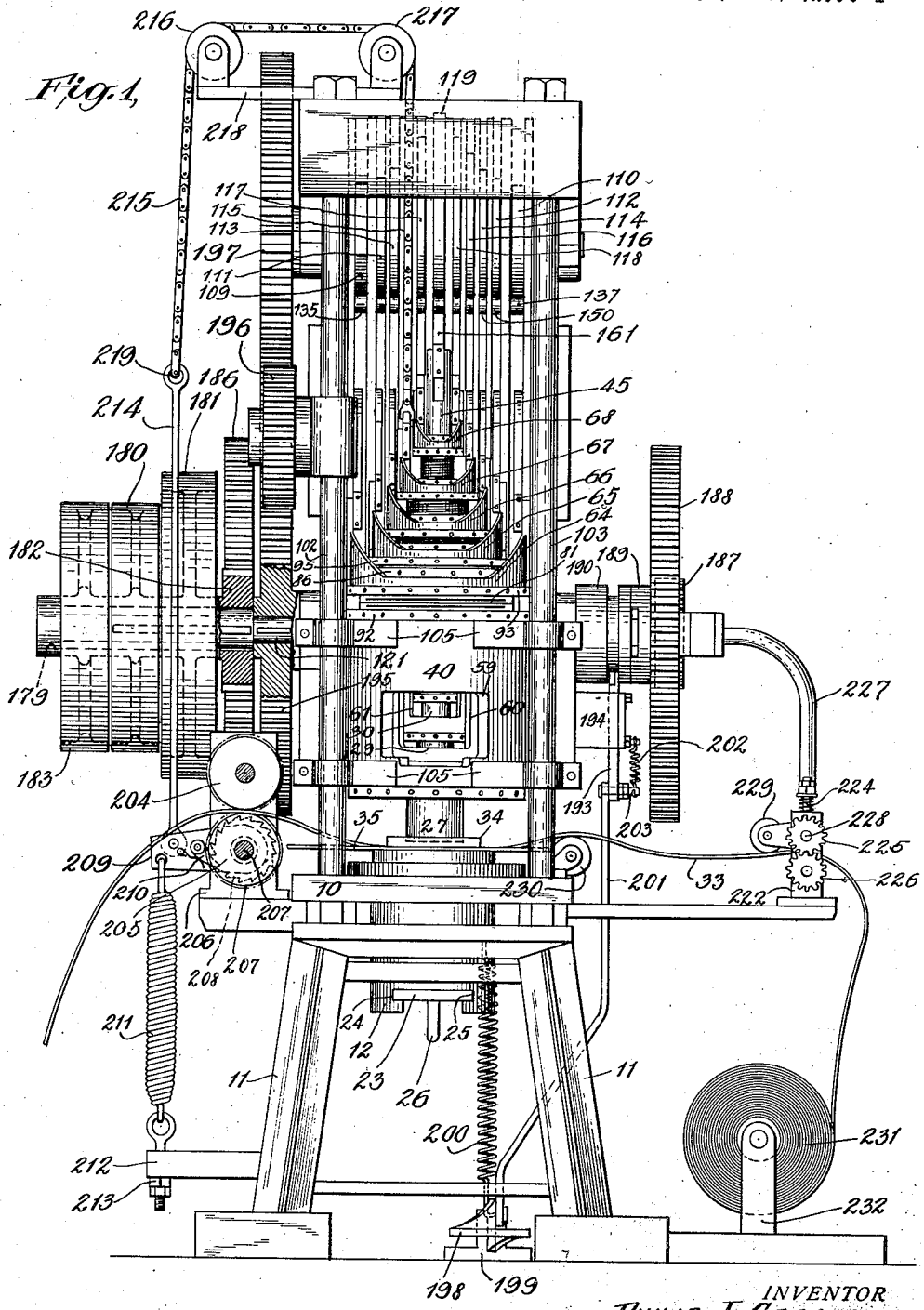
Aug. 4, 1925. 1,548,457

P. J. GREAYER

SHELL DRAWING MACHINE

Filed Oct. 21, 1921 4 Sheets-Sheet 1

Fig. 1.



INVENTOR
PHILIP J. GREAYER
BY
Meyer, Cavanagh, Whitehead & Hyde
ATTORNEYS

Aug. 4, 1925. 1,548,457

P. J. GREAYER

SHELL DRAWING MACHINE

Filed Oct. 21, 1921 4 Sheets-Sheet 2

Fig. 2.

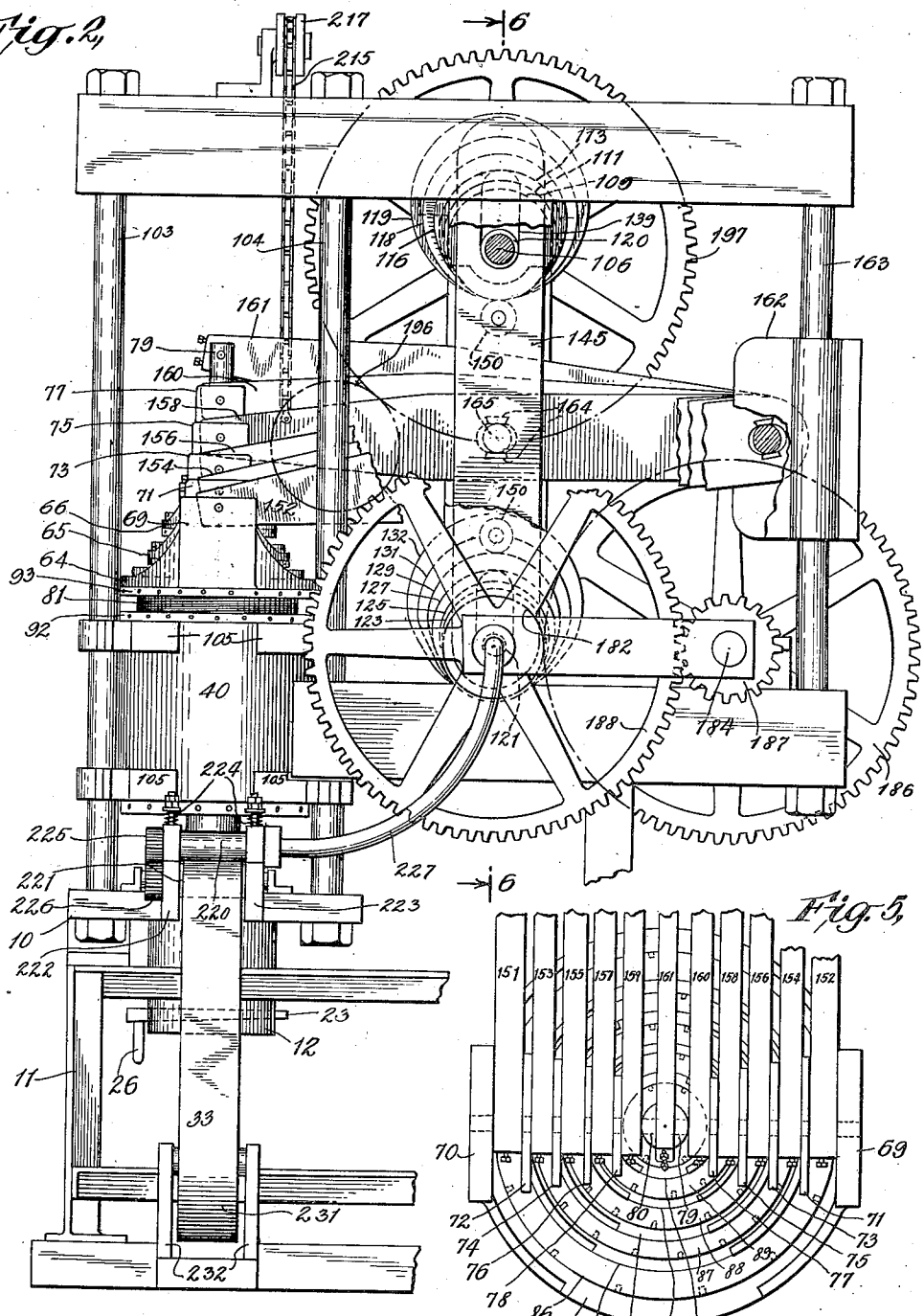


Fig. 5.

INVENTOR
PHILIP J. GREAYER

BY
Meyers, Cavanagh, Whitehead & Hyde
ATTORNEYS.

Aug. 4, 1925. 1,548,457

P. J. GREAYER

SHELL DRAWING MACHINE

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Fig. 4

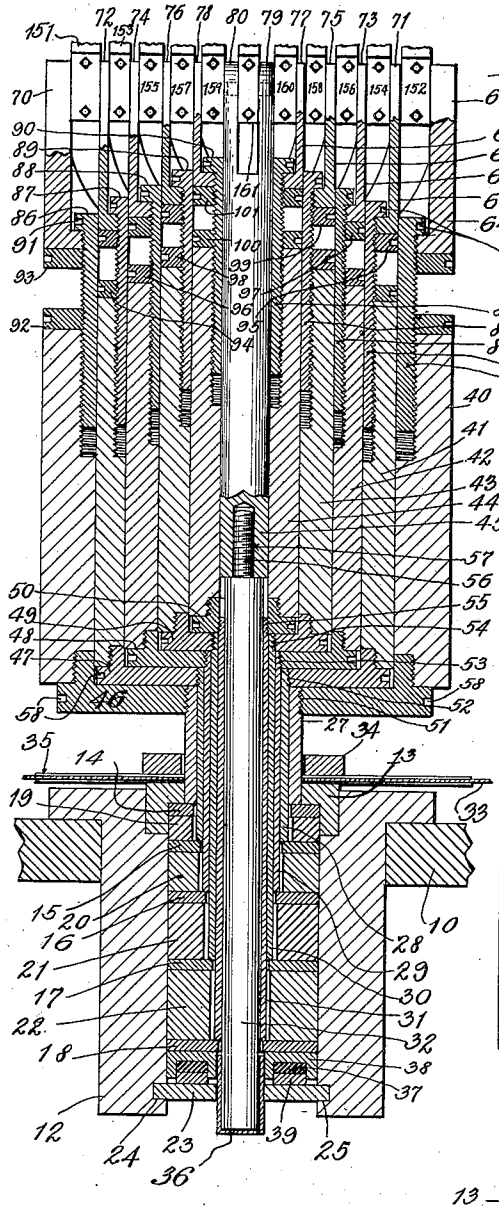
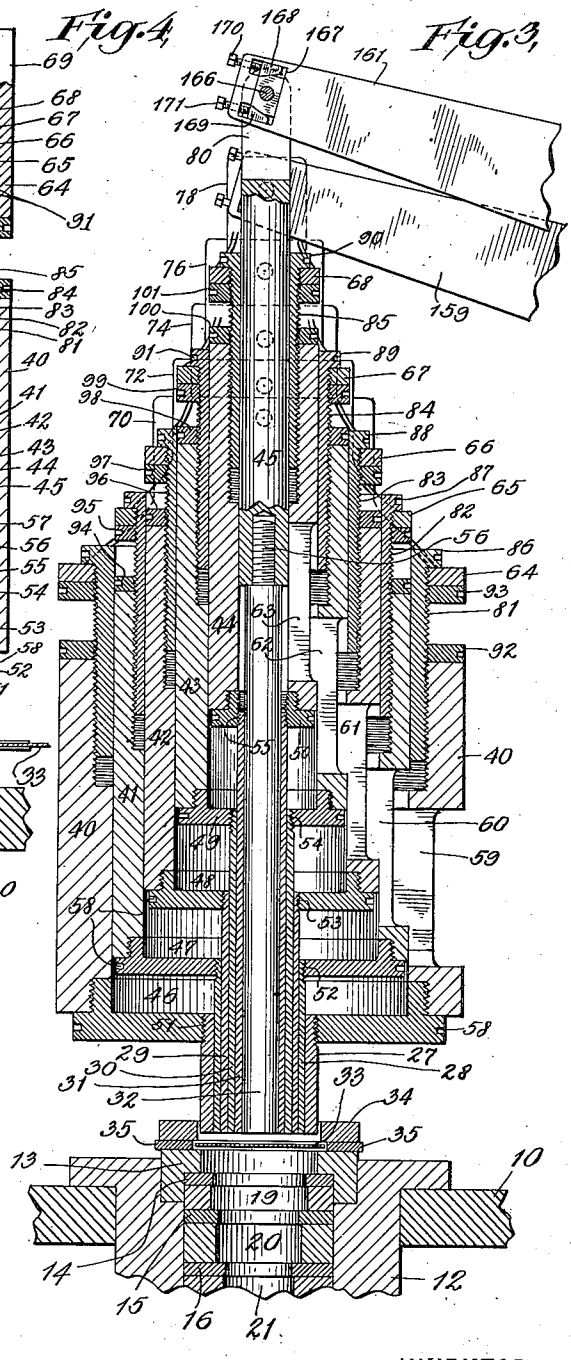


Fig. 3



INVENTOR
PHILIP J. GREAYER
BY
Meyer, Cavanagh, Whitehead & Hyde
ATTORNEYS

Aug. 4, 1925. 1,548,457

P. J. GREAYER

SHELL DRAWING MACHINE

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Fig. 6,

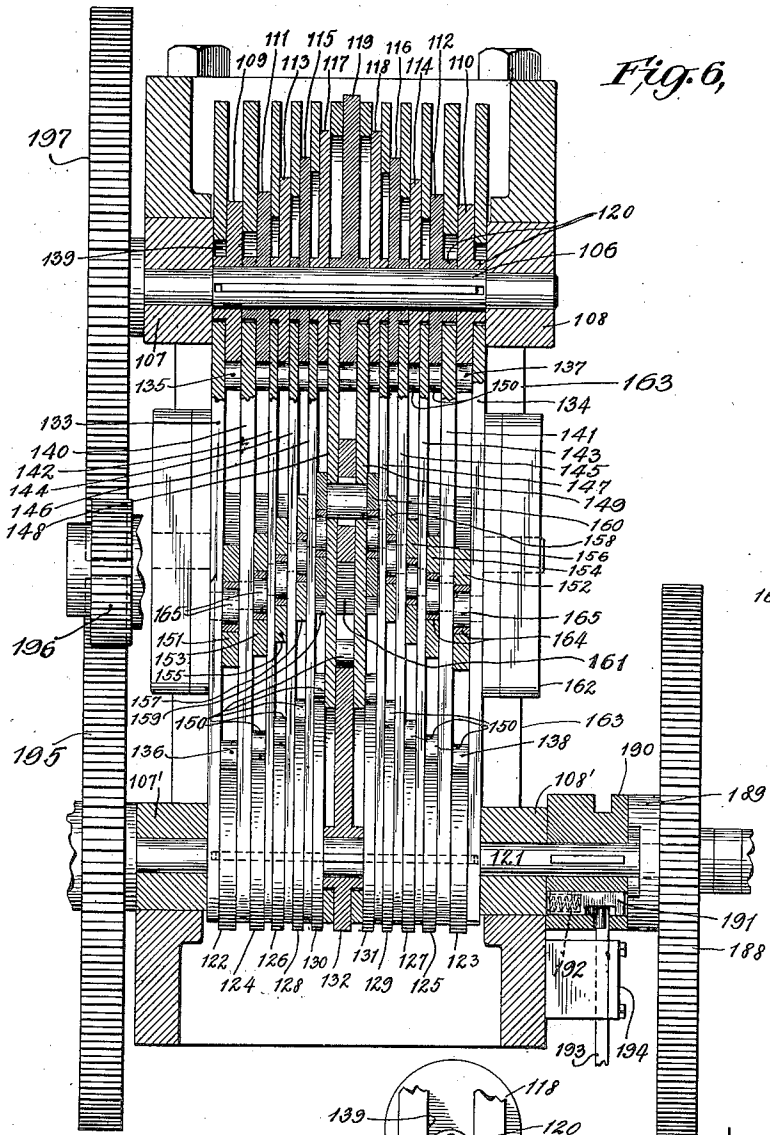


Fig. 8,

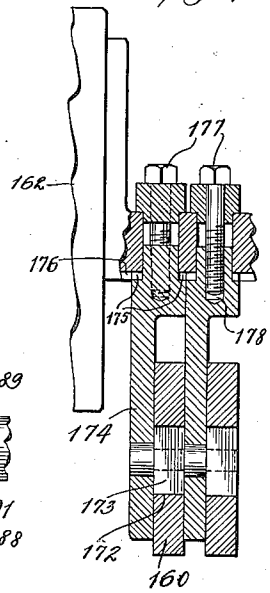
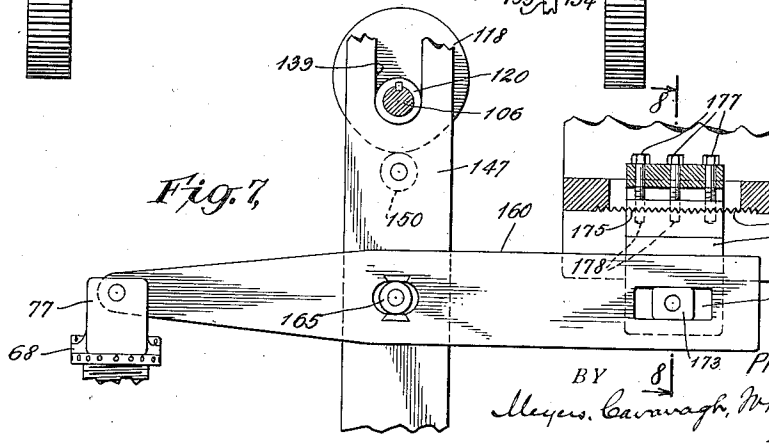


Fig. 7,



INVENTOR
PHILIP J. GREAYER
BY
Meyers, Cavanagh, Whitehead & Hyde
ATTORNEYS

Patented Aug. 4, 1925. 1,548,457

UNITED STATES PATENT OFFICE.

PHILIP J. GREAYER, OF YONKERS, NEW YORK, ASSIGNOR, BY MESNE ASSIGNMENTS, OF ONE-HALF TO IRA N. LIND, DOING BUSINESS AS CRESCENT SPECIALTY COMPANY, OF NEW YORK, N. Y., AND ONE-HALF TO DAVID LIND.

SHELL-DRAWING MACHINE.

Application filed October 21, 1921. Serial No. 509,323.

To all whom it may concern:

Be it known that I, PHILIP J. GREAYER, a subject of the King of Great Britain, and resident of Yonkers, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Shell-Drawing Machines, of which the following is a specification.

This invention relates to a shell drawing machine and more particularly to a machine or press for making successive draws on a metal blank to form deep drawn shells; and has special reference to the provision of a machine of this nature in which sheet material fed to the press is cut and drawn in a series of successive draws for making the shell in a single set of operations or strokes of the press.

A prime desideratum of my present invention comprehends the provision of a machine of the nature referred to in which tubular articles or shells having a depth which greatly exceeds the shell diameter may be produced in a single stroke or operation of the machine, the parts of the machine being so constructed and interrelated as to provide an apparatus of relatively small mass and bulk and of relatively high speed compared with prior shell drawing machines of the same power.

In prior apparatus for shell drawing where deep drawn articles such as boxes, battery cups, cartridge shells and similar seamless drawn tubular articles were desired to be produced with machinery of small weight and size and high speed, a metal blank was put through a plurality or series of drawing operations generally with the use of different machines, a shallow embryo cup being produced at the first operation with the first machine, a deeper drawn cup being then produced at a subsequent operation either with a different machine or with a structural modification of the machine used for the first drawing. In the use of such apparatus the multiple handling by the operator of the blank and the embryo cup and the multiple machine operations accomplished at separate times for first producing the embryo cup and then the finished cup resulted, as will be readily apparent, in a relatively high production cost. Where a plurality of machines were used for producing the successive draws, the cost of installation and upkeep of the additional machinery necessary added its component or increment to the production cost of the manufactured article. Miltiple handling and operation, besides directly increasing the cost of manufacturing of the cups or shells, resulted in subjecting the cups to increased liability of cup breakages and in subjecting the machinery to increased liability of breakdowns, the cost of production being thereby further enhanced. To eliminate this multiple handling and operation it has been suggested that the blank be subjected to a series of successive draws in one machine to produce a full drawn cup in a single operation. Although this form of machine has been suggested, there has been, to my knowledge, no machine of this type that has been practical and commercial enough to warrant general adoption, prior suggestions having involved machinery of low power capable of producing only relatively small articles where it was desired that the size and mass of the machine be kept within bounds, the presses for producing the larger articles having been found too bulky and massive and too slow and therefore inefficient to permit of practical adoption in the art. To the end of eliminating the multiple handling and manipulation of the articles as practised with machines of prior makes, my present invention contemplates the provision of apparatus for effecting all the necessary draws to produce deep drawn shells with a single machine and in a single operation, the apparatus having the desired speed for large capacity or quantity production and having the compactness, strength, simplicity of construction and efficiency desired for a shell drawing machine.

The principal objects of my invention may therefore be said to include, besides the provision of a shell drawing machine having the characteristics and performing the functions above referred to, the provision of a shell drawing machine capable of effecting three or more successive draws in which the operated and operating parts of the machine are so nested or massed together as to permit any number of successive

drawing operations; the provision of a machine of this type in which the said operated and operating parts of the machine are so nested as to yield an apparatus in which the parts mutually support and strengthen each other, the size of each part being thus capable of reduction with the number of operating parts corelatively capable of being increased, a large number of draws being thus obtained with a machine of relatively small size; the further provision of a shell drawing machine in which male dies or punches cooperate with female dies or matrices to produce shells having a uniform bodily thickness, the shells being produced with a minimum of wrinkling and a minimum of breakages; the further provision of a novel support for the female dies; the provision of a machine of the type referred to in which the shells or cups are produced from sheet material fed to the press in a novel manner, permitting the high speed operation desired and the general provision of a machine of this nature in which the parts are relatively few in number compared with the manifold functions performed thereby and in which the machine is capable of simple control and efficient operation.

To the accomplishment of the foregoing and such other objects as may hereinafter appear, my invention consists in the elements and their relation one to the other, as hereinafter particularly described and sought to be defined in the claims, reference being had to the accompanying drawings which show a preferred embodiment of my invention and in which:

Figure 1 is a front elevational view of the shell drawing machine of my invention with parts broken away,

Figure 2 is a right end elevational view of the machine with parts broken away,

Figure 3 is an enlarged detail cross sectional view of the cooperating male and female dies showing the male dies in ascended or fully retreated position,

Figure 4 is a cross sectional view of the same showing the male dies in mating cooperation with the female dies and in fully advanced position,

Figure 5 is a plan view of the parts shown in Figures 3 and 4,

Figure 6 is an elevational view taken in cross section along the line 6—6 of Figure 2, and

Figures 7 and 8 are views of details.

One of the desiderata of my invention, as hereinbefore referred to, comprehends the provision of a shell drawing machine or press in which deep drawn shells may be obtained from sheet material in a single set of operations or strokes of the press. To accomplish this my invention contemplates an apparatus in which a series of successive draws may be effected operative on sheet material to produce therefrom, through successive embryo stages, the finished deep drawn shell, the series of successive draws being accomplished in one operation of the press without any annealing between draws. To this end I provide a series of matrices or female dies having openings of graduated diameters and a series of telescoping punches or male dies adapted for mating cooperation with the matrices to effect the series of successive draws. Referring to Figures 1 and 2 of the drawings, wherein are shown the front and side elevational views of an exemplification of my invention, I provide the operating bed 10 supported on suitably spaced standards or legs 11 and from the bed 10 depends a casing or housing 12 adapted for supporting and housing the series of female dies or matrices, the latter being shown in detail in Figures 3 and 4 of the drawings. Referring to these figures, I provide a series of superposed female dies 13 to 18 inclusive, the said dies being arranged in stepped relation and having openings of graduated diameters, the die 13 comprising a cutting die stationarily located and fixed to the casing 12, the dies 14 to 18 comprising annular members removably mounted in the casing 12. The dies or matrices 14 to 18 are spacedly mounted in the casing 12, spacing collars 19 to 22 inclusive being provided for spacing the matrices in a predetermined manner, the collars being interposed between the matrices, as is clearly shown in Figures 3 and 4 of the drawings.

The matrices or dies 14 to 18 and the spacing collars 19 to 22 are removably inserted in the housing 12 from beneath the bed and are supported in position in the said housing by means of the slidably tapered shelf 23 received in suitable guides or grooves 24 and 25 in the housing 12, the slidable shelf 23 being provided with a handle 26 adapted to be grasped by the operator for moving the shelf into and out of the casing when the matrices are desired to be removed or reinserted. By the provision of this means whereby the matrices may be removed and inserted from beneath the bed 10 it will be apparent that these matrices may be handled with perfect safety by an operator, the operator or workman being in no danger of loss of limb if the press is operated during removability or reinsertion of the matrices.

Cooperating with the matrices 13 to 18 inclusive I provide a series of telescoping punches or male dies, 27, 28, 29, 30, 31 and 32, the outermost punch 27 cooperating with the matrix 13 for cutting a metal blank from a sheet material 33, which is fed to the punches in a manner to be described hereinafter, the sheet material being fed between the cutting punch 13 and a plate 34 spaced therefrom by means of the spacing and guiding members 35, as is clearly shown in Fig-

ures 3 and 4 of the drawings. The punches 28 and 32 cooperate in turn with the matrices 14 to 18 for drawing the sheet metal blank successively from the blank into a shallow embryo cup, then into a deeper and deeper drawn cup until the finished cup is formed by the cooperation of the innermost punch 32 and the lowermost matrix 18, the cup then assuming the position as shown at 36 in Figure 4 of the drawings, expulsion of the cup from the machine being effected upon the retreat of the punches.

For the purpose of producing cups in which any wrinkling is entirely eliminated, the punches 27 to 32 cooperate with the matrices for holding the blank and the embyro cups in each drawing by the next successive punch. Thus, after the outermost punch 27 cuts the blank from the sheet material 33, the said punch 27 descends into engagement with the matrix 14, the blank being held between the punch and the matrix, the advance of the next successive punch 28 drawing the metal against the holding resistance of the punch 27. Similarly, after the punch 28 has performed its drawing function, in cooperation with the matrix 14, the said punch 28 cooperates with the next successive matrix 15 for holding the embryo cup securely in position during the drawing operation of the next successive punch 29. Thus, each punch with the exception of the innermost punch 32, performs the dual functions of drawing the metal and holding the same for the next successive draw, a smooth, unwrinkled cup being thereby obtained.

With the provision of the cooperating punches and matrices described, it will be seen that during a single operation of the press effecting the successive downward actuation of the series of punches into mating cooperation with the series of matrices, that a shell or cup will be produced in a single operation of the press. This is clearly evident from Figure 4 of the drawings, which shows the punches in fully advanced position with the cup 36 being expelled, Figure 3 showing the punches in ascended or fully retreated position and ready for the next stroke of the press.

For the purpose of reducing uneven draws and to the end that a cup of which the metal has a uniform thickness throughout may be obtained, and to the further end of effectively minimizing and in fact eliminating cup breakages resulting from drawing strains, I provide a novel and simple resilient support for the female dies or matrices. This support comprises means for yieldingly offering resistance to the holding punches and for offering such resistance circumferentially of the dies. This is shown in Figure 4 of the drawings, the said means comprising preferably an annular buffer or bumper 37, which may be made of rubber, the said buffer being confined between the flanged annular member 38 and the ring 39, the buffer 37 and its supporting parts being arranged beneath the bottommost matrix 18 and supported preferably directly on the shelf 23. This annular buffer or bumper is effective with each of the dies and punches and offers resistance to the dies and punches when the same cooperate for drawing and holding the metal blank or the embryo shell. By the provision of this bumper means unevenness of material is compensated for and uniform drawing with consequent reduction of liability of breakdowns and in fact substantial elimination of breakages has been obtained.

A further desideratum of my invention, as hereinbefore referred to, contemplates the provision of a shell drawing machine having the required strength and power for making deep draws and having a relatively small mass or weight and bulk and a relatively high resulting speed of operation compared with prior shell drawing machines which are adapted for making the same depth of draw on blanks or planchets of sheet material having a given thickness. For the purpose of accomplishing these ends, the operated and operating parts of my machine are constructed and arranged in massed or nested relation, such that the parts mutually support and strengthen each other, adjacent parts aiding in taking up the strains and stresses to which adjoining parts are subjected in the shell drawing operation of the machine. Referring to Figures 1 to 4, and more particularly to Figures 3 and 4 of the drawings, I show the manner in which the operated parts of the machine are nested or massed to secure the desired decreased weight and bulk and the desired increased strength and speed of operation. For supporting the telescoping punches 27 to 32 I provide a series of nested rams 40, 41, 42, 43, 44 and 45, the rams 40 to 44 comprising cylindrical members or sleeves and the ram 45 preferably comprising a rod, these rams being constructed to have a sliding fit within one another, as is particularly shown in Figures 3 and 4 of the drawings. The bottoms of the rams 40 to 44 are provided with the flanged disks 46 to 50 inclusive, the annular flanges of said disks being threaded and received by correspondingly threaded portions of the rams 40 to 44. The disks 46 to 50 are intended for receiving and supporting the punches 27 to 31 and to this end the said disks are centrally tapped to receive the upper threaded ends 51 to 55 inclusive of the punches. The innermost punch 32 may be directly connected to the rod 45 by providing the upper end of the punch 32 with a threaded portion 56 received by a suitably tapped bore 57 in the said rod 45. The form-

ing tools or punches are threaded into the disks in the assembling of these parts, the said disks being threaded into the rams, the disks being each provided with a series of spaced recesses or apertures 58 arranged circumferentially in the disk peripheries, the said apertures being intended for the reception of a tool to permit facility of rotation of the said disks into the respective rams. For the purpose of permitting accessibility to the inner rams and disks, the rams 40 to 44 are each provided with openings or windows 59, 60, 61, 62 and 63 respectively, as shown particularly in Figure 3 of the drawings. The rams 40 to 45 to which the operating punches are connected have, it will be noted, a greater thickness of material and a greater diameter than the respective punches with which they are associated. By the provision of these rams a construction is afforded in which the punches may be considerably reduced in diameter and thickness in order to provide a narrow resulting cup, the necessary strength and power being obtained mainly in the enlarged operating rams 40 to 45 inclusive. The provision of the rams also affords means for connecting the relatively small punches to operating mechanism of the desired strength and power, as will be described more in detail hereinafter. By the provision of rams which are arranged in nested relation having a sliding fit within one another, the thickness of each ram may be considerably reduced, each ram holding the adjoining ram in properly spaced position, such ram laterally supporting and taking up the strains and stresses in the next adjoining ram, the outer ram 40 only being made of increased thickness. In this manner and by this means a large number of rams may be nested together in a relatively small space, the bulk of the machine being substantially reduced without sacrificing power or strength. This nested arrangement of the operated parts having a relatively running or sliding fit, minimizes the bulk and weight, increases the number of operating punches and rams possible and permits a construction having the desired high speed of operation yielding an apparatus capable of quantity production.

Connected to the rams 40 to 44 inclusive and also arranged in nested or telescoping relation, I provide the supporting members 64, 65, 66, 67 and 68, the said supporting members being preferably in the form of annular links, each annular link being provided with integral upstanding ears providing means adapted to be connected to operating elements, the link 64 being provided with the opposed ears 69 and 70, the links 65 to 68 being in turn provided with the ears 71 to 78 inclusive. The rod 45 comprising the innermost ram is also provided with opposed portions adapted for connection to an operating element and to this end the ram 45 is forked at its upper end, providing the forked portions 79 and 80 respectively. The annular links 64 to 68 and the parts integral therewith are constructed also to permit of their being laterally massed or nested upon the downward stroke of the punches, this being clearly shown in Figure 4 of the drawings.

For the purpose of obtaining the desired adjusted stroke of the rams and punches relative to the matrices, the rams are adjustably mounted on the links 64 to 68 and to this end I provide a series of flanged sleeves 81, 82, 83, 84 and 85, the said sleeves being threaded, as clearly shown in the drawings and being received by internally tapped or threaded walls of the rams and links respectively, as will be clearly apparent from an inspection of Figures 3 and 4 particularly. For the purpose of facilitating rotation of the threaded sleeves to permit the desired adjustability, the flanges 86, 87, 88, 89 and 90 of these sleeves are each provided with a series of spaced perforations 91 arranged in the periphery of the flanges, the perforations being intended for the reception of a suitable tool to facilitate rotation of the sleeves. For the purpose of locking the sleeves in any adjusted position I provide locking rings threaded on each sleeve and engaging respectively the ram and the link associated therewith, the outermost sleeve 81 being provided with the locking rings 92 and 93, the inner sleeves being provided with the locking rings 94 to 101 inclusive.

Referring now to Figures 1 and 2 of the drawings, the rams, punches and links are shown guided for vertical reciprocation in the frame work of the machine, the spaced guide rods, three of which, 102, 103 and 104 are shown in the figures, being provided for this purpose. Fixed to the outermost ram 40 I provide a plurality of spaced straps or yokes 105, the said straps or yokes encircling the guide rods for guiding cooperation therewith.

Connected to opposite sides of each of the supporting links 64 to 68 and to opposite sides of the innermost ram 45 to produce symmetrical thrusts of each ram, I provide a series of laterally massed or nested operating elements. These operating elements may comprise means directly connected to the links at opposite sides thereof, but for the purpose of further decreasing the size of the machine and the weight of the parts, I provide a series of operating elements preferably in the form of cams spaced from the links with means provided between the cams and the links for amplifying the motion of the operating cams. Referring now to Figures 2, 6 and 7 of the drawings, I provide preferably two series

of cams arranged one above the other, the cams being laterally massed on the frame work of the machine. Referring particularly to Figure 6, I show keyed to the cam shaft 106 journalled in opposed bearings 107 and 108, a plurality of sets of cams, the outermost set 109 and 110 being intended for operating the outermost ram 40, the other sets of cams 111 and 112, 113 and 114, 115 and 116, 117 and 118 being intended for connection to the other rams, as will be described hereinafter. The central cam 119 is in turn adapted for operating the innermost ram 45, as will be shown hereinafter. The cams of a set are contoured, as clearly shown in Figures 2 and 6 of the drawings to provide the successive operation of the rams referred to hereinbefore. All the cams 109 to 119 inclusive are provided with central flanges designated as 120. These flanges encircle the cam shaft 106 and suitably space the cams to permit the reception therebetween of a series of links to be described presently. Spaced in vertical alinement with the cam shaft 106, I preferably provide a second cam shaft 121 journalled in opposed bearings 107′ and 108′, upon which are keyed the sets of cams 122 and 123, 124 and 125, 126 and 127, 128 and 129, 130 and 131 and the central cam 132, these cams being arranged on the cam shaft 121 in a manner similar to the arrangement of the upper series of cams on the cam shaft 106.

Arranged between the plurality of sets of cams I provide a series of floating links adapted to be operated downwardly by the upper sets of cams and upwardly by the lower sets of cams. Referring to Figure 6, the outermost set of floating links 133 and 134 is arranged between the outermost set of cams and the bearings for the cam shafts, the link 133 being provided with the top roller or cam follower 135 and with the lower roller or cam follower 136, the link 134 being correspondingly provided with the cam followers 137 and 138 adapted to cooperate with the respective cams, rotation of the cams effecting the reciprocation of the links 133 and 134. The links are suitably recessed as at 139, the recesses receiving the flange 120 of the cam, the side walls of a recess cooperating with the flange of the cam and guided thereby, the recess being elongated in the direction of the link to permit the reciprocation thereof. In a similar manner and cooperating with the other cams, I provide the sets of links 140 and 141, 142 and 143, 144 and 145, 146 and 147, 148 and 149, each of these links being provided with cam followers or rollers collectively designated as 150 cooperating with the respective cams. The links and cams have a sliding fit with respect to each other, as particularly shown in Figure 6, a large number of elements being thus capable of being nested to provide the decreased mass combined with the desired power in the operating parts of the machine.

Upon operation of the machine the upper series of cams move the sets of links successively downwardly, the lower series of cams functioning to return the sets of links to ascended or upper position, the links being provided for transmitting the motion of the cams to other operating elements to be described presently. Arranged substantially centrally of each link and located in the spaces between the said links, I provide a series of levers comprising the sets of levers 151 and 152, 153 and 154, 155 and 156, 157 and 158, 159 and 160, a central lever 161 being provided for cooperation with the central set of links 148 and 149. The levers 151 to 161 are each fulcrumed at a point behind the cams, these levers being connected to the rams for transmitting the motion of the operating cams to the said rams. Referring to Figure 2 of the drawings, the levers are shown fulcrumed at one end in the bearing frame 162 fixed to the guide rods 163, one of which is shown in Figure 2, the other ends of the levers being shown connected to the rams in a manner as will be presently described. The levers 151 to 161 are provided at a point intermediate the ends thereof with slots in which are fitted bushings designated collectively as 164, these bushings receiving rollers designated collectively as 165, the said rollers being journalled in the floating links, one roller being fitted to each link. With the provision of this means it will be apparent that upon vertical reciprocation of the floating links the levers 151 to 161 will be oscillated about the fulcrums thereof, motion of the links being thus transmitted to the series of levers. The links and levers are also arranged in nested relation, a maximum strength with a minimum mass being thus obtained. By the provision of the levers and links I am enabled to further reduce the size of the machine and the size of the operating cams, the levers acting in the nature of an amplifying device for amplifying the operating strokes of the cams.

The outer or free ends of the operating levers 151 to 161 inclusive are connected to the links 64 to 68 and to the rod 45, the levers being connected specifically to the upstanding ears 69 to 78 formed integrally with the links and the forked portions 79 and 80 formed integrally with the rod 45, as particularly shown in Figures 1 to 4 of the drawings. The connection between the levers and the links may be a simple pivotal connection, as will be apparent, and in order to provide a further adjusting means between the levers and the links for independently adjusting the operating stroke of the

punches, I may provide an adjustable pivotal connection between these parts, as particularly shown in Figure 3 of the drawings. Referring to this figure, the connection between any of the levers, such as lever 161 and any of the links may comprise a rotatable block 166 pivoted in the forks 79 and 80 of the ram 45, the said block 166 being transversely slidable in a slot 167 provided at the free end of the lever 161. Slidable longitudinally of the lever 161 are a plurality of spaced shims or tapered elements 168 and 169 respectively, the said shims being held against correspondingly tapered walls in the sliding block 166 by means of adjusting screws 170 and 171. By the provision of this means it will be apparent that upon loosening one of the adjusting screws and tightening up on the other adjusting screw that the ram 45 may be adjusted relative to the operating lever 161. The remaining levers may be similarly adjustably connected to the connecting links and the integral ears thereof. It will be observed that each ram is operated from spaced cams comprising a set of cams and spaced levers, these operating elements being connected to spaced portions of a ram, a symmetrical thrust being thus obtained on each ram in the downward actuation thereof.

For the purpose of providing means in which the operating strokes of the punches may be substantially varied, I may provide means for adjusting the fulcrum of the levers, in this manner obtaining a wide range of adjustment of the operating strokes of the punches. Referring to Figures 7 and 8 of the drawings, I show the manner in which the fulcrum of the levers may be adjusted to provide the desired result. In these figures a lever such as 160 fulcrumed in the frame 162 is provided with an elongated slot 172, a pivoted block 173 journalled in a slide 174 being received by and being adjustable longitudinally in the said slot 172. The slide 174 is provided with two rows of teeth 175 cooperating with complemental teeth 176 formed on a stationary part of the frame work 162, a plurality of securing screws 177 received in suitably tapped bores 178 in the slide 174 providing means for securing the slide 174 in any adjusted position with its teeth engaging the complemental teeth 176 in the frame work of the machine. It will be apparent with this construction that the securing screws 177 may be loosened to permit the adjustment of the slide 174 and the pivoted block 173 forming the fulcrum of the lever, the slide being secured in any adjusted position. Rough adjustments may be made in this manner, the finer adjustments being obtained by means of the adjustable links hereinbefore described.

For the purpose of driving the operating parts I provide the following means. Rotatably mounted on the cam shaft 121, reference being had to Figure 1 of the drawings, is a sleeve 179 and keyed to said sleeve I provide the belt pulley 180, fly wheel 181 and the spur gear 182. Freely rotatable on the sleeve 179 I may provide the loose belt wheel 183. Fixed to a cross shaft 184 in horizontal alinement with the cam shaft 121 (see Figure 2) I provide the large spur gear 186 located to one side of the machine, the said shaft 184 being provided with the small spur gear 187 located on the opposite side of the machine. Meshing with the spur gear 187 I provide the gear 188 freely rotatable on the cam shaft 121, the said spur gear 188 carrying a clutch element 189. Keyed to the cam shaft 121 I provide the collar 190 carrying the complemental spring actuated clutch element 191, the said clutch element 191 being normally urged to engage the complemental clutch element 189 by means of a spring 192 housed therein, the said clutch element 191 being movable to unlocking position by means of a plunger 193 slidable in the frame work 194 (see Figure 6 of the drawings). Keyed to the cam shaft 121 adjacent to the spur gear 182 I provide the gear 195 meshing with the idler 196, a gear 197 being connected to the cam shaft 106, the idler 196 meshing with the said gear 197. By the provision of this driving mechanism it will be seen that upon engagement of the clutch elements 189 and 191 rotation imparted to the belt wheel 180 will be transmitted to the gear 188 through the clutch elements and to the cam shafts 121 and 106 respectively, the arrangement of gears providing a balanced structure on opposite sides of the machine to properly withstand the shock incident to successive downward actuation of the punches operated by the cams. For the purpose of connecting and disconnecting the clutch elements I may provide the usual treadle 198 fulcrumed to the standard 199 and normally held in elevated position by means of the spring 200, the said treadle being connected to the plunger 193 by means of the link 201, a spring 202 anchored on the frame 194 being connected to the link 201 and more specifically to the securing means 203 which connects the link 201 to the plunger 193, and aiding in retaining the plunger in normally elevated position. It will be apparent that upon actuation of the treadle 198 downwardly the plunger 193 will be withdrawn, permitting the complemental clutch elements 189 and 191 to interengage in locking and driving position.

Cooperating with the drawing punches and feeding thereto the sheet material 33 from which are cut the blanks drawn by the punches, I provide a novel feeding apparatus so associated with the operation of the punches as to feed the sheet material be-

tween the punches and the matrices within the fraction of a second, during which the former are in fully retracted position, and to so feed the sheet material as to provide for the greatest economy in the cutting thereof. In the operation of the punches the innermost punch travels a substantial distance in its advancing and retreating strokes, as will be readily apparent, and during the time consumed by its advance and retreat the sheet material, as will be readily understood by reference to Figure 4 of the drawings, cannot be fed forwardly for the next cutting operation. It is only when all the punches are in fully retreated position, as shown in Figure 3, that sheet feeding is possible and where speed of operation is a desired end the punches should hold their retreated position only for a fraction of a second, as is the case in the present embodiment of my invention. To feed the sheet material forward within this time I have provided a feeding apparatus, shown in Figures 1 and 2 of the drawings, in which mechanism is provided operative on the sheet material to place the same under tension when the material is engaged and held by the punches, the mechanism functioning to rapidly feed the material forward in the nature of intermittent "jerks" when the material is released by the retreated punches. To these ends I provide (referring to Figures 1 and 2) the friction feed rollers 204 and 205 positioned to the left of the punches and matrices, the feed rollers being suitably journalled in upstanding brackets 206. Fixed to the shaft 207 of the lower feed roller I provide the ratchet wheel 208 and rotatably mounted on the said shaft 207 I provide the lever 209, a spring pressed pawl 210 being mounted on said lever and arranged for engagement with the teeth of the ratchet wheel 208. Connected to the outside end of the lever 209 I provide the tension spring 211, the said tension spring being anchord to a bracket 212 of the machine, the spring being preferably adjustably anchored to the bracket 212 as by the adjustable securing means 213. Connected to the lever 209 also at its outer end I provide the link 214, the said link being connected for actuation by any of the nested levers, as by means of the chain 215 trained over the pulleys or sheaves 216 and 217, the latter being suitably journalled on the frame work 218 forming part of the machine, one end of the said chain 215 being connected to the link 214 as at 219, the other end of the chain being connected to one of the nested levers such as 158 (see Figure 2). With the provision of this means it will be apparent that as the punches and rams, and more specifically the lever 157, moves downwardly during the drawing operation of the machine, the link 214 will be moved upwardly by the chain 215, the lever 209 being caused to ascend, placing the spring 211 under tension, the pawl 210 freely riding over the teeth of the ratchet wheel 208. After the drawing operation when the lever 157 will be moved upwardly to retreated position, the link 214 will be released, the lever 209, however, being prevented from moving by virtue of the fact that the sheet material 33 is held in position by the engagement of the forming punches, as described hereinbefore. When, however, the punches are moved to fully retreated position, the sheet material 33 is released and the lever 209 is caused to move downwardly rapidly under actuation of the tensioned spring 211, this effecting the rotation of the feed wheels 204 and 205, the rapid rotation of these feed wheels giving a rapid impulse to the sheet material 33, feeding the same forwardly.

The impulse given to the sheet material by the tensioned feeding means tends to impart thereto a momentum which results in an irregular feeding of the sheet material and in order to eliminate this irregularity of feed and to further effect the economic feeding of the sheet metal to permit forward feed of only that amount of metal necessary for producing a cup, I provide secondary feeding elements which feed forward just the right amount of material, the latter feeding means functioning as a check or stop means to prevent the tensioned feeding elements from feeding forward too large a quantity of the sheet material. This secondary feeding means is shown in Figures 1 and 2 and comprises the friction feed rollers 220 and 221 journalled in the brackets 222 and 223, the upper feed roller 220 being spring pressed as by means of the spring controlled plungers generally designated as 224. The feed rollers 220 and 221 are provided with the meshing spur gears 225 and 226, the spur gear 225 being positively driven by means of the flexible shaft 227 connected to the shaft 228 (see Figure 1) of the spur gear 225, the said flexible shaft being, in turn, directly connected to the cam shaft 121. For guiding purposes the guides 229 and 230 may be provided. The gearing of this mechanism is so proportioned that the feed roller 220 and its cooperating roller 221 feed continuously only that amount of sheet material necessary for the production of one cup from the unwinding roll 231 journalled in brackets 232 beneath the said feed rollers. When the spring actuated or spring tensioned forward feed rollers 204 and 205 impel the sheet material 33 forwardly, the momentum of the latter is checked by the friction feed rollers 220 and 221, these rollers permitting only that amount of slack in the material between the rollers and the punches to permit the desired amount of feeding.

The operation of my shell drawing ma-

chine will, in the main, be apparent from the above detailed description thereof. Upon downward actuation of the treadle 198 the cam shaft 121 is locked to the driving gear, the said cam shaft 121 being rotated thereby and effecting the rotation of the upper cam shaft 106. Rotation of these shafts set into motion the top and bottom sets of cams, the top set of cams effecting the downward movement of the sets of floating links associated therewith, the bottom set of cams effecting the return or upward movement of the said sets of links. It will be apparent that although I have provided in the present exemplification of my invention two sets of cams, that one set of cams may be provided functioning to effect the downward and upward motion of the floating links. The links actuated by the cams transmit motion and power to the sets of levers arranged laterally of the machine in nested relation, the said levers being connected to the series of rams and punches in the manner described, the sets of levers being actuated downwardly successively to effect the successive movement of the punches 27 to 32 in mating relation with the matrices 13 to 18 inclusive, a deep drawn shell 36 being produced from the sheet material 33 in this operation, the shell 36 being expelled in a simple manner from the bottom of the machine beneath the operating bed. The sheet material 33 is given intermittent impulses to cause the same to feed forward rapidly, the feed of the said sheet material being properly checked by a continuous roll feed, the intermittent and continuous roll feed being located on opposite sides of the machine.

With the provision of the above described apparatus it will be apparent that I have provided a shell drawing machine in which a seamless drawn shell may be obtained in a single stroke or operation of the machine, the parts of the apparatus being so relatively arranged and so constructed as to yield apparatus of small mass or weight, of relatively small bulk or size, having a strength or power necessary in shell drawing operations and having a high speed of operation, quantity production of seamless tubular drawn articles being thereby obtained in a highly efficient manner.

While I have shown my device in the preferred form, it will be obvious that many changes and modifications may be made in the structure disclosed without departing from the spirit of the invention, defined in the following claims.

I claim:

1. In a shell drawing machine adapted for making a series of successive draws on a metal blank, a series of nested cup shaped rams each having a side wall and a bottom wall, a series of telescoping punches one for each ram and carried by the bottom wall of the same, and means for actuating the rams successively in one direction to effect three or four successive draws.

2. In a shell drawing machine adapted for making a series of successive draws on a metal blank, a plurality of nested rams having a sliding fit within one another, each ram including a side wall and a bottom wall, a plurality of telescoping punches one connected to the bottom wall of each ram, and means for actuating the rams successively in one direction to effect three or more successive draws.

3. In a shell drawing machine adapted for making a series of successive draws on a metal blank, a series of nested cylindrical rams having a sliding fit one within the other, a series of telescoping punches, a punch connected to the bottom wall of each ram, the rams having graduated diameters of substantially greater dimensions than the diameters of the corresponding punches with the wall of a ram substantially greater in thickness than the wall of its corresponding punch, and means for actuating the rams successively in one direction to effect three or more successive draws.

4. In a shell drawing machine adapted for making a series of successive draws on a metal blank, a series of nested rams, a series of telescoping punches, one for each ram, provisions comprising a series of nested mutually supporting ram carrying members adjustably connected to said rams and means for actuating the rams successively in one direction to effect three or more successive draws.

5. In a shell drawing machine adapted for making a series of successive draws on a metal blank, a series of nested rams, a series of telescoping punches, one for each ram, provisions comprising a series of nested annular mutually supporting arm carrying members adjustably connected to the said rams and means for actuating the rams successively in one direction to effect three or more successive draws.

6. In a shell drawing machine adapted for making a series of successive draws on a metal blank, a series of nested cylindrical rams, a series of telescoping punches, a punch connected to each ram, the rams having graduated diameters of substantially greater dimensions than the diameters of the corresponding punches, provisions comprising a series of nested annular mutually supporting ram carrying members adjustably conected to the said rams and means for actuating the rams successively in one direction to effect three or more successive draws.

7. In a shell drawing machine adapted for making a series of successive draws on a metal blank, a series of nested rams, a series of telescoping punches, one for each ram, and means for actuating the rams successively in

one direction to effect three or more successive draws, the said rams having provisions on opposite sides of a dameter thereof adapted for direct engagement with said actuating means.

8. In a shell drawing machine adapted for making a series of successive draws on a metal blank, a series of nested rams, a series of telescoping punches, one for each ram, and means for actuating the rams successively in one direction to effect three or more successive draws, the said rams having provisions on opposite sides of a diameter thereof adapted for engagement with said actuating means, the said provisions being constructed to permit the same to be laterally massed or nested in the operation of the machine.

9. In a shell drawing machine adapted for making a series of successive draws on a metal blank, a series of telescoping punches, and means for actutating the punches successively in one direction to effect three or more successive draws, the said punches having provisions on opposite sides of a diameter thereof adapted for engagement with said actuating means, the said provisions being constructed to permit the same to be laterally massed or nested in the operation of the machine.

10. In a shell drawing machine adapted for making a series of successive draws on a metal blank, a series of matrices having openings of graduated diameters, a series of telescoping punches for cooperation therewith and means for actuating the punches successively in one direction for mating with the matrices to effect three or more successive draws; a punch cooperating with a matrix for drawing the blank and cooperating with the next successive matrix for holding the blank for the next successive draw, the said punches having provisions on opposite sides of a diameter thereof adapted for engagement with said actuating means, the said provisions being constructed to permit the same to be laterally massed or nested in the operation of the machine.

11. In a shell drawing machine adapted for making a series of successive draws on a metal blank, a series of stationarily mounted matrices having openings of graduated diameters, a series of telescoping punches for cooperation therewith and means for actuating the punches successively in one direction for mating with the matrices to effect three or more successive draws, a punch cooperating with a matrix for drawing the blank and cooperating with the next successive matrix for holding the blank for the next successive draw, the said punches having provisions on opposite sides of a diameter thereof adapted for engagement with said actuating means, the said provisions being constructed to permit the same to be laterally massed or nested in the operation of the machine.

12. In a shell drawing machine adapted for making a series of successive draws on a metal blank, a series of matrices having openings of graduated diameters, a series of telescoping punches for cooperation therewith and means for actuating the punches successively in one direction for mating with the matrices to effect three or more successive draws; a punch cooperating with a matrix for drawing the blank and cooperating with the next successive matrix for holding the blank for the next successive draw and instrumentalities for resiliently supporting the said matrices.

13. In a shell drawing machine adapted for making a series of successive draws on a metal blank, a series of stationarily mounted matrices having openings of graduated diameters, a series of telescoping punches for cooperation therewith and means for actuating the punches successively in one direction for mating with the matrices to effect three or more successive draws; a punch cooperating with a matrix for drawing the blank and cooperating with the next successive matrix for holding the blank for the next successive draw and an annular buffer supporting the said series of matrices.

14. In a shell drawing machine, a bed, a plurality of telescoping punches mounted for reciprocation above said bed, a plurality of matrices having openings of graduated diameters located below said bed, means for actuating the punches successively for mating cooperation with the matrices and means for releasably supporting the matrices constructed to permit removal and replacement of the matrices from below the bed.

15. In a shell drawing machine, a bed a plurality of telescoping punches mounted for reciprocation above said bed, a plurality of matrices having openings of graduated diameters located below said bed, means for actuating the punches successively for mating cooperation with the matrices and means for releasably supporting the matrices below the bed, the said supporting means including a slidable element.

16. For use in a shell drawing machine, a plurality of stationary matrices having openings of decreasing diameters arranged in superposed relation and a supporting means therefor including an annular buffer or cushioning element.

17. For use in a shell drawing machine, a series of superposed matrices having openings of decreasing diameters adapted for cooperation with a series of plungers to effect three or more successive draws and

means for supporting the matrices, the said means including an annular rubber buffer or cushioning element.

18. For use in a shell drawing machine, a plurality of stationary matrices having openings of decreasing diameters arranged in superposed relation and a unitary buffer or cushioning element arranged for supporting the plurality of matrices, the buffer being constructed to offer resilient support circumferentially of the matrices.

19. In a shell drawing machine adapted for making a series of successive draws on a metal blank, a series of telescoping punches and means for actuating said punches successively in one direction to effect at least three successive draws, the said actuating means including a plurality of cams massed laterally and arranged for rotation on an axis normal to said direction.

20. In a shell drawing machine adapted for making a series of successive draws on a metal blank, a series of telescoping punches and means for actuating said punches successively in one direction to effect at least three successive draws, the said actuating means including a plurality of cam elements and provisions connecting the cam elements with laterally spaced portions of the punches.

21. In a shell drawing machine adapted for making a series of successive draws on a metal blank, a series of nested rams, a series of telescoping punches, one for each ram, and means for actuating the rams successively in one direction to effect three or more successive draws, the said actuating means including a plurality of cams massed laterally and arranged for rotation on an axis normal to said direction.

22. In a shell drawing machine adapted for making a series of successive draws on a metal blank, a series of nested rams, a series of telescoping punches, one for each ram, and means for actuating the rams successively in one direction to effect three or more successive draws, the said actuating means including a plurality of cam elements and provisions connecting the cam elements with laterally spaced portions of the rams.

23. In a shell drawing machine adapted for making a series of successive draws on a metal blank, a series of telescoping punches and means for actuating said punches successively in one direction to effect at least three successive draws, the said actuating means including a plurality of elements arranged in spaced relation laterally of the machine.

24. In a shell drawing machine adapted for making a series of successive draws on a metal blank, a series of telescoping punches and means for actuating said punches successively in one direction to effect at least three successive draws, the said actuating means including a plurality of elements arranged in spaced relation laterally of the machine and provisions connecting the elements with laterally spaced portions of the punches.

25. In a shell drawing machine adapted for making a series of successive draws on a metal blank, a series of telescoping punches and means for actuating said punches successively in one direction to effect at least three successive draws, the said actuating means including a plurality of sets of operating elements arranged for rotation on an axis normal to said direction and means connecting an operating element of each set to a punch at spaced portions thereof.

26. In a shell drawing machine adapted for making a series of successive draws on a metal blank, a series of telescoping punches and means for actuating said punches successively in one direction to effect at least three successive draws, the said actuating means including a plurality of sets of plate cam elements arranged for rotation on an axis normal to said direction and means connecting a cam of each set to a punch at spaced portions thereof.

27. In a shell drawing machine adapted for making a series of successive draws on a metal blank, a series of nested rams, a series of telescoping punches, one for each ram, and means for actuating the rams successively in one direction to effect three or more successive draws, the said rams having provisions on opposite sides of a diameter thereof adapted for engagement with said actuating means, the said provisions being constructed to permit the same to be laterally massed or nested in the operation of the machine, the said actuating means including a plurality of sets of plate cams arranged for rotation on an axis normal to said direction.

28. In a shell drawing machine, a plurality of telescopic punches and means for actuating punches successively in one direction to effect a plurality of successive draws; the said means comprising a plurality of levers connected to the plurality of punches to independently operate the same with the levers arranged laterally of the machine and elements for oscillating the said levers.

29. In a shell drawing machine, a plurality of telescopic punches and means for actuating the punches successively in one direction to effect a plurality of successive draws; the said means comprising a plurality of levers connected to the plurality of punches to independently operate the same with the levers arranged laterally of the machine and a plurality of cam elements for independently oscillating the said levers.

30. In a shell drawing machine, a plurality of telescopic punches and means for actuating the punches successively in one di-

rection to effect a plurality of successive draws; the said means comprising a plurality of levers connected to the plurality of punches to independently operate the same with the levers arranged in closely spaced or massed relation laterally of the machine and plate cams also closely spaced in massed relation laterally of the machine for independently oscillating the said levers.

31. In a shell drawing machine, a plurality of telescopic punches and means for actuating the punches successively in one direction to effect a plurality of successive draws; the said means comprising a plurality of levers fulcrumed at one end on the frame of the machine and connected at the other end to the plurality of punches to independently operate the same with the levers arranged laterally of the machine and elements for oscillating the said levers, the said elements being operative on the levers intermediate the fulcrum and connected ends thereof.

32. In a shell drawing machine, a plurality of telescopic punches and means for actuating the punches successively in one direction to effect a plurality of successive draws; the said means comprising a plurality of levers fulcrumed at one end on the frame of the machine and connected at the other end to the plurality of punches to independently operate the same with the levers arranged laterally of the machine and a plurality of cam elements for independently oscillating the said levers, the said elements being operative on the levers intermediate the fulcrum and connected ends thereof.

33. In a shell drawing machine, a plurality of telescopic punches and means for actuating the punches successively in one direction to effect a plurality of successive draws; the said means comprising a plurality of levers fulcrumed on the frame of the machine and connected to the plurality of punches to independently operate the same with the levers arranged laterally of the machine and elements for oscillating the said levers and provisions for varying the stroke of the punches including means for adjusting the fulcrum of the levers.

34. In a shell drawing machine, a plurality of telescopic punches and means for actuating the punches successively in one direction to effect a plurality of successive draws; the said means comprising a plurality of levers fulcrumed at one end on the frame of the machine and connected at the other end to the plurality of punches to independently operate the same with the levers arranged laterally of the machine and elements for oscillating the said levers, the said elements being operative on the levers intermediate the fulcrum and connected ends thereof and provisions for varying the stroke of the punches including means for adjusting the fulcrum of the levers.

35. In a shell drawing machine adapted for making a series of successive draws on a metal blank, a series of nested rams, a series of telescoping punches, one for each ram, and means for actuating the rams successively in one direction to effect three or more successive draws, the said means comprising a series of levers connected to the rams with the levers arranged laterally of the machine and elements for oscillating the said levers.

36. In a shell drawing machine adapted for making a series of successive draws on a metal blank, a series of nested rams, a series of telescoping punches, one for each ram, and means for actuating the rams successively in one direction to effect three or more successive draws, the said means comprising a plurality of sets of levers, one lever of each set connected to spaced portions of the rams and elements for oscillating the said levers.

37. In a shell drawing machine adapted for making a series of successive draws on a metal blank, a series of nested rams, a series of telescoping punches, one for each ram, and means for actuating the rams successively in one direction to effect three or more successive draws, the said means comprising a plurality of sets of levers, one lever of each set connected to spaced portions of the rams and cam elements for oscillating the said levers; the levers and the cam elements being arranged in massed relation laterally of the machine.

38. In a shell drawing machine, a plurality of telescoping punches and means for actuating the punches successively in one direction to effect a plurality of successive draws; the said means comprising a plurality of levers connected to the plurality of punches to independently operate the same with the levers arranged laterally of the machine, a plurality of reciprocable links connected to the levers and elements for reciprocating the links.

39. In a shell drawing machine, a plurality of telescoping punches and means for actuating the punches successively in one direction to effect a plurality of successive draws; the said means comprising a plurality of levers connected to the plurality of punches to independently operate the same with the levers arranged laterally of the machine, a plurality of vertically floating links connected to the levers and a plurality of cam elements connected to the links for reciprocating the same.

40. In a shell drawing machine, a plurality of telescoping punches and means for actuating the punches successively in one direction to effect a plurality of successive

draws; the said means comprising a plurality of levers connected to the plurality of punches to independently operate the same with the levers arranged laterally of the machine, a plurality of vertically floating links connected to the levers and a plurality of cam elements connected to the links for reciprocating the same, the levers, links and cam elements being arranged in massed relation laterally of the machine.

41. A shell drawing machine, in combination, provisions for forming a shell from a metal blank, comprising punch means for cutting the blank from sheet material and for drawing the same and feeding means for feeding the sheet material to the punch means; the said feeding means comprising mechanism operative on the sheet material to place the same under tension when engaged by the punch means and to rapidly feed the same forward when disengaged by the punch means.

42. A shell drawing machine, in combination, provisions for forming a shell from a metal blank comprising punch means for cutting the blank from sheet material and for drawing the same and feeding means for feeding the sheet material to the punch means; the said feeding means comprising mechanism operative on the sheet material to place the same under tension when engaged by the punch means and to rapidly feed the same forward when disengaged by the punch means and means for checking the forward movement of the said sheet material.

43. A shell drawing machine, in combination, provisions for forming a shell from a metal blank comprising punch means for cutting the blank from sheet material and for drawing the same and feeding means for feeding the sheet material to the punch means; the said feeding means comprising feed rolls engaging the sheet material, elements for placing the feed rolls under tension when the material is engaged by the punch, the tensioned feed rolls and the said elements cooperating to exert a quick acting feeding pull on the material to feed the same forwardly rapidly when disengaged by the punch means.

44. A shell drawing machine, in combination, provisions for forming a shell from a metal blank comprising punch means for cutting the blank from sheet material and for drawing the same and feeding means for feeding the sheet material to the punch means; the said feeding means comprising feed rolls engaging the sheet material, elements for placing the feed rolls under tension when the material is engaged by the punch, the tensioned feed rolls and the said elements cooperating to exert a quick acting feeding pull on the material to feed the same forward rapidly when disengaged by the punch means, and means for checking the forward momentum of the feed material.

45. A shell drawing machine, in combination, provisions for forming a shell from a metal blank comprising punch means for cutting the blank from sheet material and for drawing the same and feeding means for feeding the sheet material to the punch means; the said feeding means comprising feed rolls engaging the sheet material, elements for placing the feed rolls under tension when the material is engaged by the punch, the tensioned feed rolls and the said elements cooperating to exert a quick acting feeding pull on the material to feed the same forward rapidly when disengaged by the punch means; the said elements being intermittently operated by the drawing stroke of the punch means.

46. A shell drawing machine, in combination, provisions for forming a shell from a metal blank comprising punch means for cutting the blank from sheet material and for drawing the same and feeding means for feeding the sheet material to the punch means; the said feeding means comprising mechanism operative on the sheet material to place the same under tension when engaged by the punch means and to rapidly feed the same forward when disengaged by the punch means and means for checking the forward movement of the said sheet material; the said mechanism including an intermittently operable roll feed on one side of the punch means, the said checking means including a continuously operable roll feed on the other side of the punch means.

47. A shell drawing machine, in combination, provisions for forming a shell from a metal blank comprising punch means for cutting the blank from sheet material and drawing the same and feeding means for feeding the sheet material to the punch means; the said feeding means comprising an intermittently operable feeding member operative on the sheet material to place the same under tension when engaged by the punch means and to rapidly feed the same forward when disengaged by the punch means and mechanism cooperating therewith and active upon for checking the feeding of the said sheet material.

48. A shell drawing machine, in combination, provisions for forming a shell from a metal blank comprising punch means for cutting the blank from sheet material and drawing the same and feeding means for feeding the sheet material to the punch means; the said feeding means comprising an intermittently operable feeding member operative on the sheet material to feed the same forward and mechanism cooperating therewith for checking the feeding of the said sheet material, the said feeding member being operative to effect a substantially in-

stantaneous feed of the material when released by the punch means.

49. A shell drawing machine, in combination, provisions for forming a shell from a metal blank comprising a series of telescoping punch means for cutting the blank from sheet material and for drawing the same and feeding means for feeding the sheet material to the punch means; the said feeding means comprising mechanism operative on the sheet material to place the same under tension when engaged by the punch means and to rapidly feed the same forward when disengaged by the punch means.

50. In a shell drawing machine, a feeding means for feeding sheet material to a punch means, the said feeding means comprising mechanism operative on the sheet material to place the same under tension when engaged by the punch means and to rapidly feed the same forward when disengaged by the punch means.

51. In a shell drawing machine, a feeding means for feeding sheet material to a punch means, the said feeding means comprising mechanism operative on the sheet material to place the same under tension when engaged by the punch means and to rapidly feed the same forward when disengaged by the punch means and means active upon for checking the forward movement of the said sheet material.

52. In a shell drawing machine, a feeding means for feeding sheet material to a punch means, the said feeding means comprising feed rolls engaging the sheet material, elements for placing the feed rolls under tension when the material is engaged by the punch, the tensioned feed rolls and the said elements cooperating to exert a quick acting feeding pull on the material to feed the same forward rapidly when disengaged by the punch means.

53. In a shell drawing machine, a feeding means for feeding sheet material to a punch means, the said feeding means comprising feed rolls engaging the sheet material, elements for replacing the feed rolls under tension when the material is engaged by the punch, the tensioned feed rolls and the said elements cooperating to exert a quick acting feeding pull on the material to feed the same forward rapidly when disengaged by the punch means and means for checking the forward momentum of the feed material.

54. In a shell drawing machine, a feeding means for feeding sheet material to a punch means, the said feeding means comprising mechanism operative on the sheet material to place the same under tension when engaged by the punch means and to rapidly feed the same forward when disengaged by the punch means and means for checking the forward movement of the said sheet material, the said mechanism including an intermittently operable roll feed and the said checking means including a continuously operable roll feed.

55. In a shell drawing machine, a feeding means for feeding sheet material to a punch means, the said feeding means comprising an intermittently operable feeding member operative on the sheet material to place the same under tension when engaged by the punch means and to rapidly feed the same forward when disengaged by the punch means and mechanism cooperating therewith and active upon for checking the feeding of the said sheet material.

56. In a shell drawing machine, a feeding means for feeding sheet material to a punch means, the said feeding means comprising an intermittently operable feeding member operative on the sheet material to feed the same forward and mechanism cooperating therewith and also active upon for checking the feeding of the said sheet material; said feeding means being operative to effect a rapid feed of the material when released by the punch means.

57. In a shell drawing machine, a bed, a plurality of telescoping punches mounted for reciprocation above said bed, a plurality of matrices having openings of graduated diameters located below said bed, means for actuating the punches successively for mating cooperation with the matrices and means arranged below the bed for removably supporting the matrices including mechanism for permitting removal and replacement of the matrices from below the bed.

58. In a shell drawing machine, an operating bed, a plurality of telescoping punches mounted for reciprocation above said bed, a matrix casing supported on the bed, matrix means removably contained in said casing and means for supporting the matrix means in the casing constructed to permit the matrix means to be removed from and replaced in the casing from beneath the bed.

59. In a shell drawing machine, an operating bed, a plurality of telescoping punches mounted for reciprocation above said bed, a matrix casing dependingly supported on the bed, matrix means removably contained in said casing and means for supporting the matrix means in the casing including mechanism for permitting the matrix means to be removed from and replaced in the casing from beneath the bed.

60. In a shell drawing machine, an operating bed, a plurality of telescoping punches mounted for reciprocation above said bed, a matrix casing supported on the bed, a plurality of matrices having openings of graduated diameter removably contained in said casing and means for sup-

porting the matrices in the casing constructed to permit the matrices to be removed from and replaced in the casing from beneath the bed.

61. In a shell drawing machine, an operating bed, a matrix casing supported thereon, matrix means removably contained in said casing and means including a slide member for supporting the matrix means in the casing and arranged to permit the matrix means to be removed from and replaced in the casing from beneath the bed.

Signed at New York in the county of New York and State of New York this 20th day of October A. D. 1921.

PHILIP J. GREAYER.