Oct. 19, 1943. R. W. ANDREWS, JR., ET AL 2,331,953

METAL WORKING APPARATUS

Filed Aug. 3, 1939 4 Sheets-Sheet 1

Fig. 1.

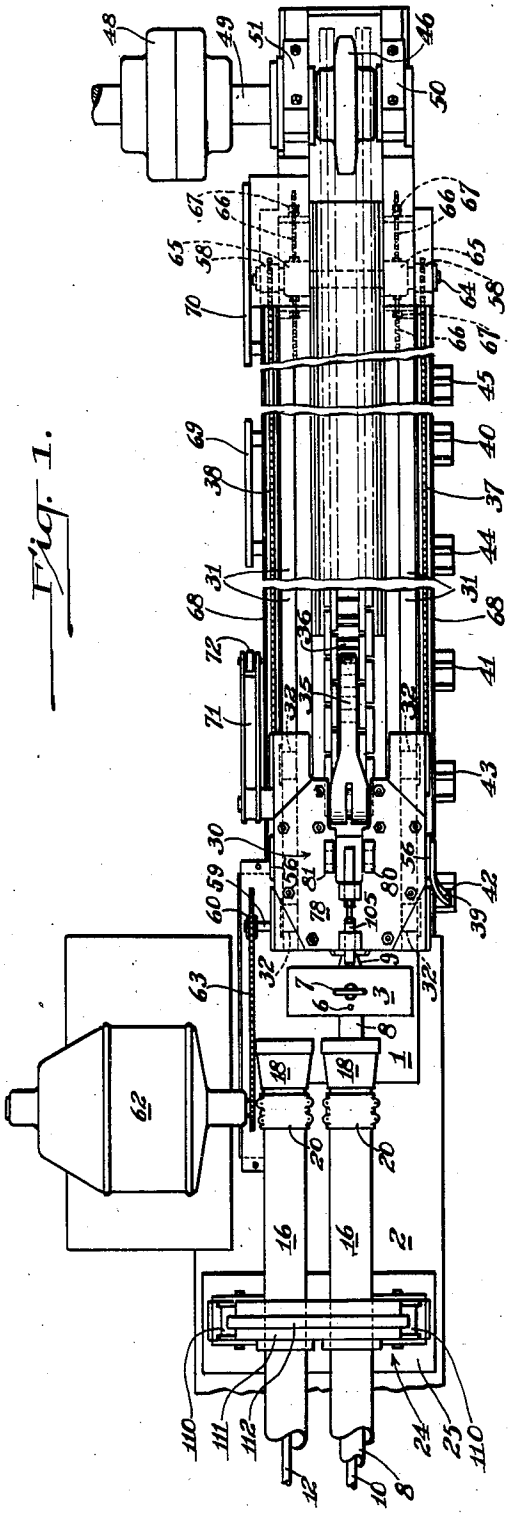
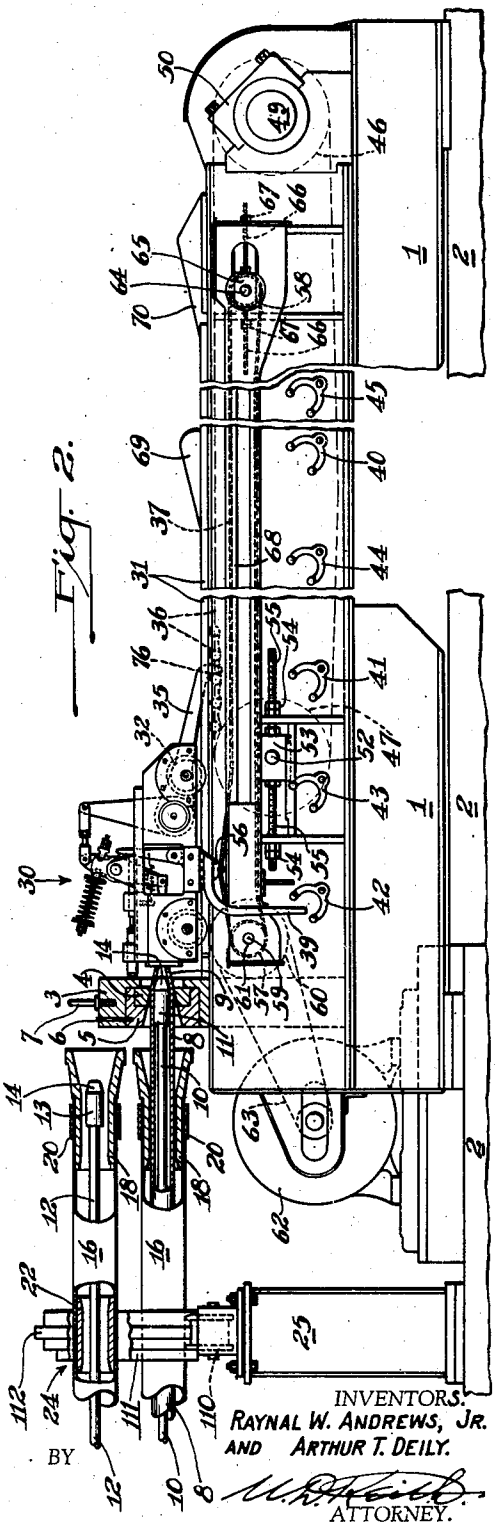


Fig. 2.



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Filed Aug. 3, 1939 4 Sheets-Sheet 2

Fig. 3.

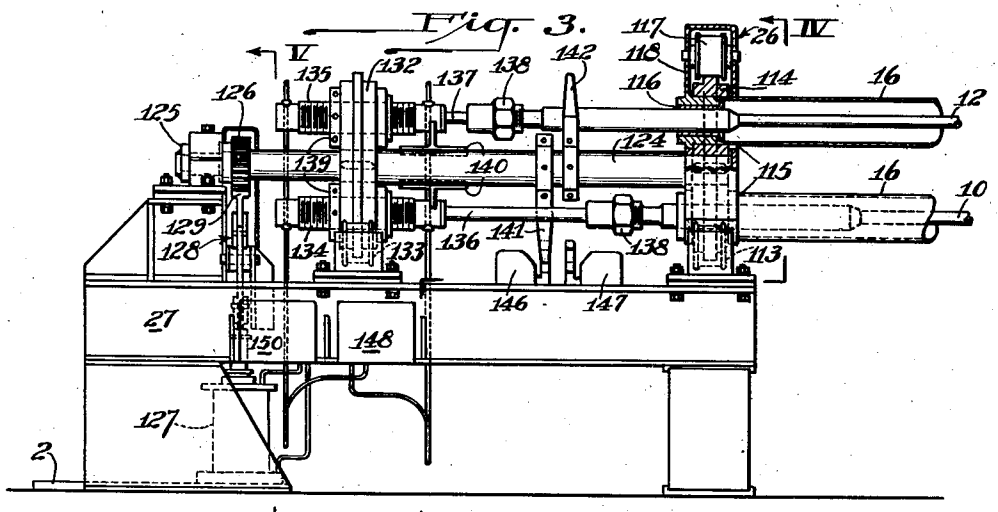


Fig. 4.

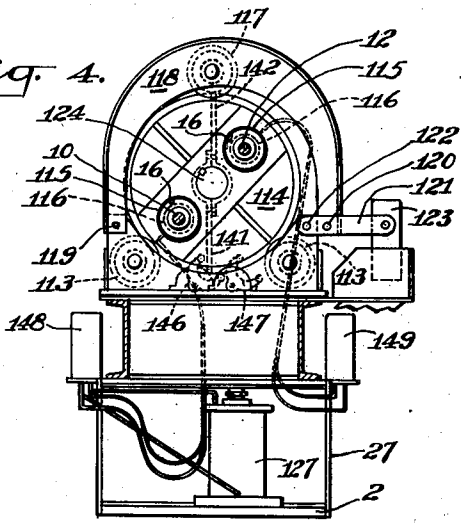


Fig. 5.

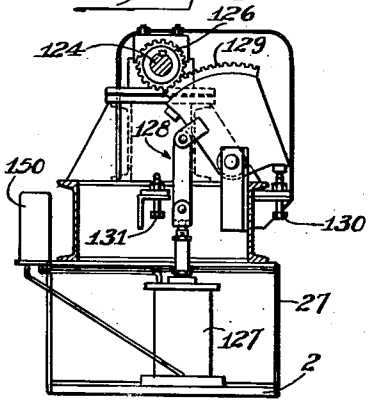
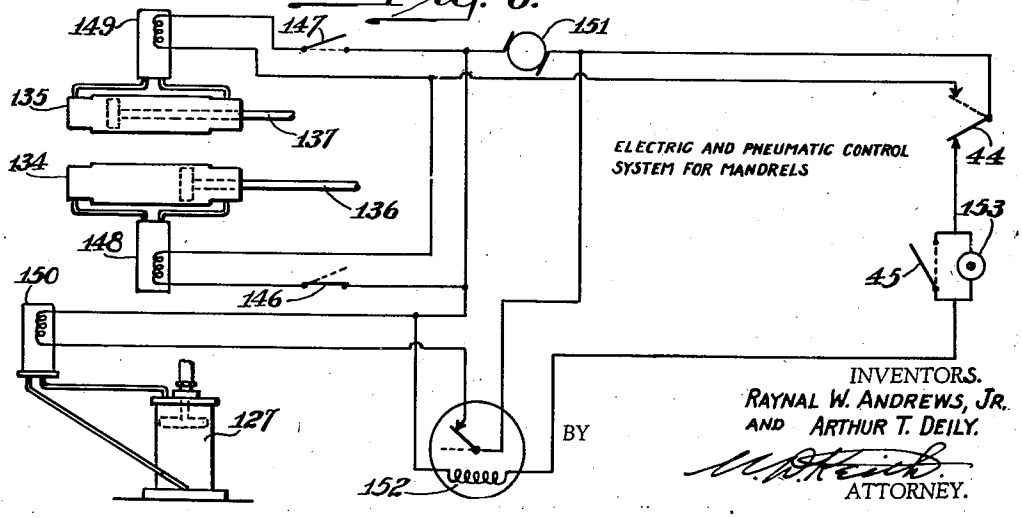


Fig. 6.



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METAL WORKING APPARATUS

Filed Aug. 3, 1939 4 Sheets-Sheet 3

Fig. 8.

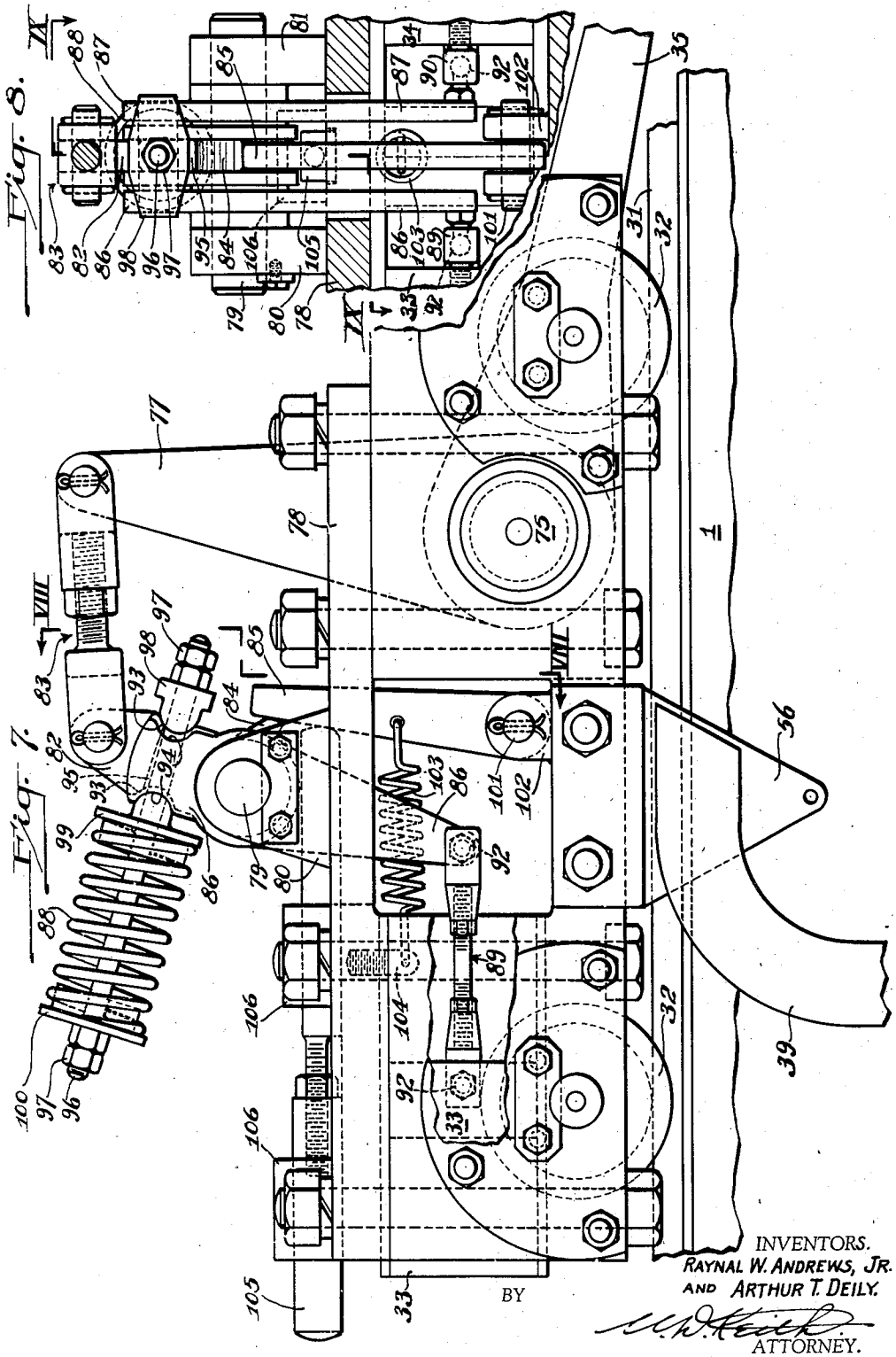


Fig. 7.

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Filed Aug. 3, 1939 4 Sheets-Sheet 4

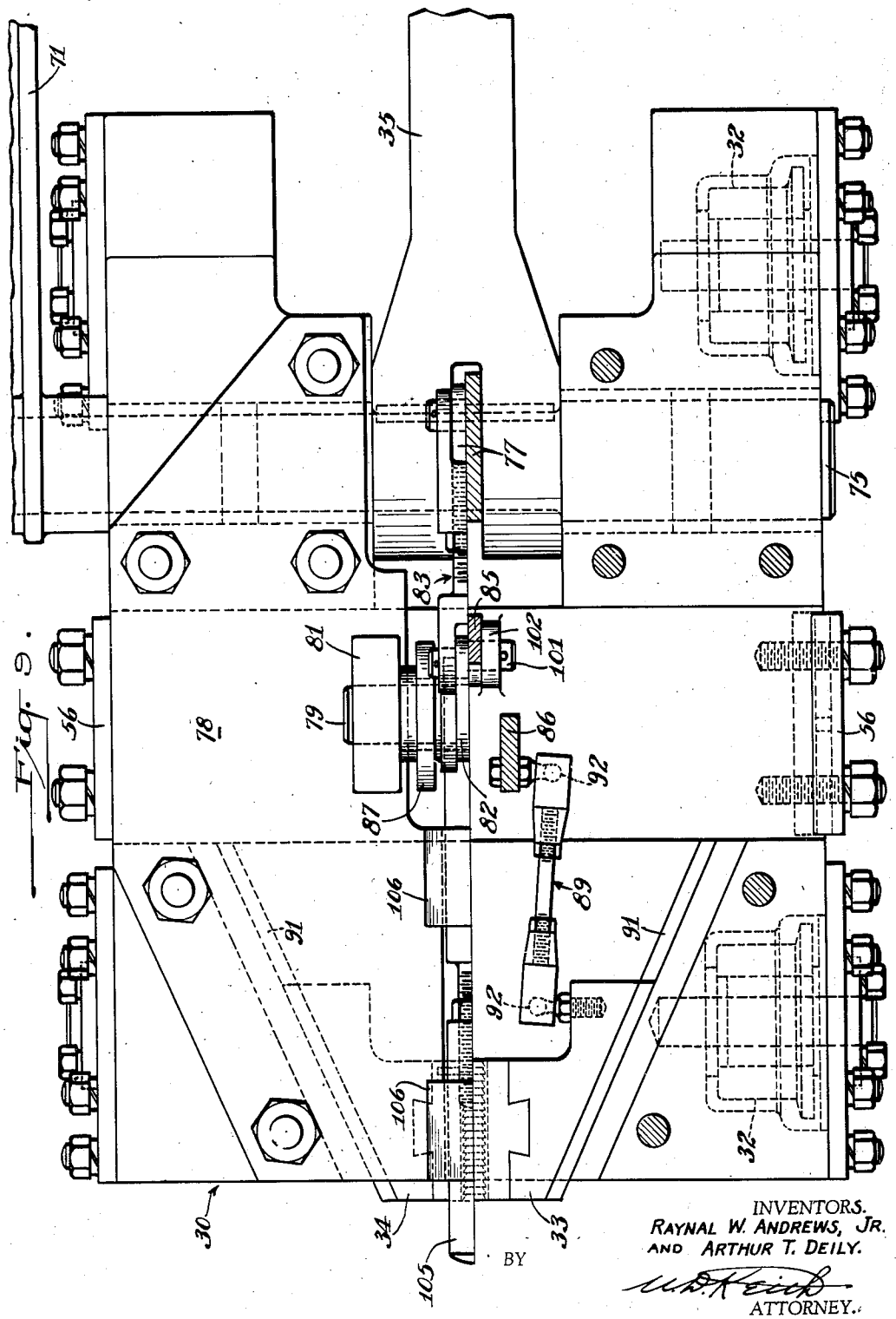


Fig. 9.

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Patented Oct. 19, 1943

2,331,953

UNITED STATES PATENT OFFICE

2,331,953

METALWORKING APPARATUS

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Application August 3, 1939, Serial No. 288,163

20 Claims. (Cl. 205—7)

This application relates particularly to means for feeding or presenting a work piece to a die, and draw head responsive devices of such character, in a metal working apparatus. Our applications, Serial No. 341,696, for improvements in Metal drawing apparatus, and Serial No. 341,697, for improvements in Carriage for metal drawing apparatus, both filed June 21, 1940, are divisions of this application.

This invention relates to apparatus for working metal shapes, and more particularly to draw benches for drawing tubular shapes, rods and the like through a die. In one specific form the invention relates to a draw bench for drawing tubular shapes which employs a die and more than one mandrel rod and bulb.

The usual draw bench for tube drawing comprises a supporting frame or frames upon which are mounted a die, a mandrel and bulb, a draw chain or the like, and a carriage having jaws for gripping the work after it has been passed over the mandrel and bulb and inserted through the die. The carriage must be moved to draw the work through the die, and for this motion generally engages with, and receives its drawing force from, a draw chain or similar device.

When tubular or hollow-shaped material is drawn, a mandrel or bulb designed to form the desired inner contour of the work is usually attached to a mandrel rod which may be slidably mounted at the rear of the mandrel end of the draw bench. The mandrel is customarily supported manually while the work is threaded thereover. Ropes and cables have been used to force the mandrel rod, bulb, and work into registry with the die. These operations and such non-positive methods of registering bulb and die have resulted in loss of useful production time and waste of material.

Also in former practices, production has been limited by the time required for the return of the drawing carriage to the die head and by the time required for passing new work over a mandrel rod and bulb.

The general object of this invention is to improve the drawing devices of the prior art to produce draw benches or similar apparatus in which the drawing operation may be performed with less loss of useful production time and less wastage of material than is now usually obtained. Specifically, this general object is obtained, in whole or in part, by the realization, singly or in combination, of the following more specific objects: The provision of a plurality of mandrel units, each one of which may be employed in registry with a die for forming a work-piece during a drawing cycle. The provision of such a plurality of mandrel units under such conditions that a new work-piece may be passed over one mandrel unit while a preceding work-piece is being worked over another mandrel unit in a drawing cycle. The provision of positive automatic means for aligning a mandrel unit with a die. The provision of positive automatic means for forcing a mandrel rod and associated bulb into registry with a die.

These and further objects and advantages of this invention, either singly or in combination, are for purposes of convenience illustrated with respect to a specific mechanism which embodies all of the specific features of the invention. It will be understood, however, that these features may be available for single use, or in any suitable combination, to improve the operation of draw benches or similar apparatus which do not include all of said features.

In the drawings :

Fig. 1 is a partial plan view of the preferred form of a mechanism embodying the features of the invention, and showing two mandrel rods, the die head, the drawing carriage, the draw chain, two return chains, and the drawing section of a draw bench generally;

Fig. 2 is an elevation of the apparatus shown in Fig. 1 showing in more detail a mandrel supporting member, the mandrel rods and bulbs, the die head, the drawing carriage, and drawing section of the draw bench generally;

Fig. 3 is an elevation, similar to and to the same scale as Fig. 2, of the mandrel manipulating, rotating, and supporting mechanism at the end of the rear or mandrel section of the draw bench and remote from the die head, in which view the mandrel rods have been rotated into a vertical plane for purposes of illustration;

Fig. 4 is a section taken on the line IV—IV of Fig. 3 showing the end mandrel supporting member, the tubular work and mandrel supporting structure, and the piping for the mandrel manipulating and rotating mechanisms;

Fig. 5 is a section taken on the line V—V of Fig. 3 showing the mandrel rotating mechanism and piping therefor;

Fig. 6 is a schematic diagram illustrative of the electric and pneumatic control system for the mandrel rotating and manipulating mechanisms;

Fig. 7 is a side elevation, to an enlarged scale, of the drawing carriage shown in Fig. 2, in which the work engaging jaws of the drawing carriage are in a closed position and the draw chain en-

gaging hook is in a lowered position, in its first engagement with the draw chain;

Fig. 8 is a fragmentary view, partly in section, of the jaw actuating crank, jaw actuating levers, and associated parts, taken along the line VIII—VIII of Fig. 7, the crank and levers being rotated into vertical position for simplicity of illustration;

Fig. 9 is a plan view of the drawing carriage shown in Fig. 7, and to the same enlarged scale, in which one-half is a section taken as indicated by the reference line IX—IX of Fig. 8.

Briefly, the apparatus as shown comprises a draw bench frame, a drawing head or carriage, a drawing die, and two work supporting mandrels. A hollow shape may be passed over one mandrel within a protecting shell or other guiding support by hand or by suitable mechanical loading mechanism (not shown); the mandrels may be rotated to align one work-piece and mandrel with the die; the point of the work-piece may be inserted through the die; and the mandrel and work-piece may be forced into registry with the die conjunctive with the beginning of the drawing action. The drawing carriage and its work gripping jaws may be actuated to clamp the point of the hollow shaped work-piece, and may be moved along the draw bench by suitable engagement with a draw chain to draw the work-piece through the die. Upon completion of a draw, the work-piece may be released to a convenient rack or removal apparatus (not shown).

Endless return means are provided for automatically traversing the drawing carriage back to the die head after completion of a drawing operation. Such endless return means are preferably operable independently of the drawing chain and preferably are adapted to control the position and rate of speed of the drawing carriage during its return movement.

It should be noted that the invention provides, inter alia, for utilizing a plurality of mandrel rods rotatable to bring each, in its turn, into position for drawing a work-piece. As will appear more fully in the detailed description of the apparatus as shown, means have been provided throughout for automatic operation of the draw bench during at least one complete drawing cycle.

Die section

The die section of the draw bench will now be described with special reference to Figs. 1 and 2 of the drawings. By the die section is meant that portion of the apparatus immediately adjacent, or associated with, the drawing die. A main frame 1 is secured on foundation 2; and at one end of the main frame (to the left as viewed in Figs. 1 and 2) is mounted a removable die head 3, incorporating drawing die 4, die retaining block 5, and retaining pin 6. The die 4 is removably mounted to facilitate change or replacement of dies to take care of different sizes and shapes of material to be drawn. The die head 3 may be removed from the frame by engagement of a crane hook with an eye-bolt 7. The die head may be suitably shimmed for alignment about the axis of draw in one or more planes, or a tilting die head, adjustable about either vertical or horizontal axes, can be employed if desired.

The work-piece, here a tube 8, is shown with its pointed end 9 inserted through die 4. As shown in the sectioned portion of Fig. 2, the drawing operation has not started, and, therefore, mandrel rod 10 and bulb 11 are not shown in full registry with die 4. A second mandrel rod 12 and bulb 13 are located above and behind mandrel rod 10 and bulb 11. Said second mandrel rod and bulb are shown in a fully retracted position, adapted to receive an undrawn work-piece. Bulbs 11 and 13 are secured to mandrel rods 10 and 12, respectively, by suitable threaded nuts 14, preferably tapered outwardly to facilitate passing of tubular and hollow-shaped stock thereover.

Means not necessarily forming part of this invention may be provided for placing a work-piece on the mandrel when it is in the position of mandrel 12. Means are shown, however, for rotating the mandrel rods to bring the mandrel rod and work-piece from the position of mandrel rod 12 to the lateral position of mandrel rod 10; and means are provided for advancing a mandrel rod and its work-piece to the die to occupy the position of mandrel rod 10, bulb 11, and tubular work-piece 8, as shown.

Means are provided for protecting and supporting a work-piece passed over a mandrel rod and bulb. These means preferably take the form of tubular shells 16 supported at convenient intervals along their length by mandrel supports 24 (one of which is shown to best advantage in Fig. 2) comprising bases 25 attached to foundation 2. Adjacent die head 3 suitable bell-mouthed guide bushings 18 are mounted within end portions of shells 16 to facilitate the entry of a hollow shape over a mandrel rod and within the protective and supporting shell. Locking bands 20, adapted to compress tubular shells 16 on bushings 18, may be readily loosened for interchange of bushings of various size depending on the size of tube to be drawn. With respect to the mandrel rod, bulb, and hollow-shaped work-piece, each guide bushing is arranged to partially support the work-piece at a point adjacent the die head when the bulb is forced into registry with the die by means of the mandrel rod. Additional guide bushings 22 are located at suitable intervals within the shells 16 and provide further points of support for the work-piece. Tubular shells 16 are designed to protect the work against scratching and dirt and, with bushings 18 and 22, to support work of considerable length. Where protection of the work from dirt is not a primary problem, the shells 16 may take the form of spaced sections or rings rather than continuous lengths of tubing as shown.

Drawing section

Referring to Figs. 1, 2, 7, 8 and 9, the drawing section of the draw bench is now described. This section of the bench is defined as that portion of the bench, including the associated apparatus, over which the stock is pulled or drawn from the die 4. The drawing section comprises generally frame 1, draw head 30, and tracks or rails 31 along which the carriage may move on carriage wheels 32. Gripping jaws 33 and 34 are located in draw head 30 and are adapted to engage the pointed end 9 of the tubular work-piece 8. Carriage hook 35 is adapted to engage endless draw chain 36. A pair of suitable return chains or other endless driving means 37 and 38 are connected to carriage 30 on either side thereof and adapted to return the carriage to die head 30 upon completion of a drawing operation.

Means are provided upon carriage 30, here in the form of trip arm 39, for actuating a plurality of limit switches 40, 41, 42, 43, 44, and 45, which

are located along the main frame 1, as shown. These limit switches are arranged to control acceleration and deceleration of drawing carriage 30 during its forward drawing and return movements, and further to control various other operations to be hereinafter described.

Draw chain 36 is centrally located within frame 1 and is supported over drive sprocket 46 and idler sprocket 47. Drive sprocket 46 is preferably driven by either one or both of two motors (preferably hydraulic, but not shown) connected to a drive coupling 48 at the extreme forward end of the bench (to the right as viewed in Figs. 1 and 2), which drive coupling 48 is connected to the draw chain drive sprocket 46 through a drive shaft 49 held in frame 1 by bearings 50 and 51. The draw chain may be lubricated by continuous immersion in a suitable oil reservoir located in the path of the under portion of the chain, but not here shown. The idler sprocket 47 is located adjacent the die end of frame 1 and is mounted on an idle shaft 52 journalled in adjustable bearings 53. These bearings may be moved longitudinally of the draw bench by means of nuts 54 on screw threaded rods 55, for adjustment of the draw chain tension or for removal of the draw chain.

The draw chain 36 has preferably a short pitch, that is, the links are made as short as possible so that variation in linear velocity of the chain will be kept at a minimum; and the drive motors for the drawing chain preferably have rigid speed control so as to produce as nearly constant drawing velocities as are feasible. By means of this preferred form of apparatus, the drawing speed may be varied from practically a stop up to normal speed, under no load up to heavy drawing load, with rapid and even acceleration, initiated by electrical control operable through limit switch 43.

Return chains 37 and 38 are fixed to carriage 30, through tie plates 56, and are supported and located on either side of frame 1, being engaged by drive sprockets 57 adjacent the die end of said frame and by idle sprockets 58 at the opposite end of said frame. Drive sprockets 57 are mounted on a common drive shaft 59, which carries belt pulley or sprocket 60, and is journalled in suitable bearings 61. The drive shaft and sprockets are driven by electric motor 62 through drive belt or endless chain 63 and belt pulley or sprocket 60. The return chain idle sprockets 58 are located on common idle shaft 64 journalled in adjustable bearings 65. Means for adjusting the tension of return chains and for permitting their ready removal are here provided in the form of threaded rods 66 and adjusting nuts 67 provided thereon. Return chains 37 and 38 are recessed in chain guards 68 for protection of both chains and operator. Suitable means may be provided for lubricating such chains where desirable.

The electric motor 62 operating said return chains is preferably adapted to be used as an electric brake upon the draw carriage 30 as it approaches the die head 3. In this way the movement of the carriage on its return to the die head is positively controlled, thus eliminating the necessity for employing previously used shock absorbers or cushioning devices to stop the carriage at the die head. The two return chains 37, 38 are preferably provided to insure alignment of the drawing carriage with the die head upon its approach thereto, but a single chain or cable may be used with satisfactory results. The acceleration and deceleration of the drawing carriage 30 on its return travel may be accurately controlled through one or more of the aforementioned limit switches, as here shown by switches 40, 41, and 42, which switches are actuated by the drawing carriage trip arm 39.

Other elements of the drawing section of the draw bench which should be noted at this point in the description are the two chain releasing cams 69 and 70. As aforementioned, the carriage 30 is positively connected to the draw chain 36 by a hook 35 carried by the carriage. Fixed upon the shaft which supports hook 35 is a hook release lever 71 (Figs. 1 and 9), which is mounted in a substantially horizontal position and extends forward of the drawing carriage on one side thereof. On the extremity of release lever 71 is a cam follower in the form of a roller 72, adapted to engage and ride up the contour of cam 69 (Fig. 2) located adjacent the die head of the drawing section of the draw bench, or of stop cam 70 located at the other extremity of the draw bench. At either cam the action of release lever 71 and its roller 72 is to lift hook 35 out of engagement with drawing chain 36, thereby bringing carriage 30 to rest.

Cam 69 is provided for the purpose of releasing the carriage hook from the draw chain when the carriage jaws have failed to engage the work-piece or in case of breakage of the work-piece during forward travel of carriage 30. In either event, there is no drawing tension on the chain. If the carriage 30 has engaged work-piece 8 through the proper clamping engagement of jaws 33 and 34 upon the work, the drawing tension exerted on draw chain 36 will lift the chain and the engaging carriage hook 35 sufficiently high to permit hook release lever 71 and roller 72 to clear the cam 69. Thus the normal drawing operation will continue until the work-piece is free of drawing die 4. At this point, drawing tension is immediately released and the draw chain tends to fall and disengage itself from the hook 35. Cam 70 functions as a safety device and hook adjusting mechanism in the event that hook 35 does not, at the end of the drawing operation and when drawing tension is released, release itself from the chain but falls therewith. In such case, the release lever 71 and its cam follower 72 contact cam 70, with the result that the hook 35 is positively raised and disengaged from the chain 36, and reset in its raised position, thus preventing the continuously traveling chain 36 from dragging the draw head 30 off the end of the bench, or preventing other injury to the assembly.

Draw head

With reference especially to Figs. 7 through 9, the draw head or carriage 30 will now be particularly described. In the carriage are the aforementioned slidable work engaging jaws 33 and 34 having suitable gripping inserts therein, as seen in Fig. 9, and which are adapted to grip the work-piece at the die head 3. These jaws are so arranged that one jaw may advance or adjust itself relative to the other, and relative to the work-piece to grip the pointed end 9 thereof and exert an axial drawing force thereon despite any irregular formation or non-axial alignment of said work-piece end. Further it may be noted that the jaws are actuated through a linkage, which will be described hereinafter, by means of

the forces exerted by the draw chain 36 on the chain engaging hook 35.

The carriage or draw head 30 is provided with a transverse shaft 75 journalled in the frame thereof. Centrally on said shaft is keyed the clevised end (see Fig. 9) of carriage hook 35. This hook has a link-engaging portion 76 which is arcuate in form (see Fig. 2) to conform with a link of the draw chain, the said arcuate portion being preferably adapted to engage somewhat more than 90° of arc on any particular link. Also keyed to shaft 75, at one end thereof, and located outside the frame of carriage 30, is the hook release lever 71 and its cam contacting roller 72. The keyed angular relationship of hook 35 and hook release lever 71 on through shaft 75 is such that when lever 71 is in its lower position, its roller 72 would engage cam 69 or stop cam 70, on approach thereto, and rise thereon, thereby raising hook 35.

Also keyed to shaft 75 between forked portions of the clevised end of hook 35 is a crank lever 77 extending in a generally vertical direction above top plate 78 of carriage 30, said hook 35 and crank lever 77 substantially forming a bell crank oscillatable with said shaft 75, in accordance with the forces imparted to the hook by means of the draw chain 36, or to the hook release lever 71 by means of the cams 69 or 70.

Disposed laterally and approximately centrally of carriage 30, above top plate 78, is pin 79 supported and retained in bearing blocks 80, 81. Oscillatable on pin 79 is a centrally disposed crank 82 which extends upwardly therefrom in a generally vertical direction. Adjustable link 83 connects the upper extremities of crank 82 to crank lever 77, whereby crank lever 77, adjustable link 83, and crank arm 82 form, with the frame of the carriage, a quadric-crank linkage.

Preferably integrally formed with the lower portion of crank 82 is a projection forming a latch 84 adapted to be engaged by pawl 85, whereby the quadric-crank linkage actuated by hook 35 or release lever 71 may be latched with the hook in its raised position in a manner which will be more fully described hereinafter.

Also oscillatably mounted on pin 79, on either side of crank 82, are jaw-actuating levers 86 and 87, which levers have portions extending in a generally vertical direction above pin 79 in normally parallel relationship with crank arm 82, and jaw-actuating portions extending below pin 79 to act as lever arms. Jaw-actuating levers 86 and 87 are independently oscillatable on pin 79 and are inter-related in their action by a double acting spring 88 and associated parts. At the lower extremities of said jaw-actuating levers are adjustable links 89 and 90 connecting to work-engaging jaws 33 and 34, respectively. Said jaws are slidable on converging ways 91 (see Fig. 9). The latterly described portion of the actuating linkage for each jaw may be referred to as a slider-crank linkage, said linkage comprising a jaw-actuating lever, an adjustable link, and a jaw slidable on a converging way.

To provide for convergence of the jaws, and for the angular movement of adjustable links 89, 90 with respect to levers 86, 87 and the jaws 33, 34, suitable ball-and-socket connections 92 have been provided between each of said levers and each of said adjustable links and between each of said links and each of said jaws.

Approximately central of the length of the crank 82 on either side, and in the directions of oscillation thereof, are recessed, concave bearing portions or seats 93, substantially semi-cylindrical in form. On the upper extremities of jaw-actuating levers 86, 87 on either side, and in the directions of oscillation thereof, are similar recessed, concave bearing portions 94, substantially semi-cylindrical in form and adapted to lateral alignment with the corresponding bearing portions 93 on crank 82. Crank 82, at the level of recessed bearing portions 93, has an aperture 95 extending therethrough in a direction substantially tangential to the arc of rotation thereof. Extending through aperture 95, in approximately the same plane as contains the quadric-crank linkage and normally perpendicular to crank 82, is adjustable tie bolt 96 threaded at either end, to receive adjusting nuts 97. Mounted preferably on the forward end of the tie bolt 96, in the direction of draw, is bearing member 98 engaging crank 82 and jaw-actuating levers 86, 87 in the aforedescribed bearing portions 93 and 94, respectively. The said bearing member 98, which is axially slidable on tie bolt 96 and positionable thereon by means of nuts 97, extends laterally across crank 82 and across the jaw-actuating levers 86, 87, and is adapted to engage with either of said jaw-actuating levers or said crank independently, or at times with all of them simultaneously. For engaging the opposite bearing portion of crank 82, or the opposite bearing portions in jaw-actuating levers 86, 87, is a second bearing member 99 similarly mounted on said tie bolt 96. The two bearing members 98 and 99 are provided with semi-cylindrical or convex bearing surfaces adapted to engage in the aforesaid semi-cylindrical or concave bearing recesses of the crank and the levers.

The bearing member 99, slidable on tie bolt 96, serves further as a spring seat for double-acting spring 88, which spring is mounted surrounding the said tie bolt 96 on that portion of the tie bolt which extends, to the left as viewed in Fig. 7, toward the jaw portion of the draw head 30. An opposing spring seat 100 is located at the end of tie bolt 96 and is slidable thereon, being adjustable for position by means of adjusting nuts 97.

Levers 86, 87 and crank 82 are cooperatively related by means of the aforementioned double-acting spring, tie bolt, spring seats, and bearing members. The two-fold purpose of the spring and associated elements is, briefly, (1) to tend to keep levers and crank in the same axial line so that they may function substantially as one split lever oscillatable on the pin 79, and yet permit the levers to advance or retract relative to each other in response to movement of the crank, and in response to the relative positions assumed by the work-engaging jaws as they positively and separately engage the work; and (2) to store jaw-opening energy by compression in the spring whereby the spring may effectuate movement of the levers to assist in the opening of the jaws, as will hereinafter be specifically explained. Adjustabilities afforded in the various links, and the yieldability of the spring permit ready accommodation of the apparatus to work of varying size and shape.

For engaging the aforementioned latch 84, the pawl 85 is pivotally mounted on pin 101, fitted in suitable bearings 102 located in the base of carriage or draw head 30. A spring 103 connects pawl 85 and an anchoring pin 104, and tends to hold the pawl against either latch 84 (Fig. 7), or the base of crank 82 under the said latch. For moving said pawl from its latched position under latch 84, a longitudinally-extending trip rod 105

is mounted in bearings 106 on top plate 78 of carriage 30. The said trip rod is adjustable for length, as indicated in the drawings, and is so mounted upon the carriage as to contact die head 3 as the carriage approaches said die head. Upon contacting die head 3, trip rod 105 moves against pawl 85, thereby unlatching crank 82 and allowing movement of the said quadric-crank linkage to take place.

The operation of the carriage will not be enlarged upon since it is fully set forth in our divisional application, Serial No. 341,677, abovementioned.

Mandrel section

The preferred means of presenting work-pieces to die 4 will now be described with reference to Figs. 3, 4, 5, and 6, as well as to Figs. 1 and 2. Along the mandrel section of the bench, which is that portion of the bench located on the stock feeding side of the die head 3, are a plurality of mandrel-supporting members 24. The portion of the mandrel section of the bench between an end mandrel-supporting member 26, shown in Fig. 3, and the mandrel-supporting member 24 adjacent the die head 3, shown in Fig. 2, is not illustrated in the drawings, since it will be apparent that, regardless of the length of the tubular shells 16, any convenient number of mandrel-supporting members 24 in the form shown in Fig. 2, may be provided. The end mandrel-supporting member 26, as shown in Figs. 3 and 4, is mounted upon a mandrel end frame 27.

In the form of the invention illustrated, there are two sets of mandrel rods and cooperating tubular shells. These mandrel rods are preferably rotatable about a common axis located centrally therebetween so that either mandrel rod 10 or mandrel rod 12 may be aligned with die 4. In Fig. 3 the lower mandrel rod 10 is shown in forward position corresponding to the position of the same mandrel rod as illustrated in Fig. 2, where its bulb is substantially in registry with the die 4. For purposes of illustration in Fig. 3, the mandrels have been rotated into a vertical plane, whereas in Figs. 1 and 2 they are shown in actual operable position.

The mandrels are preferably mounted parallel with, and oscillatable or rotatable about, an axis located centrally therebetween so that their peripheries have a locus describing a cylinder. It is obvious, however, that they may be mounted at an angle to each other so that their peripheries will have a locus describing a frustum of a cone. This, or other, alternate construction preferably would be such that when a mandrel is presented to a die, it would assume a position in axial alignment with the axis of draw. Alternate alignment of the respective mandrels with the die has been provided for so that a tubular shape may be drawn while registered with the die by one mandrel rod and bulb, while a new work-piece may be threaded over the second mandrel rod and bulb, in order to speed up the production of the draw bench. The mandrel-supporting members 24, including the end mandrel-supporting member 26, are provided to support the tubular shells 16 and indirectly the mandrels, throughout their length, and for constraining the path of rotation thereof.

Each mandrel-supporting member 24 comprises essentially a frame base structure 25, on which are suitably journalled two supporting rollers 110 adapted to support a disc-like block 111, adapted to be rotated with its track portion 112 bearing on said rollers. Tubular shells 16 are mounted through apertures in block 111.

End mandrel-supporting member 26 (Figs. 3 and 4) is associated with and forms part of the mandrel end frame 27. Two supporting rollers 113 are journalled on end frame 27 and on them is rotatable a disc-like block 114 similar to blocks 111 in the other mandrel-supporting members 24. On opposite sides of the axis of rotation of the block 114, suitably mounted in apertures 115 are the ends of the tubublar shells 16. Also suitably journalled in restricted bushed portions 116 of the apertures are the end portions of the mandrel rods 10 and 12. These mandrel rod end portions extend through the said apertures to make connections to the mandrel manipulating mechanisms.

To impart stability to end mandrel-supporting member 26, a third upper supporting and restraining roller 117 is mounted in a curved channel member 118 hingedly connected to one side of the end frame 27, as at 119, and retained in position over block 114 by means of a pin connection, as at 120, with a link 121 hingedly connected to end frame 27, as at 122, the link 121 having an extension thereof adapted to carry counterweight 123.

For imparting rotational movement to block 114 and thereby to the mandrel rods and tubular shells, a shaft 124 is connected to metal block 114 at its center of rotation and extends longitudinally backward from said block to a journalled thrust bearing 125 in the opposite end of mandrel end frame 27. Keyed to shaft 124 is a toothed pinion 126 at the bearing end thereof (see Figs. 3 and 5). Air cylinder 127, linkage 128, and angularly movable gear segment 129 in toothed engagement with pinion 126, are adapted to impart rotational movement to shaft 124 and thereby to the mandrel rods, first in one direction and then in the other direction, through an angle of approximately 180°. Adjustable stops 130, 131 are located on end frame 27 in relation to gear segment 129 to limit the rotational movement of said gear segment in either direction. These adjustable stops may be so arranged that when gear segment 129 is brought in contact with one or the other stop upon its rotation, a mandrel rod and bulb will be in proper alignment with the draw die 4.

Mounted on shaft 124 between the end mandrel-supporting member 26 and the mandrel rotating mechanism just described is another disc-like block 132 bearing on rollers 133 suitably journalled on mandrel end frame 27. This block 132 is adapted to support manipulating mechanisms 134, 135 for the mandrel rods 10 and 12, respectively. These manipulating mechanisms comprise suitable double acting pistons and piston rods 136 and 137 adjustably connected to the end portions of the mandrel rods. The manipulating mechanisms are preferably operable by means of compressed air but other suitable motive means may be employed. The adjustable couplings 138 between the end portions of mandrel rods 10, 12 and the piston rods 136, 137 permit slight adjustment of the position of each mandrel to locate its mandrel rod bulb correctly with respect to the die, but are primarily provided to make convenient the interchange of various sizes of mandrel rods.

The manipulating mechanisms 134 and 135 are adapted to longitudinally or axially move the mandrel rods and bulbs into and out of registry

with the die in response to control which will now be described. The mechanisms are adjustable for longitudinal position to initially correct any appreciable error in registry of bulb and die. This adjustment is obtained by means of suitable spanner nuts 139 located in apertures in the block 132, and adapted to engage threads on mechanisms 134 and 135, said mechanisms being keyed to shaft 124, as at 140, to prevent relative rotation, while permitting relative longitudinal adjustment.

To make clear the function of the various elements of the mandrel section just described, certain parts of its operation will now be explained. Each manipulating mechanism 134, 135 is adapted to move a mandrel rod and bulb into registry with the die 4 at the beginning of a drawing operation. Upon the beginning of a drawing operation the friction of the material being drawn over the mandrel rod bulb immediately places the mandrel rod in tension which must be resisted by the mandrel manipulating mechanism, the end mandrel-supporting member, and the thrust bearing provided on the end of the shaft 124. The channel member 118 and upper roller 117 in end mandrel-supporting member 26 are adapted to maintain the block 114 in vertical position and resist the overturning couple which may be imparted thereto by the drawing force on a mandrel rod and reacting force in the shaft 124. Bushed portions 116 have been provided in the apertures 115 in block 114 to support and locate the mandrel rods 10 and 12, and to prevent overflexing thereof and the transmission of flexure to the mandrel manipulating mechanisms.

Mounted on shaft 124 between end mandrel-supporting member 26 and manipulating mechanisms 134 and 135 are two limit switch dogs 141 and 142 in the form of radial arms extending in opposite directions along approximately the same diametrical line. Located approximately centrally of mandrel end frame 27 beneath shaft 124 are two limit switches 146 and 147 adapted to be engaged and actuated respectively by limit switch dogs 141 and 142. Rotational movement of shaft 124 is adapted to bring one limit switch dog into position to actuate one limit switch, and opposite rotational movement of shaft 124 is adapted to reverse the position of that limit switch dog, while the other limit switch dog engages and actuates the second limit switch in alternate fashion. Limit switches 146 and 147 are electrically inter-connected with spring-held solenoid valves 148 and 149 which are in pneumatic circuit with the pressure source and the manipulating mechanisms 134 and 135. A third solenoid valve 150 is in pneumatic circuit with the pressure source and the air cylinder 127 for rotating the mandrel rods. The pressure source and intake lines therefrom to the solenoid valves 148, 149, 150 are not shown in the drawings, their arrangement being conventional.

Particular reference is now made to Fig. 6, in which the electric and pneumatic control system for the mandrel rods, including operating lines to the mandrel manipulating mechanisms 134, 135 and the mandrel rotating cylinder 127, are illustrated. For controlling the rotation and manipulation of the mandrel rods, the aforementioned limit switches 44 and 45 on the main frame 1 of the draw bench are inter-related with the limit switches 146 and 147 on the mandrel end frame.

Solenoid valve 150 controls the air, or other pressure medium, supply to either side of the mandrel rotating cylinder 127, and is connected across an electric power source 151 through ratchet-type relay 152, which is actuated by a control circuit connected across power source 151 through both limit switch 44 and limit switch 45. Limit switch 45 may be replaced by or used in parallel with a push button 153, the latter alternative being illustrated in Fig. 6; and this limit switch 45, if employed as such, should be of the momentary contact type, whereas the other limit switches described herein are of the ordinary circuit making and breaking type. By positioning limit switch 45 further from the die head 3 than limit switch 44, on the main frame of the draw bench; the successive action (45, then 44) of these limit switches (upon return movement of carriage 30) will energize and move the ratchet of the ratchet-type relay 152 to actuate solenoid valve 150, thereby directing air to one side of the mandrel rotating cylinder 127, and then open the circuit through relay 152; and upon the reverse successive opening (44, then 45) of the limit switches, they will have no effect upon the mandrel rotating cylinder 127 until the next cycle, switch 44 being moved only to select the circuit through relay 152.

For controlling the supply of air to either side of the mandrel manipulating mechanisms 134 and 135, the solenoid valves 148 and 149 are also connected across the power source 151 through limit switches 146 and 147, respectively, and through the opposite terminal of limit switch 44 on the main frame of the draw bench. Since the limit switches 146 and 147 are operable upon rotation of the mandrel rods and shaft 124, their successive effect upon the system will be automatic following the actuation of mandrel rotating cylinder 127.

The inter-relation of the electric and pneumatic control system for the mandrel rods will become more apparent as the operation of the draw bench generally is described in further detail hereinafter.

Operation

Assuming a tube on a mandrel rod in the loading position, the carriage 30 on the tracks 31 at some distance from the die head 3, and the draw chain moving, such as would be the case following completion of a previous drawing operation, a cycle of operations may be instituted by the closing of a control switch (not shown) adapted to initially energize the return chain operating motor 62.

Upon energization of the carriage return motor 62 movement of the carriage 30 toward the die head 3 will begin. The limit switch dog 39 on carriage 30 will first strike the limit switch 45 which, because of the previous closing of limit switch 44 on its first terminal in the circuit to solenoid 150 (as in Fig. 6) on movement of the carriage away from the die, will by momentary electrical contact (dotted position of switch 45, Fig. 6) energize the coil of ratchet-type relay 152, closing or opening the switch thereof. The push button 153 is shown as adapted to serve the same purpose as switch 45. The solenoid valve 150 having been energized or de-energized and actuated by relay 152 to direct air to the mandrel rotating cylinder 127, a piston therein will move to the position shown in Fig. 6, for example, causing mandrel rods 10 and 12 and associated parts to index through 180° and bring the new tube into alignment with die 4. As the mandrel rods 10 and 12 approach the end of

their rotational movement, a limit switch dog, e. g., dog 141, will engage a limit switch, e. g., 146, closing the same (as in Fig. 6) and thereby partially close the circuit to a solenoid valve, e. g., 148, adapted to control the supply of air to a mandrel manipulating mechanism, e. g., 134. The closing of the limit switch 146, or in the next cycle 147, may be described as a selective operation adapted to predetermine which mandrel rod will be advanced upon the closing of the limit switch 44 upon its second terminal (shown dotted in Fig. 6), later to be effected as the carriage moves toward the die, since when one limit switch 146 or 147 is closed, the other is necessarily opened, as here constructed.

At a position along the main frame of the draw bench nearer the die head 3, the limit switch dog 39 on the carriage 30 engages and operates limit switch 40. Upon the movement of limit switch 40, the field control of the return drive motor 62 is, in the operation here described, modified to bring the return speed of the carriage to a substantially constant base value.

At a position along the main frame of the draw bench still nearer the die head, the said limit switch dog 39 engages and operates limit switch 44. Upon the movement of limit switch 44 to its second terminal (dotted position, Fig. 6), the energizing circuit to the mandrel rotating cylinder 127 is completely disconnected, without effect thereon since the circuit is normally open at switch 45 or push button 153; and the circuit to the previously selected manipulating mechanism solenoid valve, e. g., 148, is closed, whereupon a mandrel manipulating mechanism, e. g., 134, is operated to move a piston rod, e. g., 136, mandrel rod, e. g., 10, and bulb, e. g., 11, connected thereto forward into registry with die 4, as shown in the figures, thereby moving a tube 8 substantially into drawing position in said die. At this position the pointed end 9 of the tube extends through die 4 for engagement by the jaws 33 and 34 of the drawing carriage 30.

Upon further approach of the carriage 30 to the die head the limit switch dog 39 strikes and actuates successive limit switches 41, 43, and 42, which in that order respectively decrease the speed of the return drive motor 62 by armature shunt control, decrease the speed of the draw chain 36 to a pre-set initial drawing speed, and stop the motion of the drawing carriage as it approaches the die head by applying dynamic braking through the drive motor 62.

As carriage 30 comes to rest at die head 3, trip rod 105 contacts the die head and releases pawl 85 from under latch 84, whereupon hook 35 falls into and engages its arcuate portion 76 with a link of chain 36. The falling motion of the hook 35 imparts a closing movement to the jaws 33, 34 as described above, whereupon the jaws engage and grip the pointed end 9 of a properly positioned tube 8.

The draw chain 36 may be moving at a slow speed or stopped as controlled by the limit switch 43. If stopped the draw chain would then be started by a manually actuated switch or other device (not shown). Assuming that it is moving at a slow speed as here provided, immediately upon the engagement of the hook 35 with the draw chain, the carriage 30 begins its travel away from the die head and the drawing of the tube begins. Drawing tension through the chain, hook, carriage, jaws, tube, mandrel rod bulb, and mandrel rod raises the hook 35 to its normal position, where crank 82 is latched by pawl 85, clamps the jaws 33 and 34 upon the pointed end 9 of the tube 8, and brings the mandrel rod bulb 11 into final registry with the die 4.

Before continuing with the description of the operation, it may be pointed out that if the jaws should fail to engage the end of the tube there will be no tension on the chain 36 and the hook 35 will not be substantially raised. Rather than permit the carriage 30 to travel out the full length of the frame, means for stopping the carriage and returning it again to the die head are provided. The roller follower 72 of hook release lever 71 will strike the cam 69, which will raise the hook release lever and will release the hook from the chain, whereupon the carriage 30 may have a short return travel back to the die head to re-engage tube 8.

Assuming, however, that the jaws have engaged the end of the tube upon the falling of hook 35 into the draw chain, the motion of the carriage outward under drawing tension will continue as first described. The hook will be raised and latched by the tension on the chain, but the jaws will remain closed under the force exerted by the work tending to draw them into tighter engagement therewith despite the fact that compression of spring 88 aforedescribed will also tend to open the same.

The limit switch dog 39 on the carriage 30 will first actuate and engage limit switch 42, resetting the same and electrically disconnecting from circuit the return drive motor 62 so that the return chains 37 and 38, fixedly connected to the carriage, may cause reverse rotation of the drive motor 62 against no electromagnetic forces.

The limit switch dog 39 will next reset the limit switch 43 and cause acceleration of the drive chain 36 from its initial slow speed to normal drawing speed.

The next limit switch 41 will be merely reset without effect upon the cycle of operations.

Likewise the next limit switch 44 will be reset, to its first position (as shown in full line in Fig. 6), closing in part the circuit to the ratchet-type relay 152 with as yet no effect thereon. But the resetting of this limit switch 44, however, opens the circuit to the solenoid valve, e. g., 148, which will then be spring actuated to reverse the flow of air, or other pressure medium, to the opposite side of a piston in a manipulating mechanism, e. g., 134, tending to withdraw a mandrel rod, e. g., 10, and bulb, e. g., 11, from registry with die 4. This tendency, however, will remain ineffective while there is drawing tension on a tube 8, but will be adapted to withdraw the mandrel rod and bulb upon completion of the drawing operation.

The next limit switch 40 will be merely reset without effect upon the cycle of operations.

The final limit switch 45 will be reset to an ineffective position without affecting the cycle of operations, whereupon the electric and pneumatic control system will be then in condition for operation as described at the beginning of this drawing cycle.

Before completing the description of the operation, it is to be noted that successive drawing cycles differ in that the switch of relay 152 will be open in one case and closed in the next; likewise solenoid 150 will be spring-held in one case and electro-magnetically-held in the next; and likewise elements 141, 146, 148, 134, 136, 10, and 11 will be active in one case, and corresponding elements 142, 147, 149, 135, 137, 12, and 13 respectively will be active in the next, as far as concerns the actual drawing operation.

After passing these limit switches, preferably located within a distance from the die head corresponding to the minimum length of tube to be handled, the carriage 30 will continue to be drawn out along tracks 31 on main frame 1 by draw chain 36 until tube 8 is drawn completely through die 4. When tube 8 makes its exit from die 4, there will be an immediate release of drawing tension throughout the draw bench; and the recoiling effect of the tube 8 in connection with the stored energy in the spring 88 will immediately open the jaws 33 and 34 of carriage 30, whereupon the tube 8 will be released and allowed to fall onto any suitable unloading devices arranged therebeneath (not shown). At the same time the release of tension in the draw chain 36 will permit the chain to fall from engagement with the hook 35 and the carriage will come to rest. Also the pressure of air against the piston in the manipulating mechanism, e. g., 134, will then be effective to move the mandrel rod and bulb out of registry with die 4 and to retract the same into and within its protective tubular shell 16.

The carriage is then in position for a repetition of the cycle above described. Mandrel indexing in succeeding cycles will reset the manipulating mechanism selection switches 146 and 147, and it will be apparent to one skilled in the art that the cycle of operations which may be employed with the presently disclosed draw bench is adapted to a wide variation.

As may be understood from the foregoing description, the operation of the draw bench is substantially automatic. Certain special features may be particularly pointed out. To prevent accidental damage, both of the manipulating mechanisms 134 and 135 are normally retracted and only advance after the closing of two independent limit switches, and a mandrel rod bulb remains in the die only during the drawing operation. The work may be flood lubricated externally by a stream of oil from a suitable pipe supply, which may be arranged on the mandrel section of the draw bench, or, of course, the work may be sprayed as in prior practice before being brought to the bench.

It will also be apparent from the foregoing description that this apparatus is adapted to the drawing of rods and bars not necessitating the use of mandrel rods and bulbs, upon the provision of a push rod in place of each mandrel rod, which push rod would be adapted to advance the work into registry with the die. Also, in a similar modification a fixed mandrel could be employed for drawing substantially hollow shapes.

It should be understood that many of the auxiliary devices with which this draw bench has been described are not essential to its useful operation, and that many other combinations and relations of the parts and associated devices may be employed without departing from the nature and scope of this invention as defined in the appended claims.

What is claimed is:

1. In an apparatus for die drawing metal shapes including a die and movable drawing means for drawing a work-piece through said die, the combination comprising work-holding means adapted to support the work-piece as it is drawn through said die, means for moving said work-holding means bodily into and out of axial alignment with said die, and separate means actuated by the movement of said drawing means for initially advancing the work-piece into said die when in alignment therewith.

2. In an apparatus for die drawing metal shapes including a die and movable drawing means for drawing a work-piece through said die, the combination comprising work-holding means adapted to support the work-piece as it is drawn through said die, means actuated by the movement of said drawing means for moving said work-holding means bodily into and out of axial alignment with said die, and separate means for initially advancing the work-piece into said die when in alignment therewith.

3. In an apparatus for die drawing metal shapes including a die and movable drawing means for drawing a work-piece through said die, the combination comprising work-holding means adapted to support the work-piece as it is drawn through said die, means actuated by the movement of said drawing means for moving said work-holding means bodily into and out of axial alignment with said die, and separate means for initially advancing the work-piece into said die when in alignment therewith, said work-advancing means being separately actuated by the movement of said drawing means.

4. In a metal working apparatus including a die and a movable draw head for pulling a metal shape through said die, the combination comprising a plurality of work-holding members each adapted to support a metal shape adjacent said die, means for successively translating said work-holding members bodily into and out of axial alignment with said die, and separate means associated with each said work-holding member for initially advancing the supported shape to said die when in alignment therewith.

5. In a metal working apparatus including a die and a movable draw head for pulling a metal shape through said die, the combination comprising a plurality of work-holding members, means actuated by the movement of said draw head for positively moving each said work-holding member bodily into and out of axial alignment with said die, and separate means associated with each said work-holding member for initially advancing a supported shape to said die when in alignment therewith.

6. In a metal working apparatus including a die and a movable draw head for pulling a metal shape through said die, the combination comprising a plurality of work-holding members bodily rotatable around a common axis and means actuated by the movement of said draw head for positively indexing each said work-holding member into and out of axial alignment with said die.

7. In a metal working apparatus including a die and a movable draw head for pulling a metal shape through said die, the combination comprising a plurality of work-holding members, means actuated by the movement of said draw head for positively moving each said work-holding member bodily into and out of axial alignment with said die, and separate means associated with each said work-holding member and actuated by the movement of said draw head for initially advancing a supported shape to said die when in alignment therewith.

8. In an automatic draw bench, a die and a draw carriage, means for moving said carriage in the performance of a drawing operation, means for supporting material to be drawn adjacent said die, means for moving said supporting means bodily into and out of axial alignment with said die, separate means for advanc-

ing and projecting the material into position within said die for connection to the carriage, and means carried by the carriage for grasping the material following its projection within said die, said means for moving said supporting means, said means for advancing the material, and said means for grasping the material being each separately actuated in timed relationship responsive to carriage movement.

9. In an automatic draw bench, a die and a draw carriage, means for moving said carriage in the performance of a drawing operation, means for supporting material to be drawn adjacent said die, means for advancing and projecting the material into position within the die for connection to said carriage, and means carried by said carriage for grasping the material following its projection within said die, said means for advancing the material and said means for grasping the material being each separately actuated in timed relationship responsive to carriage movement.

10. In a metal working apparatus including a die and a movable draw head for pulling a metal shape through said die, the combination comprising a plurality of work-holding members, means for successively translating said work-holding members bodily into and out of axial alignment with said die, and separate means associated with each said work-holding member and actuated by the movement of said draw head for initially advancing a supported shape to said die when in alignment therewith.

11. In a metal working apparatus including a die and a movable draw head for pulling a metal shape through said die, the combination comprising a plurality of work-holding members bodily rotatable around a common axis, and means for positively indexing each said work-holding member by bodily rotating the same into and out of axial alignment with said die throughout its work-supporting length.

12. In a metal working apparatus including a die and a movable draw head for pulling a metal shape through said die, the combination comprising a plurality of work-holding members bodily rotatable about a common axis, means for positively indexing each said work-holding member into and out of axial alignment with said die, and separate means associated with each said work-holding member for initially advancing a supported shape to said die when in alignment therewith.

13. In a metal working apparatus including a die and a movable draw head for pulling a metal shape through said die, the combination comprising a plurality of work-holding members bodily rotatable around a common axis, means for positively indexing each said work-holding member into and out of axial alignment with said die, and separate means associated with each said work-holding member and actuated by the movement of said draw head for initially advancing a supported shape to said die when in alignment therewith.

14. In a metal working apparatus including a die and a movable draw head for pulling a metal shape through said die, the combination comprising a plurality of work-holding members bodily rotatable around a common axis, means actuated by the movement of said draw head for positively indexing each said work-holding member into and out of axial alignment with said die, and separate means associated with each said work-holding member and actuated by the movement of said draw head for initially advancing a supported shape to said die when in alignment therewith.

15. In a draw bench, a die, a draw device adapted to grip a work-piece projecting through said die and draw it through the die, a rotary carrier at the entry side of said die, means rotatably supporting said carrier with its axis parallel to and laterally offset from the pass line of said die, a plurality of work supporting members incorporated in said carrier and diametrically arranged concentrically of the axis of rotation thereof, for bodily movement in a circular path intersecting the pass line of said die, one of said supporting members being disposed in loading position to receive a work-piece and the other in axial alignment with said die to support the work-piece being drawn through said die, power means operatively connected to said carrier for rotating the same, to reverse the position of said supporting members, whereby the loaded supporting member is aligned with said die and the empty one is disposed in said loading position, and means for initially moving the work-piece in said die-aligned supporting member endwise into and through said die for gripping by said draw device.

16. In a draw bench, a die, a draw device adapted to grip a tube projecting through said die and draw it through the die, a rotary carrier at the entry side of said die comprising a pair of elongate tubular members and a plurality of coaxial circular blocks spaced along said members, said members being diametrically arranged concentrically of the axis of rotation of said blocks, with one member in axial alignment with said die and the other member laterally offset therefrom, means rotatably supporting said blocks at their peripheries, power means operatively connected to said carrier to rotate the same and reverse the position of said tubular members, manipulating devices coaxial with said members at the ends thereof remote from said die, a rod connected to each manipulating device and extending through the assoicate tubular member, and a mandrel secured to the forward end of each rod, a tube to be drawn being inserted endwise over said mandrel and supportingly received in the tubular member in said offset position for delivery into axial alignment with the die upon actuation of said power means, the mandrel of the tubular member in alignment with the die being shifted forwardly by actuation of the associated manipulating device to push the tube thereon through the die for gripping by said draw device.

17. In a draw bench as defined in claim 16, wherein said tubular members are provided with a plurality of longitudinally spaced internal guides for supporting the tube received therein and a bell-mouth guide secured to the entry end of each tubular member, said mandrels in their retracted position being disposed within said bell-mouth guides.

18. In a draw bench as defined in claim 16, characterized by the provision of a coaxial shaft extending rearwardly from the end of said carrier remote from said die, a peripherally supported bearing member secured to said shaft, said manipulating devices being adjustably carried by said bearing member, and a thrust bearing for said shaft to take the reactive drawing tension transmitted thereto.

19. In a draw bench, a die, a rotary carrier including a plurality of work supporting members

at the entry side of said die for presenting successive work-pieces to said die in longitudinal alignment therewith, a work-piece being loaded endwise into one of said supporting members at a point laterally offset from said die while another work-piece is being withdrawn from the other supporting member and drawn through said die, power means for rotating said carrier to bring the loaded supporting member into registry with said die, means operable to advance a work-piece endwise into the die with its end projecting through the die, a draw head including means for gripping said projecting end, means for moving the draw head to draw the gripped work-piece through said die, and means actuated by movement of said draw head back toward said die for actuating said power means and said advancing means sequentially in the order named.

20. In a draw bench, a die, a rotary carrier at the entry side of said die and incorporating a pair of diametrically disposed work supporting members for alternate movement into longitudinal alignment with said die, means peripherally supporting said carrier for rotative movement, power means operatively connected to said carrier to rotate the same and reverse the position of said supporting members, means associated with each of said supporting members for initially advancing a supported work-piece into position projecting through said die when in alignment therewith, means actuated by rotation of said carrier for preselecting said advancing means for alternate operation, a draw head including means for gripping the projected work-piece, means for moving the draw head to draw the gripped work-piece through the die, means actuated by said draw head during return movement thereof toward said die for actuating said power means to rotate said carrier and means subsequently actuated by said draw head during said return movement thereof for actuating the preselected advancing means to advance the succeeding work-piece into position projecting through said die for subsequent drawing therethrough.

RAYNAL W. ANDREWS, JR.
ARTHUR T. DEILY.

CERTIFICATE OF CORRECTION.

Patent No. 2,331,953. October 19, 1943.

RAYNAL W. ANDREWS, JR., ET AL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, second column, line 71, for "head 30" read --head 3--; page 5, second column, line 11, for "tubublar" read --tubular--; page 9, second column, line 45, claim 16, for "assoicate" read --associate--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 7th day of December, A. D. 1943.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.

DISCLAIMER

2,331,953.—*Raynal W. Andrews, Jr.*, New Kensington, and *Arthur T. Deily*, Pittsburgh, Pa. METALWORKING APPARATUS. Patent dated Oct. 19, 1943. Disclaimer filed Feb. 14, 1946, by the assignee, *Aluminum Company of America.*

Hereby enters this disclaimer to claims 4, 11, 12, and 15 of said specification.

[*Official Gazette March 19, 1946.*]