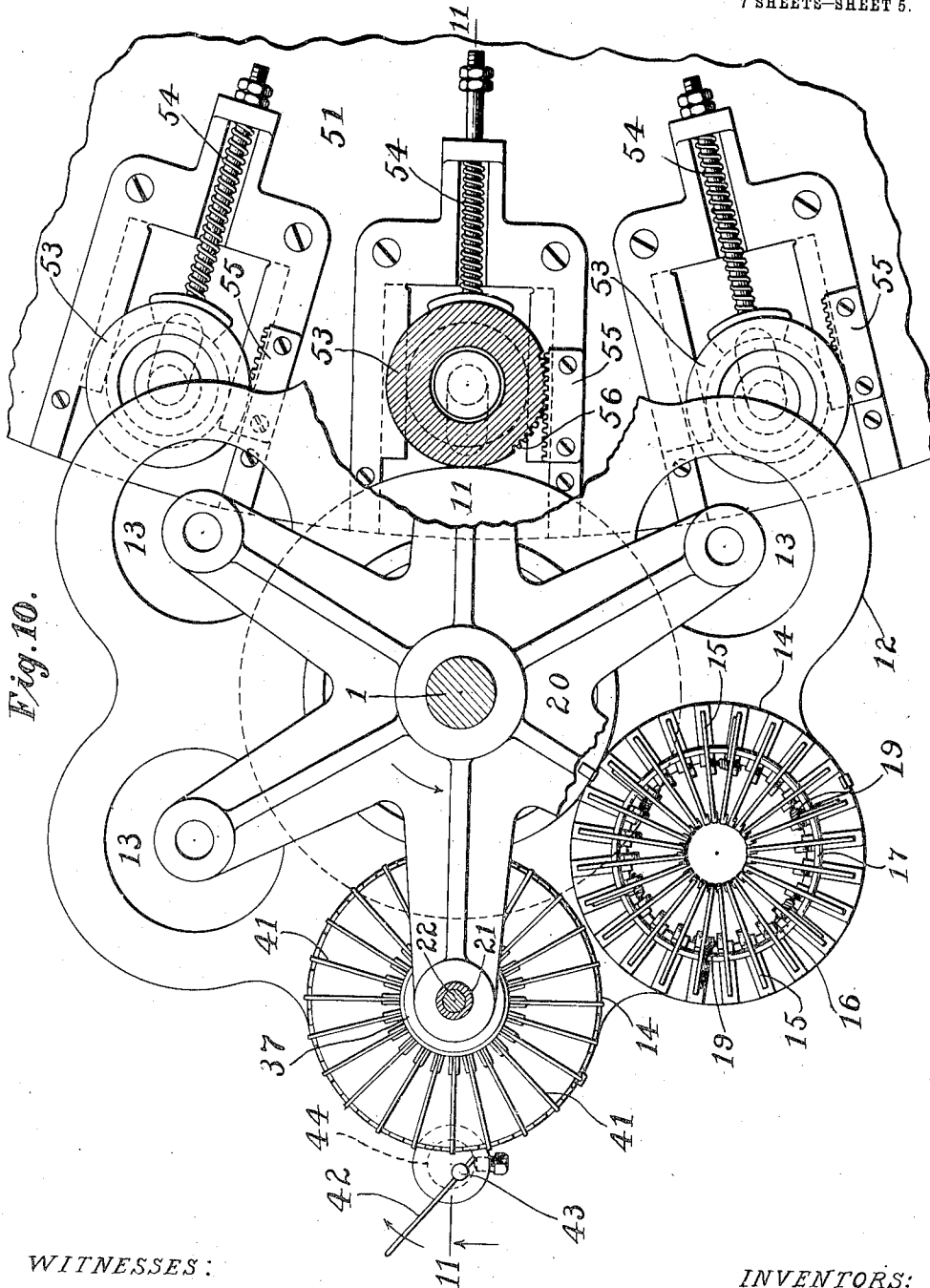
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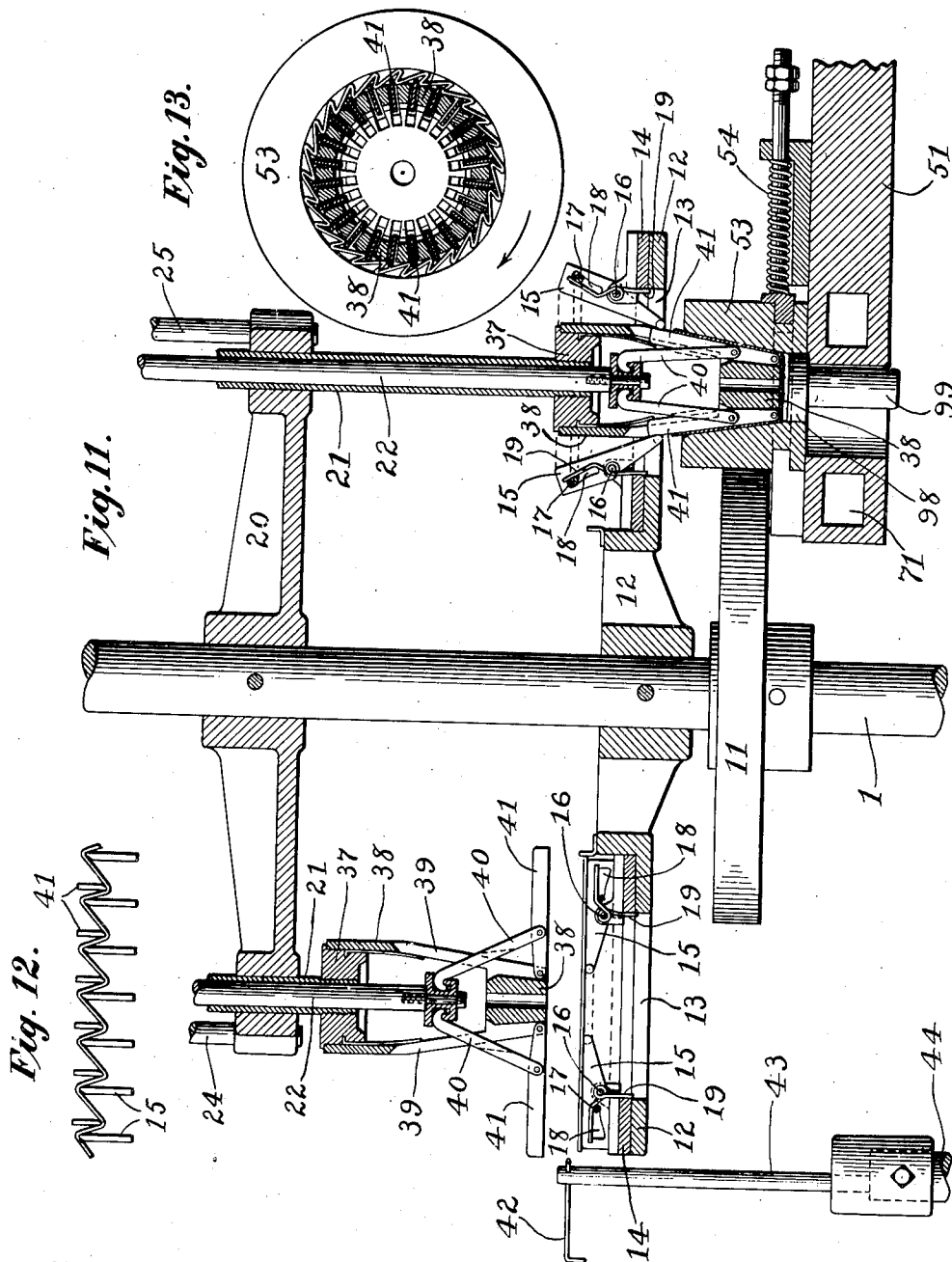
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7 SHEETS—SHEET 6.

1,047,173.



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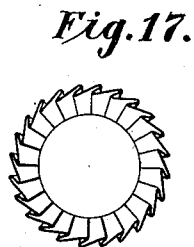
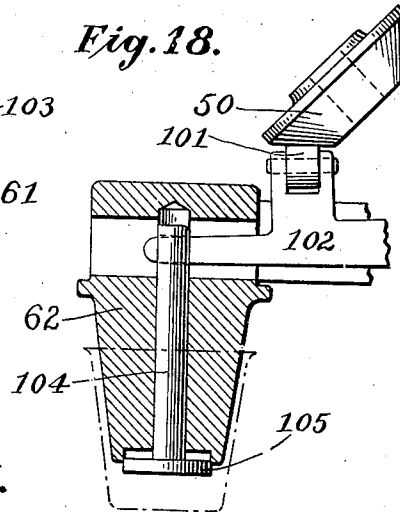
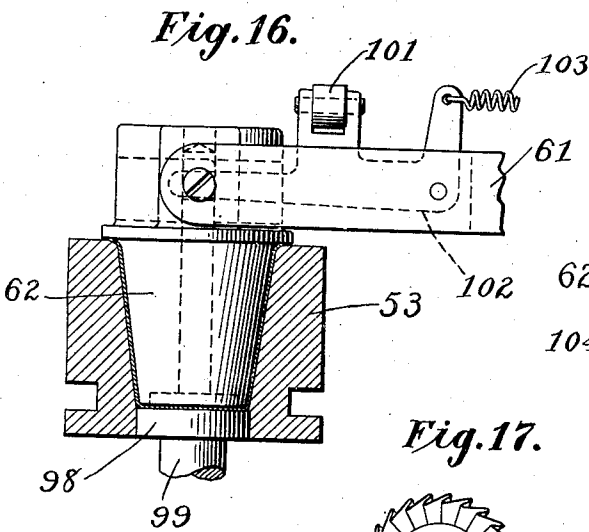
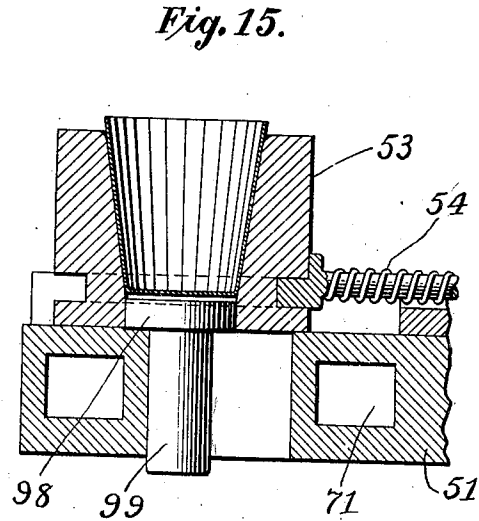
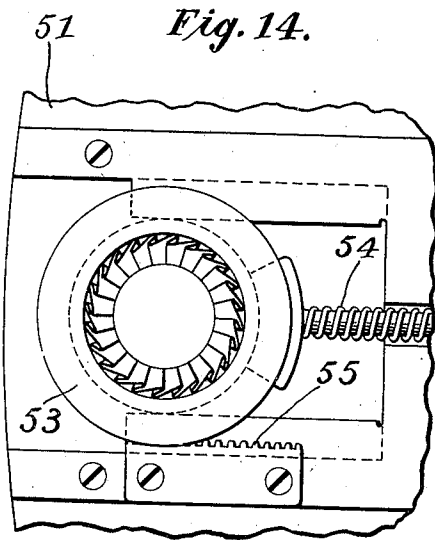
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7 SHEETS—SHEET 7.



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UNITED STATES PATENT OFFICE.

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PAPER-CUP MACHINE.

1,047,173.

Specification of Letters Patent.

Patented Dec. 17, 1912.

Application filed January 9, 1912. Serial No. 670,170.

To all whom it may concern:

Be it known that we, EDWARD E. CLAUSSEN and EMIL A. CLAUS, citizens of the United States, and residents of Hartford, Connecticut, have invented a certain new and useful Paper-Cup Machine, of which the following description and claims constitute the specification, and which is illustrated by the accompanying seven sheets of drawings.

This is an automatic machine, which is adapted to receive a succession of round flat paper disks, and to manufacture them into an equal number of paper cups.

The machine comprises two divisions. The first division receives a succession of round flat paper disks, and successively folds them into the general contour of a cup, having a flat bottom and plaited sides, but with its plaits not yet folded together to constitute a continuous circular wall. The second division folds each product of the first division completely together into a paper cup, having its final form and contour.

Figure 1 of the drawings is a general plan view of our machine; its first division being at the left, and the second at the right. Fig. 2 is a sectional elevation of the machine on the line 2, 2 of Fig. 1. Fig. 3 is a partial front elevation, showing a portion of what is absent from Fig. 2. Fig. 4 is a fragmentary vertical section on line 4, 4 of Figs. 1 and 3. Fig. 5 is a fragmentary plan view, partly in horizontal section, on the line 5, 5 of Fig. 6. Fig. 6 is a sectional elevation on the line 6, 6 of Fig. 5. Fig. 7 is an elevation, partly in section, on the line 7, 7 of Fig. 1. Fig. 8 is an elevation, with some parts absent, on the line 8, 8 of Fig. 7. Fig. 9 is an enlarged elevation, with upper and lower portions broken away, on the line 9, 9 of Fig. 7. Fig. 10 is a plan view of some of the parts of the first division of the machine, and of some of the parts of the second division of the machine, which view indicates the relations of those divisions to each other. Fig. 11 is a vertical section on the line 11, 11 of Fig. 10. Fig. 12 is a diagrammatic sketch which illustrates the mutual operation upon the paper, of a few of the parts of the inside plaiting mechanisms and the opposite parts of the outside plaiting mechanisms, which belong to the first

division of the machine. Fig. 13 is a horizontal section of one of the six inside plaiting mechanisms of the first division of the machine, when that plaiting mechanism is inside of a plaited paper cup-shaped form, and when that form is being completed by that plaiting mechanism, jointly with one of the twenty-four dies which belong to the second division of the machine. Fig. 14 is a horizontal plan view of one of those dies, showing the completed cup-shaped form within it. Fig. 15 is a central vertical section of what is shown in Fig. 14. Fig. 16 is a central vertical section of one of the twenty-four dies, with that die occupied by one of the twenty-four plugs of the second division of the machine, which plugs cooperate with the twenty-four dies respectively, and one of which dies is shown in Fig. 16, with a completely plaited paper cup shown within the die and around the plug. Fig. 17 is a view looking downward into the interior of the plaited paper cup, which is shown in section in Fig. 16, but the plaited sides of that cup are shown in Fig. 17 as having the plaits slightly open, instead of being pressed together as they are in Fig. 16. Fig. 18 is a central vertical section of the plug of Fig. 16, including a movable rod in the axis of the plug.

We will first describe the first division of the machine, the parts of which are shown around their central vertical shaft 1 in Figs. 1 and 2, and the details of the most important parts of which are shown in Figs. 10, 11 and 12.

The vertical shaft 1 is journaled in the long bearing 2, which occupies an opening in the bed 3, and is supported by its central annular flange, which rests upon that bed around that opening. The upper end of the shaft 1 is journaled in a vertical bearing in the center of the pentagonal bracket 4. Keyed to the shaft 1 at different levels, are five parts which turn with it. The lower one of those parts is the bevel gear 5, through which the shaft 1 is rotated from a revolving part of the second division of the machine through the bevel gears 6 and 7, both of which are keyed to the shaft 8, and which shaft turns in horizontal bearings in the upright brackets 9 and 10. Next above the bevel gear 5, on the shaft 1, is the disk

11, which does not participate with any other part of the first division of the machine, but operates upon some parts of the second division, in a way hereafter explained.

Next above the disk 11 upon the shaft 1, is the hexagonal carrier 12, and the outer portion of each of the six radial segments thereof is provided with a large circular vertical opening 13. The annular border of each of those vertical openings carries a ring 14. Each of those rings carries twenty-four plaiting levers 15, all of which turn upon twenty-four annularly arranged fulcrums 16, respectively, and are all carried and held in their horizontal positions by the annular wire 17, which occupies the slot 18 in the outer arm of each lever, and which wire is normally pulled and held downward by a series of springs 19, arranged around it at intervals. Each of the levers 15 has its inner end laterally extended and rounded as shown in Fig. 10, and the upper edge of each of those levers is beveled on the same side which has that lateral extension.

Next above the hexagonal carrier 12 on the shaft 1, is the hexagonal spider 20, each of the six lateral arms of which has a vertical bearing, in which a vertical sleeve 21 reciprocates to the extent shown in Fig. 11, while a vertical rod 22 reciprocates within that sleeve, to the extent shown in the same figure. The hexagonal spider 23 is keyed to the shaft 1, above the hexagonal spider 20, and each of the six arms of the spider 23 is connected with one of the arms of the spider 20, by two vertical guide rods 24 and 25, and one of the rods 22 reciprocates through a vertical bearing in each of the arms of the spider 23.

An arm 26 is fixed to the upper end of each sleeve 21, and extends laterally therefrom into the cam groove 27, which constitutes the space between the ring 28 and the ring 29, both of which rings are immovably supported by the five vertical posts 30, 31, 32, 33 and 34. And each of the arms 26 is provided at its outer end with a roller to run in the cam groove 27. An arm 35 is fixed to the body part of each of the rods 22, and extends outwardly therefrom far enough for the roller at its end to run around the upper cam-edge of the ring 29. Each of the arms 35 with the roller at its outer end, is held down in contact with that cam-edge, by a weight 36. Each arm 26 is guided by a pair of guide rods 24 and 25 in vertical movements which those arms receive from the cam groove 27. And each arm 35 is likewise guided by the same set of rods, in the vertical movements which those arms receive from the upper cam-edge of the ring 29.

Each of the six sleeves 21 has its lower end encircled by a ring 37, which is fixed to the sleeve; and that ring is encircled by the

upper border of the cup shaped mandrel 38. The wall of that mandrel has twenty-four equally spaced longitudinal slots 39, through each of which a sheet steel link 40 extends, from its connection with the lower end of the rod 22. The lower ends of those links are respectively pivoted to twenty-four sheet steel followers 41, the inner ends of which are pivoted in the lower ends of the slots 39, respectively, and the bodies of which alternately retreat into those slots, and advance out of those slots as shown in Fig. 11.

The finger 42 is located as shown in Fig. 2, and operates to insure accuracy of deposit of successive paper disks between the upper and the lower plaiting mechanisms, when opposite sets of those mechanisms occupy the positions shown at the left of Fig. 2. That finger performs that function by means of its outer and downwardly extending end, because its other end is fixed to the rod 43, the lower end of which is eccentrically fixed to the upper end of the vertical shaft 44; and because that shaft rotates six times while the shaft 1 is rotating once, those two shafts being connected in operation by the pinion 45 and the gear 46, which are keyed to the lower ends of those shafts, respectively.

Some blank feeding mechanism, not shown in the drawings is employed to successively deliver round paper disks between the upper plaiting mechanism and the lower plaiting mechanism with the center of each paper disk, located as nearly as possible, exactly under the axis of the rod 22. But inasmuch as such a deposit of a paper disk may fortuitously deviate somewhat from accuracy, such a deviation when it occurs, is corrected by the downwardly extending outer end of the finger 42, striking the edge of a misplaced disk and pushing the disk bodily into its proper location, two or more other points of the boundary of which are provided with fixed vertical stops, to assist the finger 42 to perform its adjusting function.

The five vertical posts 30, 31, 32, 33 and 34, not only support the rings 28 and 29, but they also support the pentagonal bracket 4, the outer ends of the five arms of which are rigidly fixed to the upper ends of those five vertical posts. Three of those vertical posts, namely, 30, 31 and 32, have their lower ends rigidly fixed to the bed 3 of the machine. But the posts 33 and 34 do not extend downward to that foundation and are therefore supported by the flying buttress 47, which extends upward and diagonally to the left, as shown in Figs. 1, 2 and 3, from its foot, where it is bolted to the top of the bracket 48, through the plate 49, and which bracket extends upward from the bed 3. The flying buttress 47 is bifurcated at its upper end so that one fork supports each

of the posts 33 and 34; and that buttress also carries the roller 50, for operation on some of the parts of the second division of the machine.

5 The mode of operation of the first division of the machine is as follows: Looking first at Fig. 1, it is to be understood that the carrier 20, and all the other parts which are carried by the shaft 1, are revolving continuously in an anti-clockwise direction. Looking next at Figs. 2 and 11, it is to be assumed that a round paper disk has been deposited upon that set of lower plaiting levers 15, which are under the uplifted upper plaiting mechanism at that time. Thereupon that upper plaiting mechanism descends toward and into that lower plaiting mechanism, as indicated at the right of the shaft 1, in Fig. 2, and also in Fig. 11. At the beginning of this joint operation of that upper and lower mechanism, the paper disk is bent into a shallow saucer-like form; and as the operation proceeds, that saucer-like form is gradually changed to a plaited cup-shaped form. During the downward movement of the mandrel 38, the followers 41 hold the rising and inwardly moving sides of the paper blank against the ends of the levers 15, while gradually re- treating toward the mandrel 38, as they perform that holding function. The result of this resistance to the action of the levers 15, is to enable and cause those levers to plait and collapse the sides of the paper blank into uniform narrow plaits, instead of producing an irregularly crumpled and useless cup-like form, as they would do if the middle portion of the paper disk were pressed down through the circle which is composed by the levers 15, by a round tapering plug, having the size of a desired paper cup. This operation of transforming a paper disk into a plaited cup-shaped form, occurs while the transforming mechanism is turning with the shaft 1, half of a revolution in the anti-clockwise direction, to a position between the bifurcated ends of the flying buttress 47. At that point the mandrel 38 has descended so far that the levers 15 have been left above the upper edge of the plaited cup-shaped form. Thus that paper form is carried by the mandrel 38 into that one of twenty-four dies of the second division of the machine, which at that time is directly under that mandrel.

Looking again at Fig. 1, it is to be understood that the great revolving disk 51 of that figure, is turning in the clockwise direction once, while the hexagonal carrier 12, and the other revolving parts of the first division of the machine, are rotating four times in the anti-clockwise direction. Now inasmuch as the mandrel 38 of the first division of the machine is rotating with its shaft 1, while that die 53 of the second division of

the machine, which is cooperating with it, is rotating around the fixed shaft 52, it is necessary to give to that die 53 an inward radial motion relative to the shaft 52, of such an extent in distance and such a duration in time, as to cause that die 53 to move for a while, concentric with the shaft 1, instead of moving concentric with the shaft 52, as it generally does. This temporary change of arc of motion of each of the dies 53, enables it to move for a while, directly under one of the mandrels 38, of the first division of the machine, during which time that mandrel has time enough to cooperate with the die 53 below it, and also to rise out of the place in that die which it occupies at the right side of Fig. 11; before the continued revolutions of the hexagonal carrier 20 of the first division of the machine, and the great disk 51 of the second division of the machine, must operate to carry the mandrel 38 and the die 53 below it, out of vertical alinement. This inward radial motion of the twenty-four die 53, in regular succession to each other, is accomplished by the periphery of the circular disk 11, on the shaft 1, forcing the dies 53, successively and radially toward the shaft 52, as those dies are turned successively past that disk. This inward motion of the dies 53 is provided for, as shown in Figs. 5 and 6, by placing those dies in radial slots, or above radial slots, in the border of the great disk 51, and by interposing springs 54 in proper seats between those dies and the shaft 52, to perform the function of forcing those dies outward to their customary positions, except when and as they are forced inward by the disk 11, when they are being carried past that disk. In Fig. 5, the dies 53, are shown in their outer and customary positions, but that one of them which is specially designated by the letter *d*, is just reaching contact with the periphery of the disk 11, while that one of them which is specially designated as *f*, is just passing out of contact with the disk 11, as the great disk 51, is revolving in a clockwise direction indicated by the arrow *b*, and the disk 11 with all the other parts of the first division of the machine, are revolving in the anti-clockwise direction around the shaft 1.

The inward radial motion of each die 53, is accompanied by a motion of turning on its center, which turning motion is produced by the fixed rack 55, meshing with corresponding gear-teeth 56, cut in a segment of the periphery of the die, as shown in Fig. 10. The function of this turning motion is to positively determine the direction of final folding of the plaits of the paper cup, when that folding is completed in the die. The mode of operation by which this function is performed, is illustrated in Fig. 13, and will be understood by recog-

nizing the fact that the die 53, of that figure, is turning a few degrees in the clockwise direction, while the circle of followers 41, are not turning on their common center; and the fact that the turning of the die carries the outer bends in the cup-shaped form positively in the same direction, by reason of friction between the inner side of the walls of the die and those outer bends. After each mandrel 38 has thus completed a plaited cup-shaped form, in a die 53, and has withdrawn therefrom, that mandrel continues to turn with the shaft 1, in the anticlockwise direction, until it reaches again the point for receiving another paper disk below it; and during that part of its revolution, the mandrel 38 and its levers and links, rise from a position shown at the right of Fig. 11, to that shown at the left of that figure, and that rising opens out the links 40, and the followers 41, to their upper positions.

The operation of the working parts of the first division of the machine, upon the six paper disks therein, is not simultaneous in respect of the separate parts of that operation; nor is it successive in the sense that it would be if the operation upon each disk were completed before the operation on the next disk was begun. The six operations upon the six paper disks are begun successively, but there are several such successive beginnings before the operation upon the first disk is completed; and several disks are being operated upon at the same time, though no two disks have at the same moment, the same extent of advancement of transformation.

The foregoing explanation of the mode of operation of the first division of the machine, shows how each of the six plaiting mechanisms of that division receives a paper disk on one side of the shaft 1, and while carrying that disk in the anti-clockwise direction, halfway around that shaft, transforms it into a plaited paper cup-shaped form, and completes that form, in coöperation with one of the dies 53, of the second division of the machine.

We will now describe the second division of the machine, the parts of which are shown around their central vertical shaft 52, in Figs. 1 and 2, and the details of the most important parts of which are shown in Figs. 5, 6, 7, 8, 9 and 10, and one of the twenty-four dies in which is shown at the right of Fig. 11, and in Figs. 14 and 15, while one of the twenty-four plugs of which is shown in one of those dies in Fig. 16, and is separately shown in Fig. 18.

The great carrier disk 51, revolves continuously around the central shaft 52, in anti-friction ball bearings between the top of the block 57, and the bottom of the flanged disk 58, which block and which disk are both

stationary, as also is the shaft 52, which passes vertically through them both. The cam disk 59 is also keyed to the shaft 52, above the flanged disk 58, and the lower outer border of that cam disk has a cam groove 60, the function of which is to oscillate the twenty-four levers 61, each of which carries a plug 62 at its outer end, and is oscillated through its roller 63 running in the cam groove 60 upon its pivot 64, which pivot passes horizontally between the two wings of an upright standard 65. Twenty-four of those standards are shown in Fig. 5, fixed upon the upper side of the great disk 51, around the shaft 52, at equal distances from each other and from that shaft. The outer border of the great disk 51, carries twenty-four dies 53, one of which is shown in side elevation at the left hand side of Fig. 6, and the diametrically opposite one of which is shown in central vertical section, near the right hand side of that figure. The first of these two dies is shown in that figure as occupied by its plug 62, while the plug 62, which works with the die near the right hand side of Fig. 6, is there occupying its most elevated position, which is far above its die 53.

A steam heating apparatus is in the second division of the machine for the purpose of keeping the dies 53 hot enough to enable the plugs 62 to press the plaited cups into their final forms and so firmly, that the plaits in the walls of the cups will not spring apart while they are being transferred from this machine, to a paraffining machine, where they are completed with a coat of paraffin. That steam heating apparatus comprises the inlet pipe 66, which connects with the rotating pipe-union 67 through the stuffing-box 68. The incoming steam passes from that pipe through that steam union to the pipe 69, and thence downward into the channel 70, in the interior of the great disk 51. The location of this channel is shown in Fig. 5, and is there shown to connect with the steam passage 71, which steam passage runs around the interior of the border of the great disk 51, until near the place of its beginning, where it terminates in the steam channel 72, which steam channel extends radially inward to a connection with the circular steam channel 73 in the interior of the great disk 51, and around a central enlargement of the shaft 52. An outlet steam pipe extends upward in the axis of the shaft 52, far enough from its lower end to make a steam tight connection with a longitudinal hole, which extends upward in the axis of that shaft as far as the above mentioned enlargement thereof, where it connects through a series of openings 75, with the said annular steam channel 73. To stop the escape of steam upward or downward, as it passes from the annular channel 73 through

the openings 75 into the interior of the shaft 52, a proper stuffing box 76 is used, as indicated in Figs. 2 and 6.

The great disk 51 is continuously rotated in the clockwise direction when seen from above as in Fig. 1. That rotation results from the meshing of the annular beveled gear 77, which extends downward from its underside, with the beveled gear 78, as indicated in Fig. 7. That gear is keyed to the inner end of the shaft 79, which shaft turns in bearings in the standards 80 and 81, which project upward from the bed 3 of the machine, in such a position as that the anvil 82, which is an upward extension of the standard 81, is directly under the roller 83, as it is shown to be in Fig. 7. The shaft 79 also extends radially outward beyond the standard 81, and has the gear 84 keyed thereto. The pinion 85, and the pulley 86, are integral, and turn loosely on the shaft 79. That pulley is rotated by means of a belt connected with some motor outside of the machine, and its rotation causes all the motions which automatically occur in the machine. For the pinion 85, rotates the gear 87, which is keyed to the shaft 88; and the pinion 89, being also keyed to that shaft, rotates the gear 84, the shaft 79, and the gears 78, 77, 7, 6 and 5 in that order.

The shaft 88 carries the crank 880 at its inner end, and that crank works the connecting rod 90, and thus reciprocates the slide 91. But the connection between the crank 880 and the connecting rod 90, instead of being a rigid one, is a spring connection, made through the block 92, the springs 93 and 94, the block 95 and the bolts 96 and 97. The rigid vertical rod 980 is adjustably fixed in the slide 91, and its lower end comprises the yoke 990, between the forks of which the roller 83 turns upon a horizontal axis.

The mode of operation of this second division of the machine is as follows: Looking at Fig. 1, it is to be understood that the great disk 51 is revolving around its shaft in the clockwise direction, and that that lever 61, which is marked 61^a, carries a plug 62, which has just been lowered into the interior of a paper cup, which shortly before was inserted from the first division of the machine into that die 53, which is immediately below that plug 62; and it is also to be understood that each of the fifteen dies 53 which are ahead of the last mentioned die, in a clockwise direction around the great disk 51, is carrying a paper cup, with a plug 62 in the inside of that cup. Each of those fifteen plugs has been powerfully pressed downward into its die by the roller 83, as those fifteen plugs passed successively under that roller, as indicated in Fig. 7. And the next plug in the rear of those fifteen plugs

is about to be pressed down into its die, and will be so pressed as soon as the great disk 51 turns seven and a half degrees forward in the clockwise direction from the position shown in Fig. 1. While each die 53 with its plug 62, is turning forward from under the roller 83, as far as the fifteenth place in advance of that roller in the clockwise direction in Fig. 1, that plug 62 is being held by the cam plate 59, in the seat to which it was firmly pressed by the roller 83; and during that holding the heat of the steam in the steam passage 71, is being conducted through the walls of the die 53, to the paper cup, so that by the time the die 53 and its plug has reached the fifteenth place in advance of the roller 83, the paper cup therein has had its plaits firmly folded and almost felted together. Thereupon the cam groove 60, by means of an inward turn, which is shown adjacent to that numeral in Fig. 1, operates to lift the plug 62 out from its die 53. To cause the rising plug to carry the paper cup along with it, instead of leaving the cup in the die, it is necessary to loosen the outside of the paper cup from the walls of the die, without loosening the inside of the paper cup from the periphery of the plug. This result is accomplished by means of the movable bottom 98 of the die, which is forced upward by its stem 99, when the lower end of that stem is pressed upward flush with the lower border of the great disk 51 by the inclined plane 100, which projects inward from the bracket 48, and which bracket is appurtenant to the bed 3, as shown in Figs. 3 and 4. As this upward movement of the bottom 98 occurs shortly before the withdrawal of the plug 62 from the die 53, it operates to cancel the adhesion which would otherwise exist between the outside of the wall of the paper cup and the inside of the die 53, while not affecting the adhesion between the inside of the wall of the paper cup and the periphery of the plug 62. Therefore the plug lifts the paper cup with itself to the position shown in Fig. 6. At that place, the roller 101 on the arm 102, reaches contact with the bevel roller 50 on the underside of the buttress 47, which contact forces the arm 102, against the resistance of the spring 103, and that arm forces the rod 104 down lengthwise in its seat in the interior of the plug 62. That downward movement of the rod 104 causes its foot 105 to loosen the paper cup from the periphery of the plug, whereupon that cup falls into the rocking holder 106, which is a part of a proper paraffining machine, which machine will be the subject of another application of ours for another patent. Each plug 62, having delivered its paper cup to the rocking holder 106, that plug remains lifted to permit the deposit from the first division of the machine, of another

plaited paper blank in its die 53. After its die 53 has passed from under the revolving mechanism of the first division of the machine, toward the location of the roller 83, the plug 62 which works with that die, is carried down into it by a proper turn in the cam groove 60, and is afterward pressed down into that die by the roller 83. This cycle of operations is repeated by each of the twenty-four plugs 62, with their respective dies 53, during each revolution of the great disk 51; and the separate phases of each cycle of operation follow each other in the same order in each of the twenty-four instances.

Our preferred mechanism for folding one round flat paper disk into one plaited cup-shaped form, is illustrated in Figs. 11, 12 and 13. But other forms of mechanisms to perform that function, may be made in conformity with the principle of that mechanism; and therefore we do not confine our claims relevant to that subject to the particular form of mechanism which is shown in those figures.

Our mechanism for completing and compacting together the plaits of such a cup-shaped form of paper as that shown in Fig. 17, and for discharging the completed and compacted cup therefrom, is shown in Figs. 14, 15, 16 and 18. In so far as that mechanism has the form of a die and a plug, it is not new, but in so far as that die is made to turn on its own axis, and in so far as it has an upwardly movable bottom, cooperating with the plug to loosen the paper cup from the die, and in so far as the plug has a downwardly moving bottom to loosen the cup from its sides, it is believed to be new; and we do not confine our claims relevant thereto, to any particular means for rotating the die on its own axis, or for moving the bottom of the die, or for moving the bottom of the plug, relative to the die and the plug, respectively.

We claim as our joint invention:

1. The following parts in combination: a sleeve 21; a cam to reciprocate that sleeve; intermediate mechanism between that sleeve and that cam; a rod 22, within the sleeve; a cam to reciprocate that rod; intermediate mechanism between that rod and that cam; a mandrel 38, having a series of annularly arranged and longitudinally extending slots; a series of followers 41, pivoted in those slots; and a series of links 40, having their outer ends pivoted to those followers; the combination being so organized that the relative reciprocations of the rod and sleeve, cause the followers, without assistance from any other source, to alternately retreat into the slots and advance therefrom.

2. The following parts in combination: a sleeve 21; a cam to reciprocate that sleeve; intermediate mechanism between that sleeve

and that cam; a rod 22 within the sleeve; a cam to reciprocate that rod; intermediate mechanism between that rod and that cam; a hollow mandrel 38, carried by the sleeve, and having a series of annularly arranged and longitudinally extending slots; and a series of followers 41, pivoted in those slots; a series of links 40, carried by the rod and extending through those slots, and having their outer ends pivoted to those followers; the combination being so organized that the relative reciprocations of the rod and sleeve cause the followers, without assistance from any other source, to alternately retreat into the slots and advance therefrom.

3. The following parts in combination: a series of annularly arranged and radially extending levers, of the first order, the circular space between the inner ends of which is bottomless, and the fulcrums of which are annularly arranged at equal distances from those ends, and the outer arms of which have annularly arranged slots, at equal distances from those fulcrums; an annular wire occupying all those slots; and a series of springs, attached to that wire at intervals, which, by means of that wire, gently resist the movements of the levers whenever the levers are forced to so turn on their fulcrums, so as to increase the diameter of the circular space between their ends.

4. The following parts in combination: a sleeve 21, a cam to reciprocate that sleeve; intermediate mechanism between that sleeve and that cam; a rod 22 within the sleeve; a cam to reciprocate that rod; intermediate mechanism between that rod and that cam; a mandrel 38, having a series of annularly arranged and longitudinally extending slots; a series of followers 41, pivoted in those slots; a series of links 40, having their outer ends pivoted to those followers; a series of annularly arranged and radially extending levers 15, the circular space between the inner ends of which is bottomless, and the fulcrums of which are annularly arranged at equal distances from those ends; and a series of springs, which gently resist the movements of the levers whenever the levers are forced to so turn on their fulcrums, as to increase the diameter of the circular space between their ends; the combination being so organized that the followers 41, and the levers 15, cooperate to fold a flat paper disk into a plaited cup-shaped form, and to deliver it through the circular and bottomless space between the inner ends of the levers.

5. The following parts in combination: a sleeve 21; a cam to reciprocate that sleeve; intermediate mechanism between that sleeve and that cam; a rod 22 within the sleeve; a cam to reciprocate that rod; intermediate mechanism between that rod and that cam;

a hollow mandrel 38, carried by the sleeve, and having a series of annularly arranged and longitudinally extending slots; a series of followers 41, pivoted in those slots; a series of links 40, carried by the rod and extending through those slots; and having their outer ends pivoted to those followers; a series of annularly arranged levers 15, of the first order, the circular space between the inner ends of which is bottomless, and the fulcrums of which are annularly arranged at equal distances from those ends, and the outer arms of which have annularly arranged slots at equal distances from those fulcrums; an annular wire occupying all those slots; and a series of springs attached to that wire at intervals, which, by means of that wire, gently resist the movements of the levers whenever the levers are forced to turn on their fulcrums, and thus increase the diameter of the circular space between their ends; the combination being so organized that the followers 41, and the levers 15, cooperate to fold a flat paper disk into a plaited cup-shaped form, and to deliver it through the circular and bottomless space between the inner ends of the levers.

6. The following parts in combination: the shaft 1; the carrier 12, having its center keyed to the shaft 1, and having a multiplicity of outside plaiting mechanisms located around that shaft, at equal distances therefrom and also at equal distances from each other; the spider 20, also keyed to the shaft 1, and having a multiplicity of vertical bearings equal in number to the outside plaiting mechanisms on the carrier 12, with each of those bearings in alinement with one of those plaiting mechanisms; a sleeve 21 reciprocating in each of the vertical bearings of the spider 20; a rod 22, reciprocating in each of the sleeves 21; an inside plaiting mechanism worked by each rod 22, and sleeve 21, jointly, and working harmoniously with one of the outside plaiting mechanisms on the carrier 12; a cam and proper intermediate mechanism working the sleeves 21, successively, in overlapping cycles of reciprocation; a cam and proper intermediate mechanism working the rods 22, successively in overlapping cycles of reciprocation; all the parts of the combination being so organized that each set of plaiting mechanisms receives a flat paper disk on one side of the shaft 1, and thereupon, while that shaft is turning all the plaiting mechanisms around itself as a common axis, that set of plaiting mechanisms folds that disk into a plaited cup-shaped form, and then without stopping, delivers that product thus transformed, on another side of the shaft 1, all the sets of plaiting mechanisms successively receiving flat paper disks on one side of the shaft 1, and successively delivering plaited cup-shaped forms on another side

of that shaft, and continuing to turn without stopping from the delivery side of the shaft to the receiving side of the shaft, and from the receiving side of the shaft to the delivery side of the shaft.

7. The following parts in combination: the revolving carrier 12, having a multiplicity of bottomless outside plaiting mechanisms, located on its border around its axis at equal distances therefrom, and also at equal distances from each other; a multiplicity of inside plaiting mechanisms, to cooperate with the outside plaiting mechanisms in transforming flat paper disks into cup-shaped forms having plaited sides, while those mechanisms are being carried through a segment of a circle by the carrier 12, and in delivering those cup-shaped forms successively downward through the bottomless outside plaiting mechanisms, respectively.

8. The following parts in combination: the shaft 52; the revolving carrier 51, axised on the shaft; a multiplicity of dies 53, located on the carrier, normally at equal distances from the shaft, and also normally at equal distances from each other; the stationary cam 59; a multiplicity of plugs 62, equal in number to the dies 53; and an equal number of levers 61, carrying those plugs; all the parts of the combination being so organized that each die receives a plaited cup-shaped blank on one side of the shaft 52, and thereupon, while all those dies are turning around that shaft as a common axis, one of the plugs 62 is inserted in that die, with a paper blank between them, and operates while the revolution of the carrier 51 continues, to compact that blank into a completed paper cup; all the sets of dies and plugs continuing to turn, without stopping, from the receiving side of the shaft 52, to the delivery side of that shaft, and from its delivery side to its receiving side, and the plugs being withdrawn from the respective dies, at the delivery side of the shaft.

9. The following parts in combination: the revolving disk 51, with a series of dies placed upon its outer border at equal distances from its axis, but adapted to independently move radially toward that axis, when forced in that direction by some extraneous power, and adapted to be moved back again by springs when that power is not exerted; and the disk 11, revolving on an axis parallel to the axis of the disk 51; the parts being so combined that the dies successively pass between the axes of the two disks, while the disks are revolving in opposite directions, and that the disk 11 forces all the dies in the series successively toward the axis of the disk 51.

10. The following parts in combination: a series of dies 53, revolving successively around a common axis, and each of them

having the movable bottom 98 with its stem 99; a series of plugs 62, equal in number to the series of dies, and revolving successively around the same common axis, and each of them having the movable bottom 105 with its stem 104; the inclined plane 100 to force the stems 99 successively upward, to cause a paper cup within the die to which that stem belongs, to go upward with the plug which works with that die, when it is withdrawn therefrom; and the roller 50, to force the stems 104 successively downward, and thus to cause the movable bottom 105 of each plug 62, to dislodge from that plug a paper cup adhering to its sides.

11. The following parts in combination: a series of dies, revolving successively around a common axis at normally equal distances therefrom, but each of which is adapted to reciprocate between its normal position remote from that axis, and an exceptional position nearer to that axis; and a series of plugs adapted to be respectively inserted in those dies when those dies are in their normal positions, and to be absent therefrom when those dies are in their exceptional positions, respectively.

12. The following parts in combination: a series of dies, revolving successively around a common axis at normally equal distances therefrom, but each of which is adapted to reciprocate between its normal position remote from that axis, and an exceptional position nearer to that axis, and also to turn a few degrees on its own axis when it thus re-

ciprocates; and a rack fixed adjacent to the exterior of each of those dies to cause it to thus turn by reason of meshing therewith of gear teeth appurtenant to the exterior of that die.

13. The following parts in combination: a series of dies revolving successively around a common axis, at normally equal distances therefrom; and a series of plugs equal in number to the series of dies and revolving successively around the same common axis; and a reciprocating roller, operating to force those plugs into their respective dies successively, when the plugs and the dies are carried by their joint revolutions successively under that roller.

14. The following parts in combination: a series of levers turning on fulcrums at equal distances from each other, and revolving around a common axis, around which those fulcrums are annularly located at equal distances therefrom; a series of plugs attached to the outer ends of those levers respectively; and a cam adapted to so operate on those levers as to successively lower and raise those plugs; and a series of dies equal in number to the plugs, and adapted to respectively receive those plugs when the plugs are successively lowered into those dies.

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