July 29, 1958 E. M. SCHILLER ET AL 2,844,979

PINNING MACHINE

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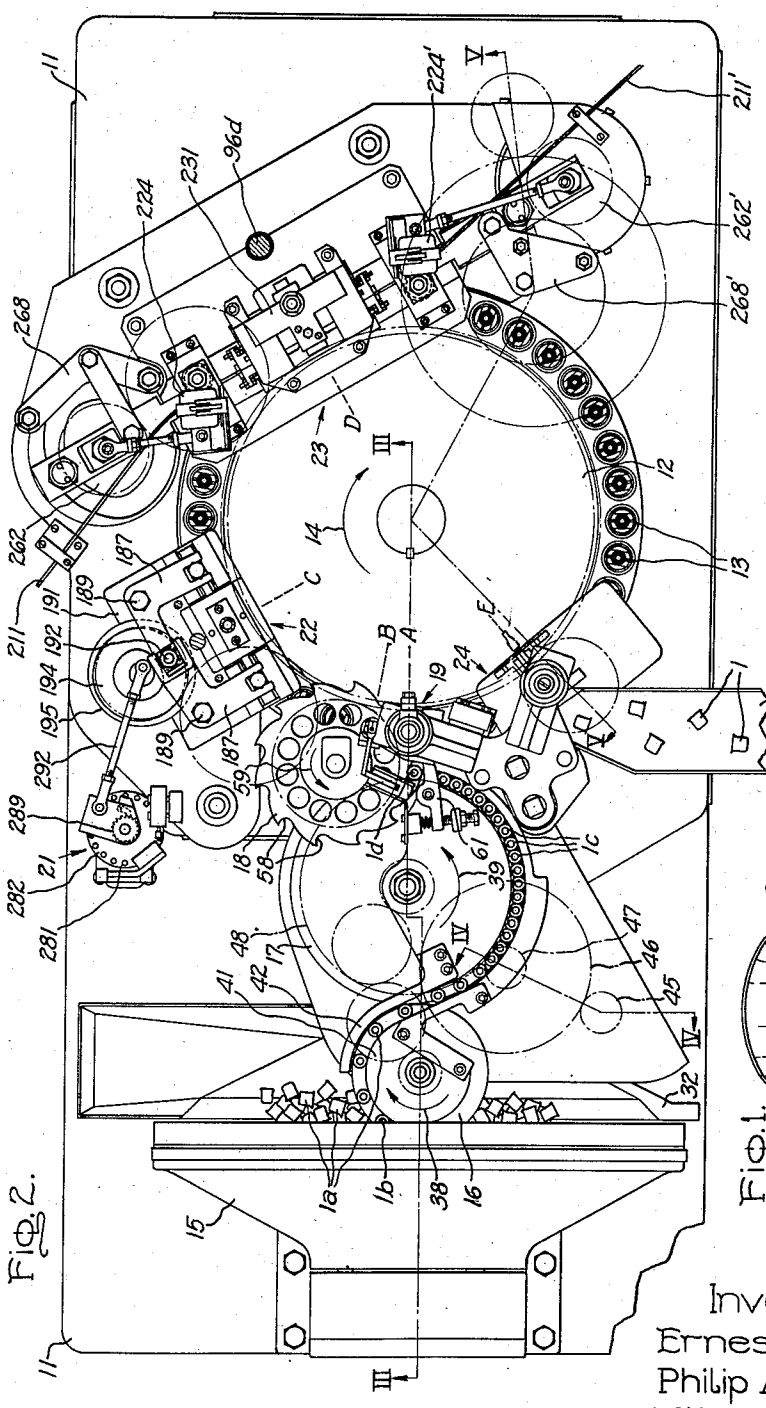


Fig. 2.

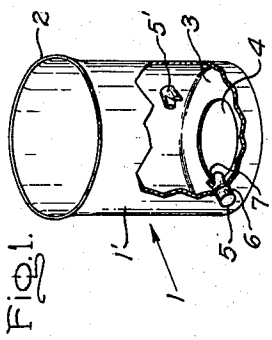


Fig. 1.

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PINNING MACHINE

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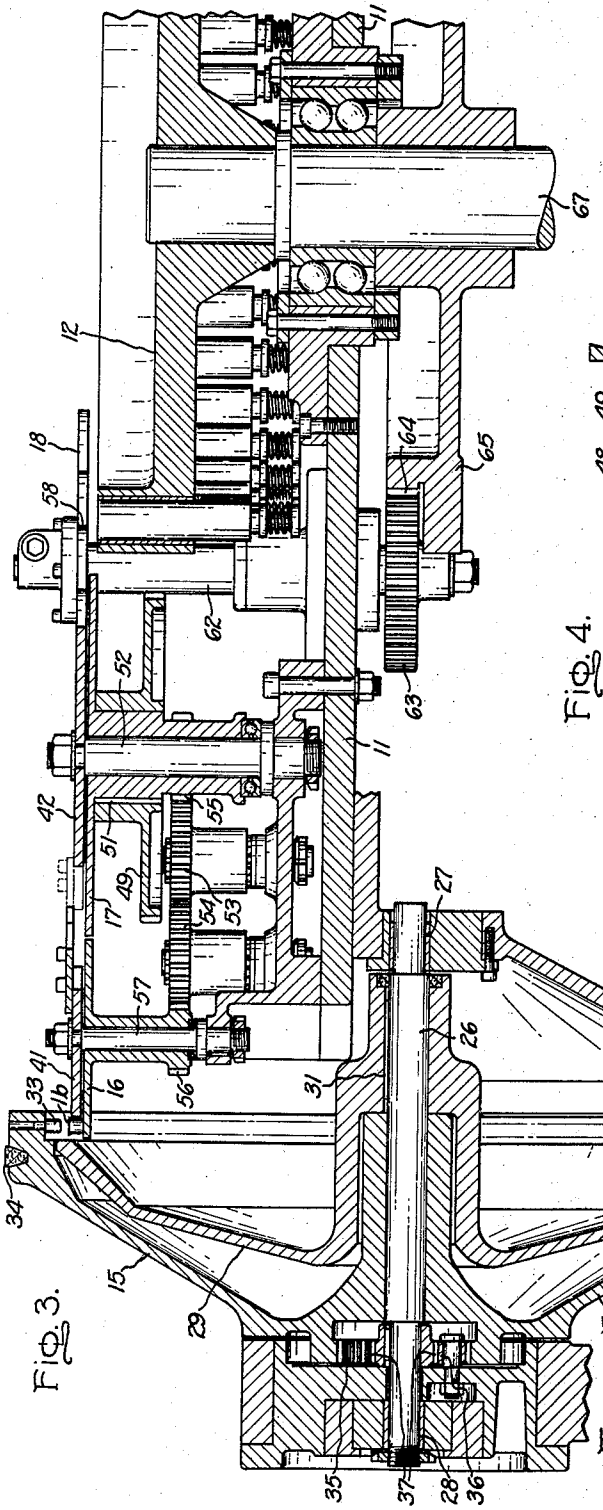


Fig. 3.

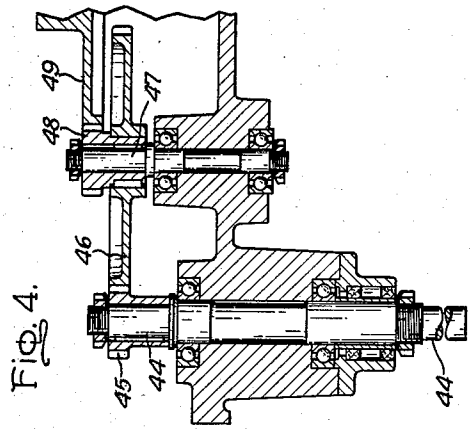


Fig. 4.

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PINNING MACHINE

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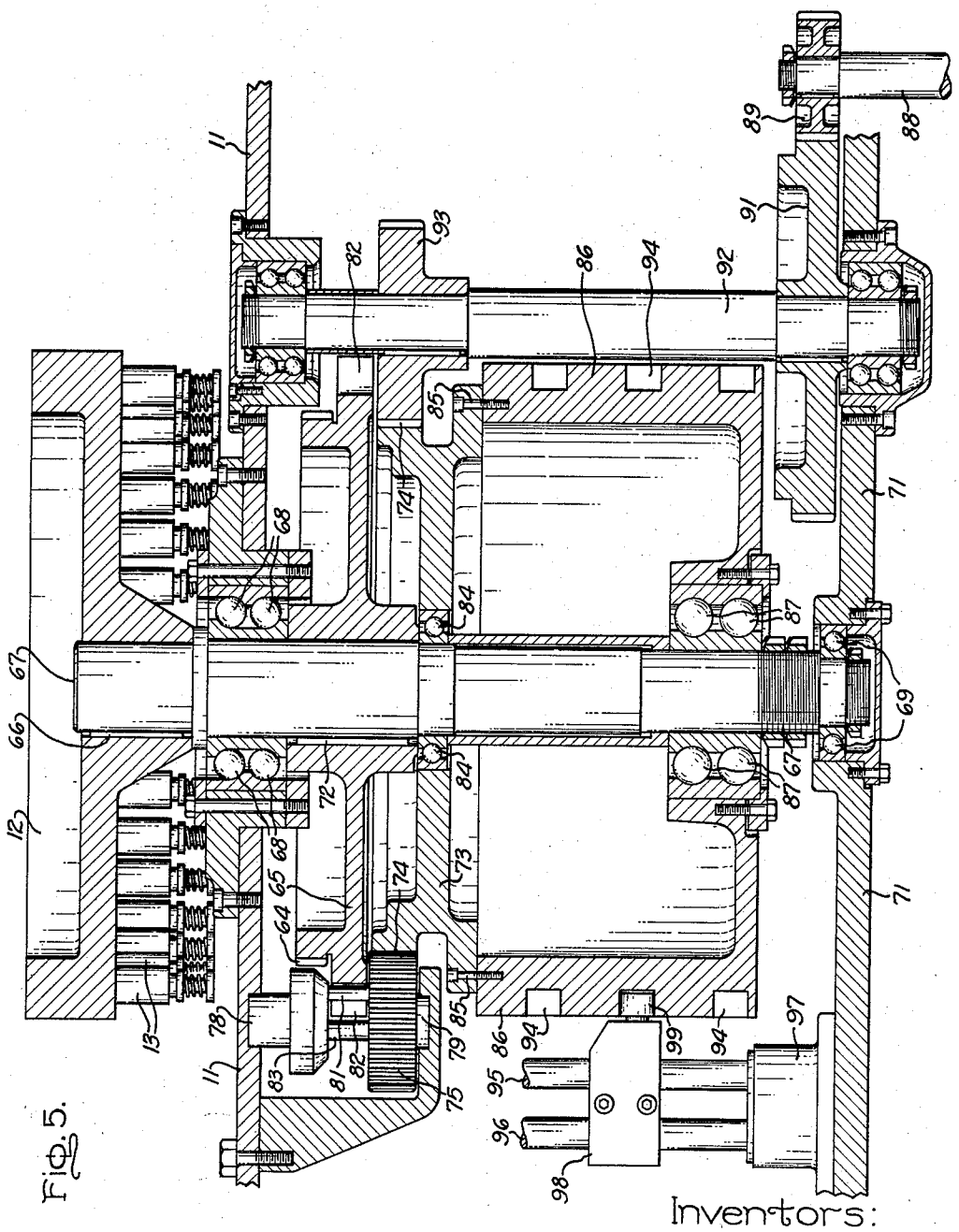


Fig. 5.

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PINNING MACHINE

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Fig. 6.

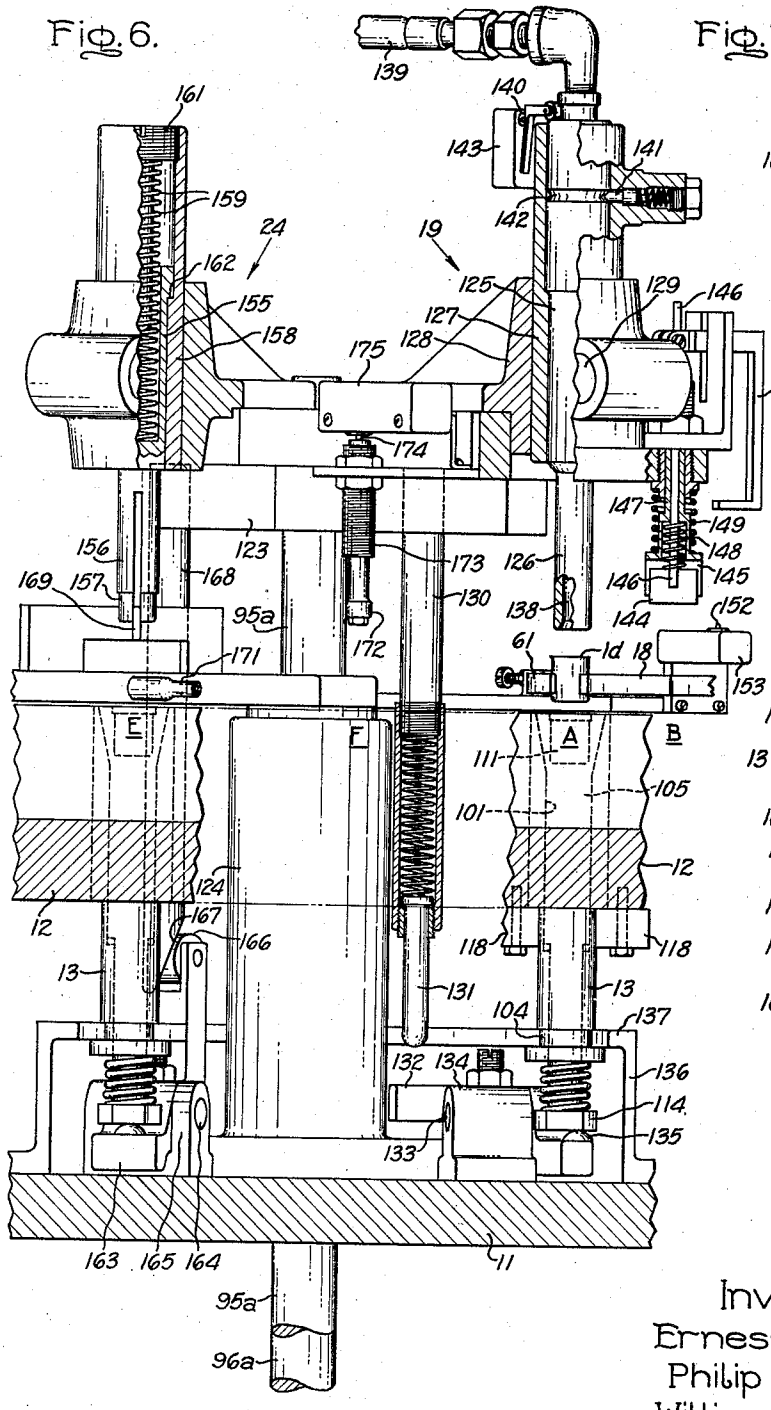


Fig. 7a.

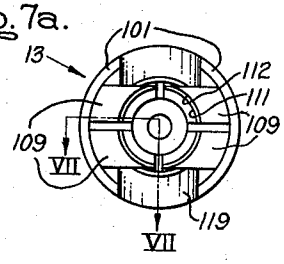
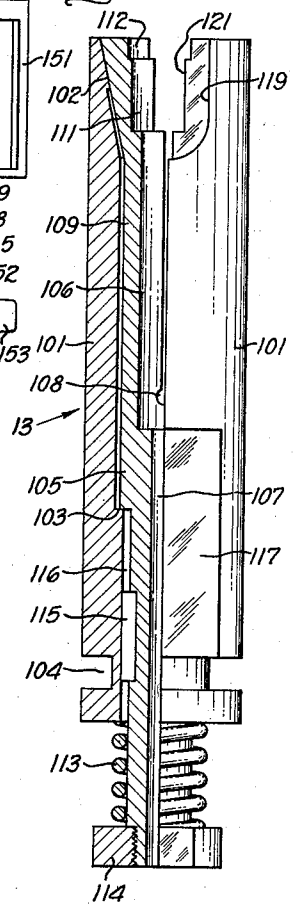


Fig. 7b.



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PINNING MACHINE

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Fig. 8a.

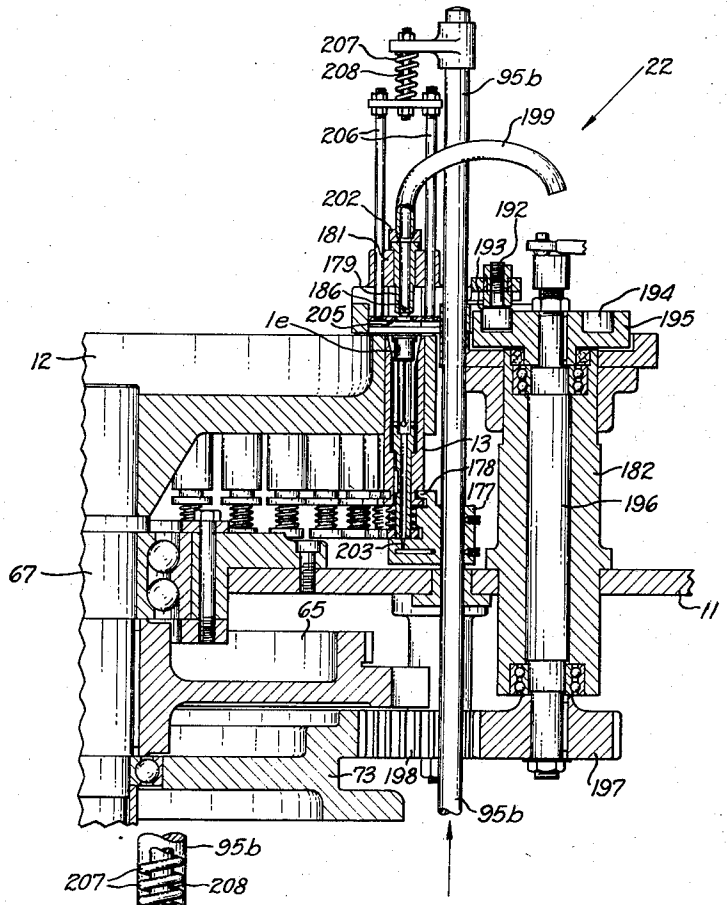
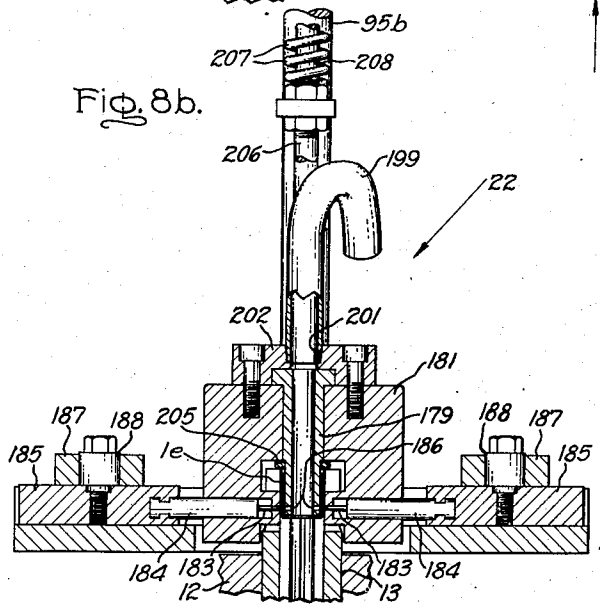


Fig. 8b.



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July 29, 1958 E. M. SCHILLER ET AL 2,844,979

PINNING MACHINE

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Fig. 9.

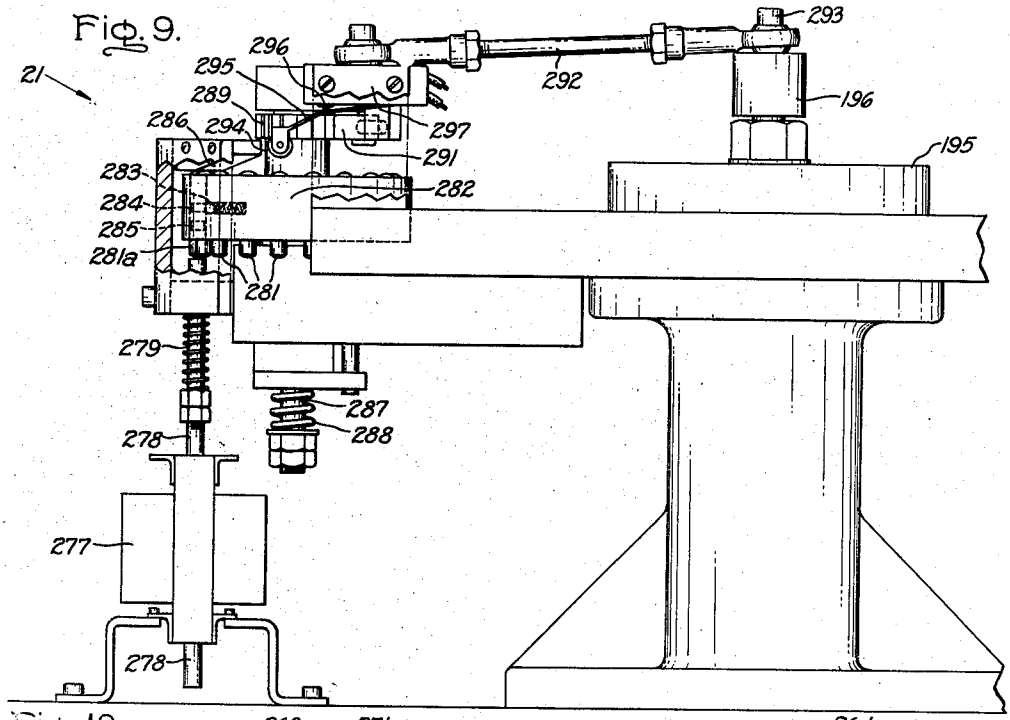
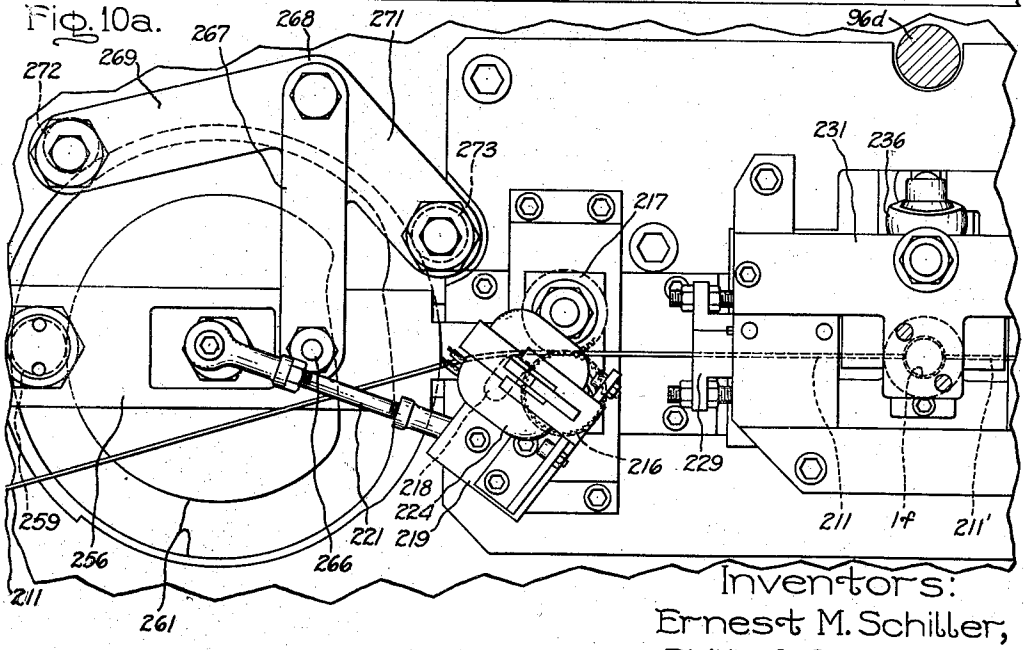


Fig. 10a.



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PINNING MACHINE

Filed April 27, 1953 9 Sheets-Sheet 7

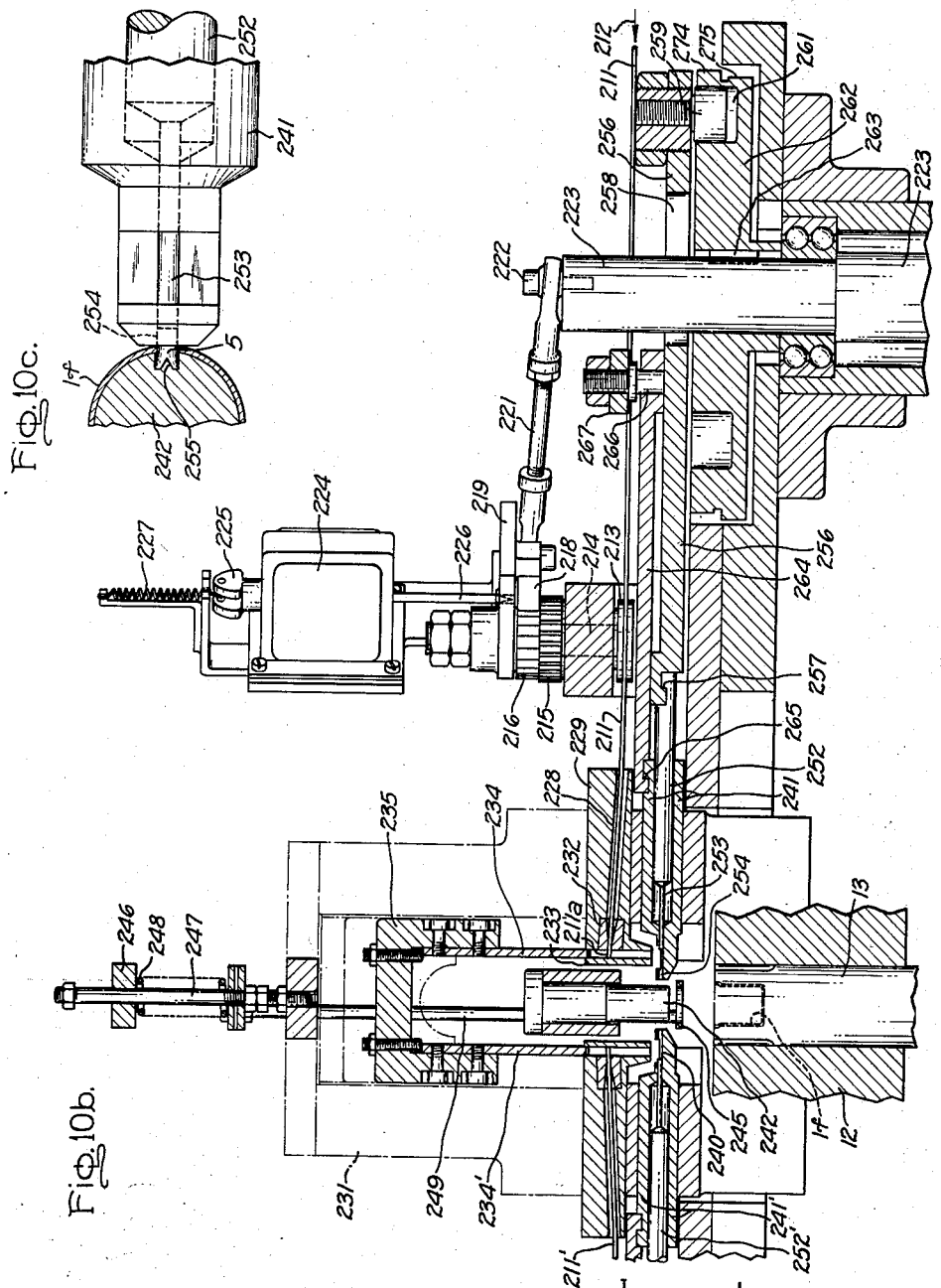


Fig. 10c.

Fig. 10b.

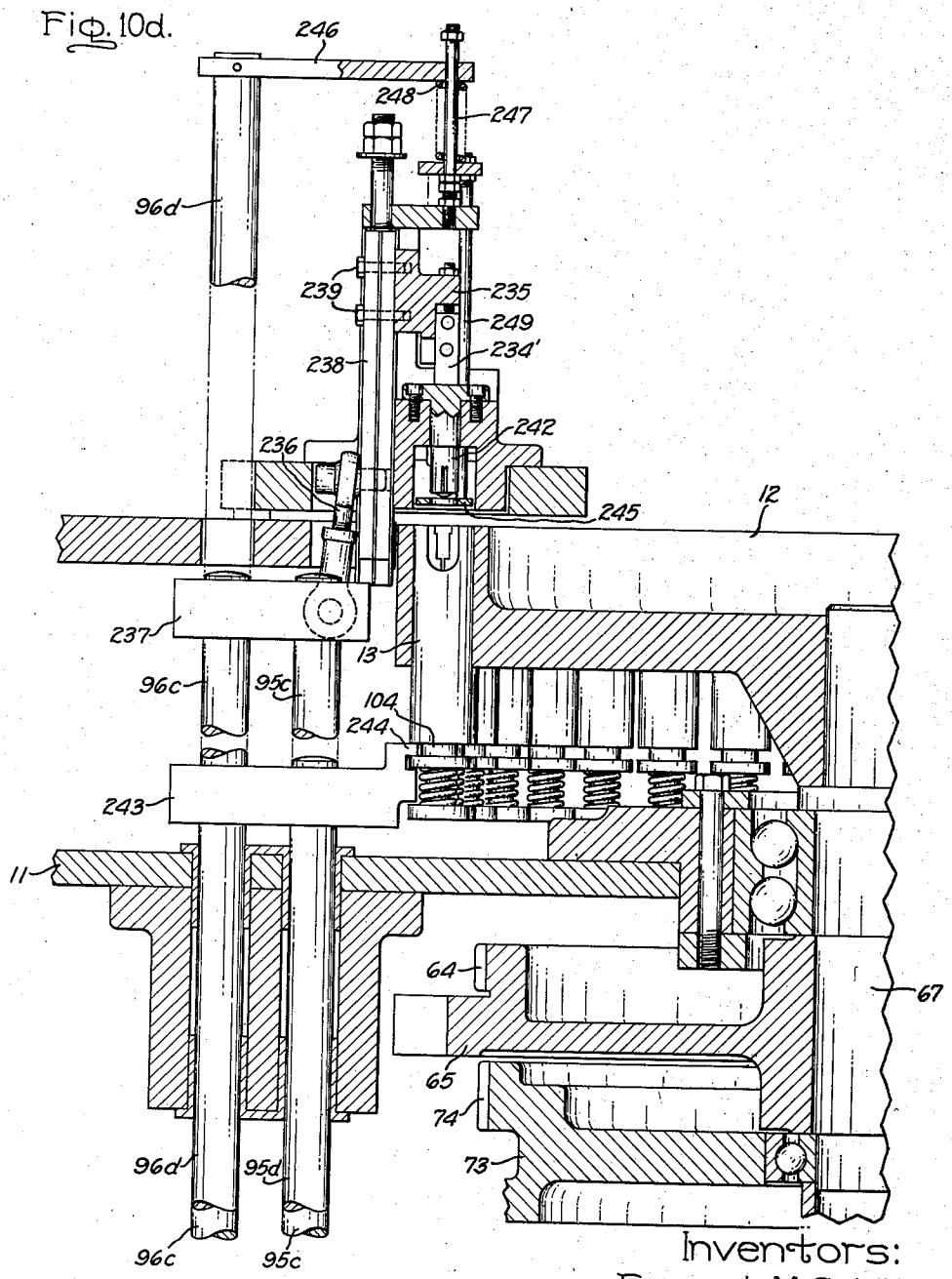
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PINNING MACHINE

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Fig. 10d.



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PINNING MACHINE

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Fig. 11a.

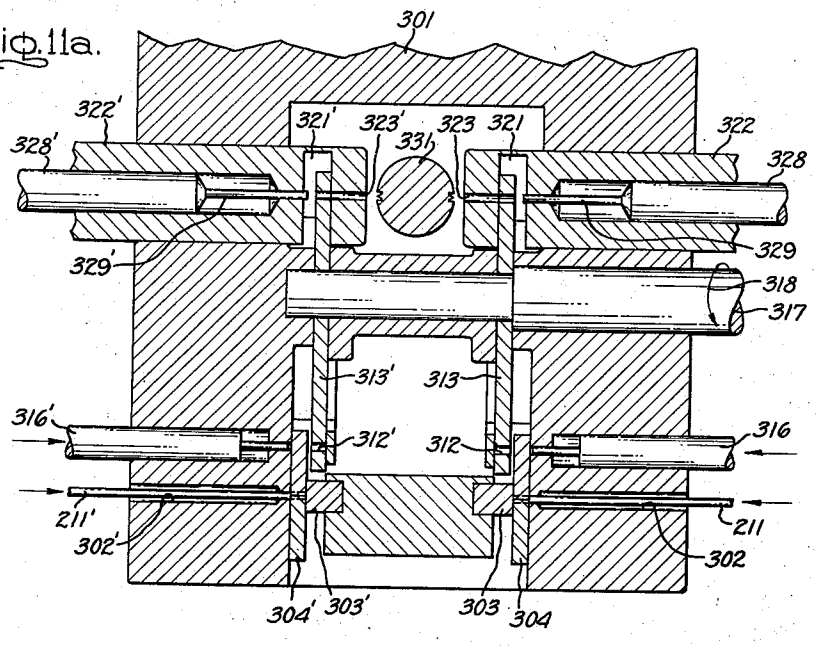
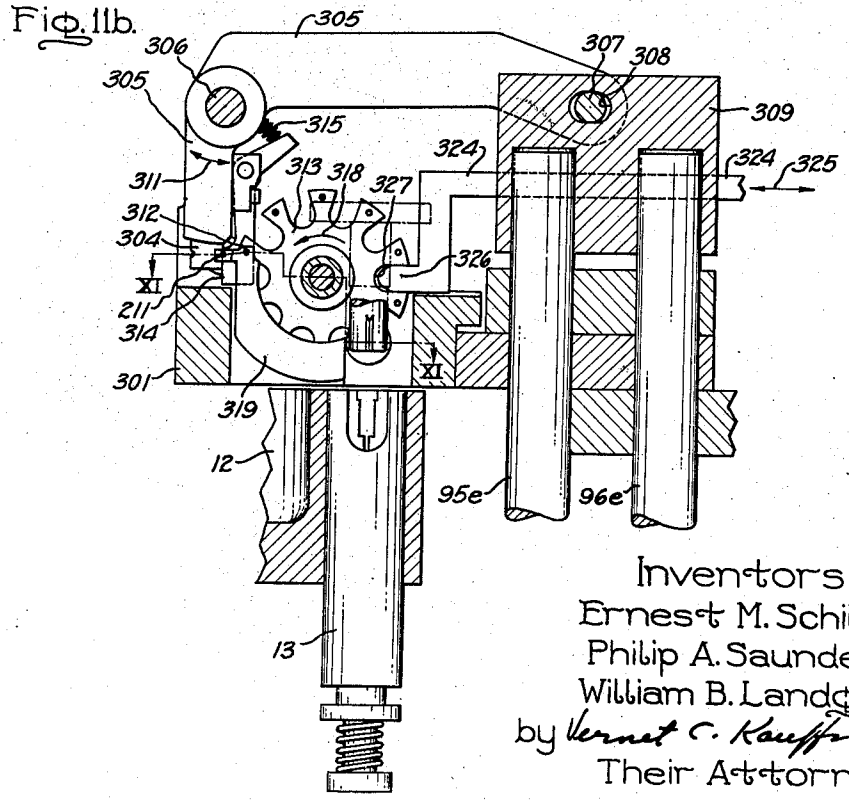


Fig. 11b.



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United States Patent Office 2,844,979
Patented July 29, 1958

2,844,979

PINNING MACHINE

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Application April 27, 1953, Serial No. 351,092

3 Claims. (Cl. 78—49)

This invention relates to a pinning machine for staking pins onto the side wall of a metal shell. It finds particular application in the manufacture of bayonet bases for electric lamps.

The bayonet bases used in certain electric lamps such as miniature incandescent, automotive, and photoflash lamps comprise a cylindrical metal shell having one or more end contacts and smal radial pins on its cylindrical side wall. These pins serve to locate the base of the lamp in the socket into which it is received, being entered into slots in the socket and then turned into offset notches whereby the lamp is locked in place. In some lamps the pins are located on diametrically opposite points of the shell of the base, and in others they are located on opposite sides but offset vertically in order to insure that the lamp can only be inserted in one way into the socket.

The pinning machine receives the drawn metal shells which will form the body of the base and inserts and stakes the radial pins. The shells must first be pierced at the proper points, the pins cut off from reels of wire fed into the machine, and the pins must thereafter be guided into the pierced holes and staked or headed in place. The pins must be tightly inserted an accurately aligned in all directions with respect to the shell, and the pin diameters and lengths must be held to very close tolerances.

The object of the invention is to provide a new and improved pining machine.

Another object of the invention is to provide a pinning machine wherein the pin dimensions are held to closer tolerances and their alignment is held to greater accuracy than heretofore possible.

A more specific object of the invention is to provide a pinning machine for bayonet bases which has a higher production speed and produces a more accurately controlled article than heretofore possible.

In accordance with the illustrated embodiment of the invention, a pinning machine achieving these objects comprises an indexing turret which carries about its periphery a plurality of collet-type shell holding chucks. The shells are loaded into the collets, and thereafter they are securely held by means of spring segments of the collet which are drawn down into a tapered sleeve having open areas on the sides where the pins are to be located. The holes for the pins are pierced by punches located at a piercing station where the shell is lifted up onto a piercing stud by raising the collet. The turret then indexes a number of stations and the collet is raised again at a heading station to lift the shell onto a heading stud. At this station, the pins are formed by feeding a wire up against a stop whereupon it is sheared by a cut-off blade and carried into a heading sleeve. This sleeve then advances the short wire piece or slug up against the shell and a heading punch moves through the sleve to form the slug into a finished pin staked to the shell. After a number of successive indexes, the collet arrives at an unloading station where the pinned shell is released and ejected.

Since the shell is firmly held in the collect from the instant when it is inserted into the collet until the instant

when it is ejected, and since the only movement of the collet with respect to the turret during the intervening stations is the raising of the collet assembly which occurs at the piercing and at the heading station, the various units can work to very close tolerances. Also, the alignment of the pierced shell is securely maintained between the piercing station where the holes are pierced and the heading station where the pins are staked into the holes.

For further object and advantages and for a better understanding of the invention, attention is now directed to the following description and accompanying drawings. The features of the invention believed to be novel will be more particularly pointed out in the appended claims.

In the drawings:

Fig. 1 is a pictorial view of a pinned shell as produced by the present pinning machine.

Fig. 2 is a top plan view of a pinning machine embodying the invention.

Fig. 3 is a vertical section through the pinning machine as seen along the line III—III in Fig. 2, and showing the shell feeding system and part of the gearing therefor.

Fig. 4 is a vertical section through the machine as seen along lines IV—IV in Fig. 2 and showing the remainder of the gearing for the shell feed system.

Fig. 5 is a vertical section through the machine along the line V—V in Fig. 2 showing the main turret and its indexing drive along with the barrel cam which actuates the vertically reciprocating devices in the machine.

Fig. 6 is a front elevation, partly in section, of the base loading and unloading mechanism, seen looking radially outward from the center of the turret.

Figs. 7*a* and 7*b* are plan and vertical section views, respectively, of one of the collet-type shell holding chucks carried in the turret.

Figs. 8*a* and 8*b* are vertical sections showing the shell piercing mechanism. The former is taken along a radius of, and the latter along a tangent to, the turret at the piercing station.

Fig. 9 is a front elevation of the recording and control mechanism.

Figs. 10*a* to 10*d* illustrate the heading mechanism. Fig. 10*a* is a plan view showing the central and left-hand portion of the mechanism. Fig. 10*b* is a vertical section through the central and right-hand portions of the mechanism along the tangent to the turret at the heading station, as seen looking radially outward. Fig. 10*c* is an enlarged fragmentary plan view of a heading sleeve and punch. Fig. 10*d* is a vertical section through the mechanism along a radius of the turret at the heading station.

Figs. 11*a* and 11*b* illustrate an alternative construction of the heading mechanism. Fig. 11*a* is a horizontal section at the heading station showing the central portion of the mechanism, and Fig. 11*b* is a vertical section taken along a radius at the heading station.

In order to facilitate understanding the invention, the general mode of operation of the pinning machine will first be explained, and thereafter each of its principal component units will be described in detail under a separate heading.

General operation

A pinned shell such as is produced by the present machine is illustrated in Fig. 1. It comprises a drawn cylindrical metal shell 1′ which is slightly outwardly flared at its upper edge 2 and which has a flat bottom wall 3 with a central circular aperture 4 therein. It will be appreciated that when the shell 1 is completed as a base and cemented to a glass bulb, the neck of the bulb rests against the flared edge 2 and the aperture 4 is filled with an apertured insulating bead or web to the outer surface of which is affixed an end contact. Staked into

suitable holes pierced in the side wall of the shell are a pair of radial pins 5, 5'. Previous to the staking or heading operation, the wire slugs which are formed into the pins are of substantially the same size as the holes. During the staking operation, the externally projecting portion 6 of the pin is expanded radially by means of pressure applied along its axis and the inwardly projecting portion 7 is split or forked. The expansion of the outer portion prevents the pin from being pushed into the shell during subsequent handling, and the forking of the inner portion locks the pin tightly in place. The pinning machine of the invention receives the shell 1' as illustrated in Fig. 1 but without the pins 5, 5' and without any holes pierced through it for the pins.

Referring to Fig. 2, the pinning machine is built about a rigid platform 11. It supports centrally an indexing turret 12 which carries about its outer rim a plurality of collet-type chucks 13 which receive and hold the shells. The turret indexes in a clockwise direction as indicated by the curved arrow 14. The various operations are performed on the shells during the dwell intervals of the collets at the successive operating station.

The unpinned shells 1' are supplied to the turret by a feed system comprising conical drum hopper 15 and transfer dials 16 and 17 which move the shells open end up along an arcuate path to toothed metering disc 18. The metering disc operates an escapement feeding the shells one by one to station A of the turret. Here the shells are pressed down into the collet chucks by means of a reciprocating plunger forming part of a loading mechanism 19. At station B a feeler carried on the reciprocating carriage of the loading mechanism checks the presence of a shell in the collet. If the shell is missing, that fact is recorded in recording and control mechanism 21. When finally the collet in which the shell is missing arrives at the heading station, the recording and control mechanism arrests the feed of the wires from which the pins are formed.

At station C the collet is raised vertically above the surface of the turret so as to lift the shell up into piercing unit 22 which pierces the holes for the pins in proper alignment on opposite sides of the shell.

At station D the collet is raised again and the shell is lifted up into heading unit 23 which forms and stakes the pins into the previously pierced holes.

At station E the pinned shells are lifted out of the collet chuck by unloading mechanism 24 and released into escape shute 25.

Shell feed system

The shell feed system is shown in plan view in Fig. 2 and the internal arrangement along with the gearing is illustrated in vertical section in Figs. 3 and 4. The parts are supported either directly or indirectly from the rigid platform or top plate 11 of the machine. Conical drum hopper 15 is rotatably borne on shaft 26 journalled at 27 and 28. Nested within the conical drum is an inner cone 29 which is fast at 31 to shaft 26. A stationary shroud 32 forms with conical drum 15 and inner cone 29 a partly closed compartment having the shape of a sector of a double cone. This compartment serves as a reservoir of unpinned shells shown at 1*a*. The inside margin of the rim of conical drum 15 is provided with a continuous series of short studs or knobs 33 of a diameter such that they can enter the bore of the shells. Conical drum 15 is driven by flexible belt 34 and a suitable source of power such as an electric motor. At the same time, inner cone 29 is caused to rotate in an opposite direction by gearing comprising inner ring gear 35 formed on the hub of conical drum 15, intermediate reversing gear 36, and spur gear 37 keyed to shaft 26. Since inner cone 29 is also keyed to shaft 26, rotation of spur gear 37 causes the inner cone likewise to rotate.

The continuous rotation of conical drum 15 and inner cone 29 in opposite directions causes the reserve of bases at 1*a* to be churned about, and as knobs 33 pass through the bases, they seat themselves at random on the knobs. The bases which have become seated are then carried upward through approximately 180° of revolution. They are prevented from falling off the knobs during this movement by means of a guide track suitably positioned with respect to the path of travel of the knobs. At the point where the guide track terminates, a shell falls off the knob into the position 1*b* where it is seated open end up on feed dial 16.

The arcuate path followed by the bases after they have been released at 1*b* onto the first feed dial 16 is best seen in Fig. 2. Feed dial 16 rotates in a clockwise direction as indicated by curved arrow 38, whereas feed dial 17 rotates in a counterclockwise direction as indicated by curved arrow 39. The shells merely sit on the dials near their edges and are carried along by friction, being channeled and retained on the discs by curved guide members 41, 42. The feed system is operated at such a speed that an excess of shells is delivered into the arcuate channel. As a result, the shells form a continuous file as indicated at 1*c*; excess shells merely fall back from position 1*b* where they are delivered, into the reserve at 1*a*.

Since the speed of rotation of the feed dials 16 and 17 is not critical, they are driven from an auxiliary source of motive power such as a small electric motor which may be connected to auxiliary drive shaft 44 shown in Fig. 4. Keyed to shaft 44 is a spur gear 45 which drives larger gear 46 to effect a speed reduction. Gear 46 is keyed to jack shaft 47 to which is also keyed smaller gear 48 meshing with larger gear 49 to effect a further speed reduction. Gear 49, shown in fragmentary section in Fig. 4 and in full section in Fig. 3, is keyed at 51 to the hub of feed dial 17 which is rotatably borne on stud shaft 52. The other feed dial 16 is driven through meshing intermediate gears 53 and 54, the former being driven by gear teeth milled at 55 into the hub of feed dial 17, and the latter driving gear 56 milled into the hub of feed dial 16. Feed dial 16 is rotatably borne on stud shaft 57 and revolves in opposite direction to feed dial 17.

The frictional drag of feed dial 17 on the file of accumulated shells at 1*c* presses foremost shell 1*d* against the side of transfer disc 18, as best seen in Fig. 2. Disc 18 is shaped somewhat like a coarse circular rip saw having large teeth 58 with a leading edge curved so as to permit the shells to nest snugly therein. The shell at 1*d* nests in the tooth of the transfer disc during its dwell interval. The transfer disc then indexes one tooth interval in a counterclockwise direction, as indicated by curved arrow 59, and the shell is swept into a position immediately above the collet at loading station A. The shell is meanwhile prevented from falling out of the tooth of the transfer disc by a spring loaded dog 61. The shell is then pressed down out of the transfer disc and into the collet by loading mechanism 19 which will be described in detail shortly.

The arrangement for indexing transfer disc 18 is shown in Fig. 3. Disc 18 is fast on the upper end of shaft 62, to the lower end of which is fastened gear 63. Gear 63 meshes with ring gear 64 formed on Geneva wheel 65 which drives main turret 12. The Geneva wheel 65 is rotated intermittently as will be explained shortly; transfer disc 18 is thus likewise rotated intermittently, and the pitch ratios of gears 63 and 64 are chosen so that disc 18 is rotated one tooth interval for each index of the main turret.

Indexing turret and collet chucks

The construction of the indexing turret 12 which carries the collet-type chucks 13 and the gearing therefor are illustrated in Fig. 5. The turret is keyed at 66 to a main shaft 67. The load of the shaft is taken up by ball bearings 68 whose outer race is supported from the platform or main plate 11 of the machine. The shaft is

maintained in vertical alignment by ball bearing **69** at its lower end; the outer race of this bearing is supported by an inferior structural plate **71** of the machine.

Geneva wheel **65** is keyed at **72** to main shaft **67**; thus the Geneva wheel and the turret are fast together and turn as a unit. Immediately below the Geneva wheel is located gear wheel **73** whose teeth at **74** mesh with the gear teeth of dog wheel **75** journalled at **78** and **79**. The dog wheel is provided in the usual fashion with a pin or dog **81** which enters slots **82** in the periphery of Geneva wheel **65** to cause the intermittent rotation thereof. During the dwell interval, sector **83** of the dog wheel meshes in the usual fashion with circular cut-outs in the periphery of the Geneva wheel to lock it in place.

Gear wheel **73** is borne on shaft **67** but is free to rotate with respect thereto. It is supported in part by ball bearing **84** and is fastened peripherally by bolts **85** to the upper rim of drum cam wheel **86** whose load is taken up by shaft **67** through ball bearing **87**. Gear wheel **73**, and of course drum wheel **86**, are rotated continuously by motive power from a suitable source such as an electric motor coupled to drive shaft **88** The transmission of power occurs through spur gear **89** fast on the drive shaft, to gear **91** meshing therewith and fast on jack shaft **92**, and then from gear **93** fast on the jack shaft to gear wheel **73** which meshes therewith

The drum wheel **86** has machined into its periphery three cam tracks or grooves **94** which are used to operate the vertically reciprocating devices of the pinning machine. Each device is served by one of the cam tracks, and includes a pair of vertical slide rods **95**, **96** which are slidably received in a bushing **97** fastened to the inferior plate **71**. A block **98** clamped to the slide rods is provided with a lateral roller **99** which enters, in the case of that illustrated in Fig. 5, the middle cam track **94**, thereby causing the slide rods to move up and down in accordance with the contour of that track. Four such sets of slide rods are provided, one to operate the loading and unloading mechanism, one to operate the piercing unit, and two to operate the heading unit.

The construction of the collet-type chucks **13** in which the shells are held on the turret is illustrated in Figs. 7*a* and 7*b*. Fig. 7*a* is a plan view and Fig. 7*b* is a half-sectional vertical elevation, the section being taken along line VII—VII in Fig. 7*a*. The collet assembly comprises an outer sleeve **101** having an internal taper at **102** reaching out to its upper end, a step within its bore at **103**, and an external annular groove **104** near its lower end. Within the sleeve is located a hollow spindle **105** having therethrough an axial hole **106** of relatively large size in its upper portion, and an axial hole **107** of smaller size in its lower portion. The upper portion of the spindle above transverse drill hole **108** is slotted in cruciform fashion into four segments **109** having outwardly flared uppermost portions which mate with the tapered upper end of the sleeve. At their upper end, the segments **109** are hollowed out to a somewhat larger size to form cavity **111** having an internal diameter just slightly greater than the outside diameter of the shells **1**. The expanded upper rim of the cavity at **112** accommodates the flared upper rim **2** of the shell (as shown in Fig. 1).

The walls of the spindle segments **109** are relatively thin and springy and, previous to the assembly of the spindle to the sleeve, they are sprung outwardly. A shell is inserted into cavity **111** at a time when the spindle is raised vertically with respect to sleeve **101**. Thereafter the shell is locked in place by pulling the spindle down into the sleeve so that internally tapered upper portion **102** of the sleeve engages the flared upper ends of segments **109** and forces them inwardly so as to grip the shell tightly.

An important feature of the invention whereby the desired accuracy and close tolerances of the various operations of piercing the shell and staking the pins into the pierced holes are achieved, is that of holding the shell firmly in a single collet-type chuck throughout its course through the machine. At the various stations such as the piercing and heading stations where operations are performed on the shell, the collet chuck assembly **13** is raised as a unit. On the other hand, at the loading and unloading stations where it is desired to insert or remove the shell from cavity **111**, inner spindle **105** is raised vertically with respect to sleeve **101**. The spindle is normally held down at its lowermost position within the sleeve by spring **113** compressed between the lower end of the sleeve and nut **114** threaded on the lowermost extremity of the spindle.

To insure the accurate alignment of the holes pierced in the shell at the piercing station with the heading punches which insert the pins into those holes at the heading station, inner spindle **105** must not be allowed to rotate with respect to sleeve **101**, and sleeve **101** must be prevented from rotating with respect to turret **12**. Key **115** fitted into the lower portion of the spindle engages in keyway **116** in the bore of the sleeve and prevents any relative rotation between the spindle and the sleeve but allows vertical displacement of one with respect to the other. To prevent relative rotation of the collet assembly with respect to the turret, the lower portion of the sleeve is provided with flat sides **117** which are engaged by locating blocks **118**, shown in Fig. 6, bolted to the underside of the turret **12**. In order to simplify the illustration, these blocks are not shown elsewhere in the drawings.

To make the shell accessible to the piercing and heading punches, U-shaped openings **119** are provided at the upper end of sleeve **101**. Somewhat smaller openings **121** are cut in the corresponding sides of spindle segments **109**. When the collet assembly is mounted on the turret, openings **119** and **121** face tangentially with respect to the turret.

Shell loading and unloading mechanisms

The unpinned shells are loaded into the collets at station A by loading mechanism **19**, and after a full index around the turret through the piercing and heading stations, the pinned shells are removed at station E by unloading mechanism **24**.

The loading and unloading mechanisms are shown in plan in Fig. 2 and in vertical elevation in Fig. 6. They are fastened to plate **123** supported above the turret on vertical slide rods **95***a* and **96***a*. The rods are maintained in alignment by bushing **124** fastened to platform **11** and are actuated, in the same manner as slide rods **95** and **96** previously described with reference to Fig. 5, by means of a roller fastened thereto and engaging in one of the cam tracks **94** in drum cam wheel **86**. The slide rods are lowered from the upper rest position in which the parts are shown in Fig. 6, and thereafter are lifted back to the position illustrated, during the dwell interval of the collet.

Loading mechanism **19** comprises hollow spindle **125** the lower end of which forms a plunger **126** of reduced diameter such that it can enter into shell **1***d*. Spindle **125** is retained within sleeve **127** secured in bracket **128** by locking pin **129**, bracket **128** being in turn fastened to plate **123**.

As previously mentioned, transfer disc **18** positions unpinned shell **1***d* immediately above the collet chuck indexed into station A. At this moment, the shell is held in one of the curved teeth of the disc, being resiliently pressed thereagainst by spring loaded dog **61**. As slide rods **95***a* and **96***a* move down, plunger **126** enters the shell and presses it down and out from between the transfer disc and the dog. At the same time, spring loaded pin **131** carried at the lower end of rod **130** depending from plate **123** engages one extremity of rocker arm **132** causing it to pivot down about pivot pin **133** in pedestal **134** fastened to platform **11**. Ball portion **135** on the opposite end of the rocker arm is thereby caused to press

up against nut **114** which raises inner spindle **105** of the collet assembly. Sleeve **101** meanwhile is held fixed by cam track **136** having an inwardly flanged edge **137** which engages in groove **104** of the sleeve. The shell cavity **111** of the collet is thus expanded sufficiently to permit the shell to be easily pressed into it by the continued downward movement of plunger **126**. Thereafter, the slide rods are returned upwardly to their rest position, the shell **1***d* being left in the shell cavity of the spindle which is thereupon drawn back into the sleeve of the collet assembly to hold the shell tightly in pace.

In order to prevent any possibility of the shell sticking to the end of plunger **126**, as might occur if the shell were slightly out of round, and being withdrawn out of the collet when the plunger is returned to its upper position, a jet of air is blown down through passage **138** in plunger **126**. Compressed air is supplied for that purpose to the upper end of spindle **125** by an air hose **139**. As previously described, spindle **105** of the collet assembly has a hole **107** going right through it, and the compressed air blown down from plunger **126** escapes through this hole.

In order to prevent any damage to the machine should a deformed shell arrive at the loading station, spindle **125** is slidably fitted in sleeve **127** and is normally held in place by a spring loaded plunger **141** which engages in an annular groove **142** in the upper portion of the spindle. If plunger **126** encounters excessive resistance in pressing a shell into a collet, pin **141** is forced back out of the groove and the spindle is released, thereby preventing any damage to the related parts. At the same time, armature **140** of safety switch **143** is actuated and the operation of the machine is arrested.

On the right-hand extremity of bracket **128**, there are carried a pair of small plates **144** and **145**, in alignment with the collet at station B of the turret. Plate **144**, the lowermost of the two, is fastened to rod **146** slidable through sleeve **147** to which is fastened the other plate **145**. Both plates are resiliently loaded, plate **144** being urged downward by spring **148**, and plate **145** by spring **149**. Fastened to the upper end of rod **146** is a reverted bracket **151** whose lower end is aligned to actuate armature **152** of switch **153** positioned below it.

The function of plates **144** and **146** is as follows: On the downward stroke of slide rods **95***a*, **96***a*, plate **144** checks whether a shell was successfully loaded into the collet at the previous index of the machine, the collet in question now being located at station B. If a shell was loaded, plate **144** is prevented by the shell from descending into U-shaped opening **119** in the collet, spring **148** is compressed and bracket **151** fails to descend sufficiently to engage armature button **152** of control switch **153**. However, if a shell was not loaded, plate **144** does descend into U-shaped opening **119** and bracket **151** moved down sufficiently to actuate switch **153**. The actuation of switch **153** completes a circuit to recording and control unit **21** to arrest the wire feed at the heading station when the empty collet eventually arrives there. The other spring loaded plate **145** merely presses down on the inner spindle of the collet and assists collet spring **113** in drawing the spindle fully down into the outer sleeve of the collet.

Unloading mechanism **24** comprises spindle **155** having a hollow upper portion and a slotted lower portion **156** forming springy tongues whose lowermost extremities at **157** are proportioned to fit inside a shell while pressing resiliently against its side. Spindle **155** is slidable within sleeve **158** and is urged resiliently downward by internal spring **159** compressed between the spindle and cap **161** threaded into the upper end of the sleeve. The spindle is normally restrained in the position in which it is illustrated in the drawing by the engagement of its shoulder with a corresponding shoulder in the sleeve at **162**.

During the downward movement of slide bars **95***a* and **96***a*, the lowermost end **157** of the unloading spindle enters the shell held in the collet at station E. At the same time, the inner spindle of the collet assembly is raised with respect to its outer sleeve, in order to release the shell and permit it to be withdrawn readily, by the pivoting of bell crank **163** pivotally mounted at **164** on pedestal **165** fastened to platform **11**. The other end of the bell crank carries a roller **166** which is engaged by the beveled lower end **167** of rod **168** depending from carriage **123** and reciprocating therewith.

In moving down, tongues **156** of the unloading spindle straddle a fixed bar **169**, seen on end in Fig. 6. When spindle **155** moves back upward, bar **169** forces the shell off the lowermost ends **157** of the spindle; the shell is then blown into unloading chute **25** by a jet of air from tube **171**. If a deformed base should be encountered into which the lowermost ends **157** of the spindle cannot enter, spring **159** is compressed and spindle **155** rises relative to sleeve **158** so that no damage is done to the mechanism.

In case the unloading mechanism should fail to remove the shell from the collet at station E, the shell is carried to succeeding station F intermediate unloading station E and loading station A. Here a testing plunger **172**, spring loaded with respect to bushing **173** fastened to reciprocable carriage **123**, is lowered into the spindle opening of the collet. If the pinned shell has not been removed from the collet, plunger **172** is prevented from entering the shell cavity and slides up with respect to bushing **173**. The upper end of plunger **172** thereupon actuates armature **174** of safety switch **175** and this arrests the operation of the machine.

Piercing unit

The piercing unit makes the two holes in the shell into which the radial pins are staked. It is located at station C of the turret and is shown in plan in Fig. 2, and in vertical section in Figs. 8*a* and 8*b*. Fig. 8*a* is a section taken through a plane radial to the turret, whereas section 8*b* is taken through a plane tangential to the turret and seen looking outward from the center of the turret.

Upon being indexed into the piercing station, the collet **13** is raised by the upward movement of slide rod **95***b* similar to slide rods **95**, **96** previously described. The motion of the slide rod is transmitted to the collet by block **177** having a tongue portion **178** which engages in groove **104** in the outer sleeve of the collet. The collet is thus lifted without any relative movement between outer sleeve **101** and inner spindle **105** so that shell **1***e* remains tightly held in the shell cavity.

The upward movement of the collet lifts the shell onto a hollow stud **179** which is mounted so as to project downwardly into a central cavity within block **181** rigidly supported from platform **11** by pedestal **182**. In Fig. 8*b*, the shell is shown lifted up onto the stud in the proper position for the piercing operation.

The piercing operation proper is performed by the reduced end portions **183** of a pair of punches **184** keyed into sliding blocks **185**. Stud **179** is provided with die holes **186** into which end portions **183** of the punches penetrate in piercing the shell. Blocks **185** are actuated by bell cranks **187**, the linkages being effected through rollers **188**. As shown in Fig. 2, the bell cranks are pivoted at **189** on fixed plate **191** and are rocked in unison by link pin **192** to which is fastened roller **193** riding in groove **194** in face cam wheel **195**. Cam wheel **195** is keyed to vertical shaft **196** to the lower end of which is keyed spur gear **197** which is driven from the main gear wheel **73** of the machine by means of intermediate idler gear **198**. Thus cam wheel **195** is driven in synchronism with the indexing movement of the turret and groove **194** is shaped to actuate the punches during the dwell interval of the collet at the piercing station.

The metal shavings or piercings which result from the piercing operation are disposed of by blowing them up through the interior of hollow stud **179** and out through curved disposal tube **199** which is threaded at **201** into collar **202** which clamps the stud into block **181**. The air jet is directed into the central passageway through the

collet from passage **203** in block **177** which engages the bottom of the collet.

To prevent any possibility of the shell sticking on the stud when the collet is lowered after the piercing operation, there is provided a stripper plate **205** with a central aperture therethrough making a sliding fit with stud **179**. The stripper plate is fastened on the lower ends of rods **206** which pass slidably through block **181**, and which are connected at their upper ends to slide rod **95***b* through a resilient linkage comprising a tension bolt **207** and a compression spring **208**. When the slide rod rises to lift the shell onto stud **179**, rods **206** move up in like fashion and raise stripper plate **205** about the stud into the position shown in Fig. 8*b* so that shell **1***e* is not obstructed. After the piercing operation, the stripper plate presses resiliently down on the shell, thereby forcing it off the stud and insuring that it remains properly seated in the cavity of the collet.

Heading unit

The heading unit forms the pins from wire stock, transports them into the holes previously pierced in the shell by the piercing unit, and stakes them in place. The operation is performed at station D of the turret by heading unit 23, whose general disposition with respect to the rest of the machine is shown in Fig. 2 and which is illustrated in Figs. 10*a* to 10*d*. The various operations performed by this unit include cutting off two pieces or slugs of wire of the required length for the pins, transferring these slugs into heading sleeves, and thereafter forcing the slugs through the sleeves by punches which stake them into the previously pierced holes in the shell.

The wire from which the pins are formed may be supplied from reels (not shown in the drawings) and guided into the heading unit from opposite sides as shown at **211** and **211'** in Fig. 2. The path followed by the wires into the heading unit is shown in Figs. 10*a* and 10*b*. Both wires are fed in toward the center of the unit under which collet chuck **13** is shown indexed with a pierced shell **1***f* in its cavity. Since the operation of both halves of the heading unit on either side of the center are essentially the same, only one will be described in detail.

Wire **211** is fed forward, that is to the left as indicated by arrow **212** in Fig. 10*b*, by a pair of grooved rollers located side by side and pressing resiliently against the wire. Roller **213** appears in Fig. 10*b* fast on the end of short shaft **214** to the upper end of which are fastened spur gear **215** and ratchet wheel **216**. Gear **215** meshes with corresponding gear **217** seen in Fig. 10*a* and which drives the other roller cooperating with roller **213**. Ratchet wheel **216** is rotated in step-by-step fashion by spring pawl **218** supported on plate **219** which is oscillated through a small arc by connecting rod **221** linked to eccentric stud **222** on shaft **223**. Shaft **223** is geared to main gear wheel **73** in a ratio providing one revolution per index of the turret. The parts of the wire feed mechanism including the feed rollers are proportioned to overfeed the wire, the excess being absorbed by slippage at the feed rollers **213**.

Mounted on plate **219** is a solenoid **224** to whose armature **225** is attached a pointed rod **226**. Tension spring **227** normally holds the armature and the rod in the raised position in which they are illustrated in the drawing. When the solenoid is energized, its armature is pulled down and the point of rod **226** forces pawl **218** out of engagement with ratchet wheel **216** and thereby stops the rotation of the wire feed rolls. The solenoid is connected to recording and control unit **21** which sends the electrical signal arresting the wire feed when an empty collet is indexed into the heading station.

Wire **211** is pushed by the feed rollers into passageway **228** in sub-block **229** positioned below main block **231** shown in phantom view in Fig. 10*b*. The wire emerges from the passageway through a constricted opening in a hardened insert **232** into a vertical or transverse channel defined by sub-block **229** and wall portion **233**. The wire feed rollers push the end of wire **211** hard against wall portion **233**, and thereafter the excess rotation of the rollers is taken up by slippage against the wire.

The short length **211***a* of wire projecting into the vertical channel is sheared off to become the slug that is formed into a radial pin of the shell. The shearing of the wires is done by hardened cutter blades **234**, **234'** which descend into their respective vertical channels on the down stroke of crosshead **235**. The reciprocation of the crosshead is effected from drum cam wheel **86** through vertical slide rods **95***c*, **96***c* shown in Fig. 10*d*. The linkage from the slide rods to the crosshead is through connecting rod **236** which is linked at one end to block **237** fastened to the slide rods, and at the other to sub-slide **238** to which the crosshead is bolted at **239**.

After the cutter **234** has sheared off the wire, its continued downward movement forces the sheared piece or slug **211***a* down through the vertical channel into semicircular groove **240** constituting a lateral aperture in the forward end of heading sleeve **241**. It will be observed that the die insert **232** feeds the wire into the vertical channel at a slight inclination above the horizontal. This feature assists in making the ends of the slug square with its body by counteracting the distorting effect of the shearing operation. The slug fits snugly in the vertical channel so that friction maintains it in horizontal alignment while it is forced down by the cutter and deposited lengthwise in the groove of the heading sleeve.

While the cutters **234**, **234'** are descending and driving the slugs into the grooves of the heading sleeves, the collet **13** is being raised to lift shell **1***f* onto heading stud **242**. The raising of the collet is effected from drum cam wheel **86** through slide rods **95***d*, **96***d* to which is fastened block **243** having a tongue portion **244** which engages in groove **104** of the collet sleeve. The heading unit is also provided with a stripper mechanism similar to that of the piercing unit. Stripper plate **245** is shown in its lowermost position in both Figs. 10*b* and 10*d*. It is raised or lowered, in synchronism with the collet, by slide rod **96***d* through a spring linkage comprising cross-bracket **246**, sliding bolt **247**, spring **248** and tie rods **249** to the lower ends of which the stripper plate is fastened.

As soon as the wire piece or slug **211***a* has been deposited in groove **240** in heading sleeve **241**, punch **252** begins sliding forward within the bore of the heading sleeve, and its reduced end portion **253** pushes the slug forward into the passageway at **254** which is in effect a continuation of the groove but wherein the wire piece is totally enclosed. Simultaneously, heading sleeve **241** slides forward and its nose presses against shell **1***f* which has meanwhile been lifted up onto heading stud **242**. The continued advance of heading punch **252** then pushes the wire piece into the previously pierced holes in shell **1***f* and against heading stud **242**. The end of the slug strikes into a vertical notch in the stud having a reverted V-shaped ridge **255** shown in Fig. 10*c*. The pressure against the wire piece causes its inner end to split into a forked shape, and its outer end to expand slightly within hole **254** into a truly cylindrical shape, thereby achieving the desired configuration of the pin **5**. The forking of the inner end of the pin is not essential and, by eliminating the V-shaped ridge from the notch in the stud, the pin may be staked by merely squashing its inner end. Thereafter the heading punch and heading sleeve withdraw from the heading stud to their original positions illustrated in Fig. 10*b*. Collet **13** is then lowered, stripper plate **245** assisting in drawing the pinned shell off the heading stud, and thereafter the turret indexes a succeeding collet into the heading station and the sequence repeats.

The sliding movement of heading punch **252** is effected through inferior slide rod **256** which is keyed at **257** to the rear end of the punch. The slide rod has an opening at **258** in order to clear shaft **223** and carries at its rear

end roller 259 which engages in cam groove 261 in the face of cam wheel 262. The cam wheel is keyed at 263 to shaft 223 which, as previously stated, is geared to rotate in synchronism with the indexing of the turret.

The sliding movement of heading sleeve 241 is effected through superior slide rod 264 which is keyed thereto at 265, and which is engaged at its rear end by roller 266 fast to central arm 267 of three-armed bell crank 268. The outer arms 269 and 271 of the bell crank (shown in Fig. 10*a*) carry rollers 272, 273, respectively, which bear against different portions of the periphery of cam wheel 262. These portions, shown at 274 and 275 in Fig. 10*b*, form cooperating cam outlines whereby the bell crank is rocked back and forth through a small arc providing the desired reciprocation to heading sleeve 241. It may be noted that corresponding three-point bell crank 268′ shown in Fig. 2 is somewhat different in external outline from bell crank 268 and has a triangular shape. This difference is due to space limitations in the latter case, and both three-point bell cranks 268, 268′ operate in essentially the same fashion.

Recording and control unit

As earlier stated, it is desirable that the feed of the wires to the heading unit be arrested when an empty collet is indexed into the heading station. Otherwise, a pair of loose wire slugs will be released into the shell cavity of the collet which might cause jamming at a later time.

The detecting mechanism, located at station B and previously described with reference to Fig. 6, causes switch 152 to close when an empty collet is indexed into that station. The electrical signal cannot be utilized immediately and must be preserved over a number of index intervals until the time when the empty collet will be indexed into the heading station.

The signal is supplied to recording and control unit 21 shown in Fig. 9, and the switch is connected so that upon closure, solenoid 277 is energized. The solenoid is arranged so that its armature 278 strikes spring loaded plunger 279 causing it in turn to strike one of pins 281 of recording disc 282. The pins 281 are slidable in vertical holes spaced around the rim of the disc and may be snapped into an upper or a lower position, being retained in one or the other by spring loaded balls 283 engageable in spaced circumferential grooves 284, 285. The pins are normally located in their lower position, being eventually returned thereto, after a displacement, by inclined bracket 286.

Disc 282 is mounted on shaft 287 and is frictionally loaded by spring 288 to prevent idle coasting. It is indexed in synchronism with the turret and moves one pin interval when the turret moves one collet interval. The indexing is achieved through a ratchet wheel and pawl mechanism, ratchet wheel 289 being fast on shaft 287 and engageable by pawl 291. The pawl is rocked by connecting rod 292 connected to eccentric stud 293 on the upper end of shaft 196. This shaft, as previously described, is geared to main gear wheel 73 of the turret.

The passage of an empty collect at testing station B is recorded on the disc 282 by raising corresponding pin 281*a* to its upper position. The disc indexes at the same rate as the turret and, when the empty collet arrives at the heading station, the raised pin contacts roller 294 carried on the end of spring blade 295 and forces it up, thereby actuating armature button 296 of switch 297. Switch 297 is connected so that its closure causes the energization of solenoids 224, 224′ in the heading unit and these in turn, when energized, disable the ratchet pawls of the wire feeding rollers, thereby arresting the feed of the wires.

Alternative heading unit construction

In the heading unit which has been described, the cutters transfer the wire pieces or slugs directly into the heading sleeves. This unit has been found entirely satisfactory in actual operation. We have also constructed a modified heading unit having somewhat different characteristics and which may be advantageous for certain applications. In this unit, the slugs are sheared off from the wire stock by means of a swinging cutter and transferred into suitable cavities in a carrier disc. The carrier disc then indexes a number of times and carries the pin into alignment with the aperture in the heading sleeve. Thereupon a heading punch forces the pin out of the disc into the cavity in the nose of the sleeve and, upon continued movement, heads it up against the stud.

Referring to Figs. 11*a* and 11*b*, wire stocks 211 and 211′ are fed from the left and right, respectively, into block 301 through channels 302, 302′ with the forward end coming to rest against stop blocks 303, 303′. Since the unit is generally symmetrical about the center line, reference will be made to one side only and, unless otherwise stated, the same considerations apply to the other side. The projecting end of the wire stock is sheared off by swinging cutter 304 which is fastened to and projects somewhat below the shorter vertical arm of bell crank 305 (Fig. 11*b*). The bell crank pivots on stud shaft 306 and has a pin 307 at the end of its longer horizontal arm which engages in slot 308 within block 309. Block 309 is reciprocated vertically by slide rods 95*e* and 96*e* which are actuated from drum cam wheel 86 of the machine in the usual fashion. Cutter 304 swings through an arc indicated by arrow 311, and on the inward stroke shears off the projecting end of the wire 211 and carries the slug into alignment with axial hole 312 in carrier disc 313. The cutter blade is notched at the point where it engages the wire and the slug is held in this notch by finger 314 which pivots inwardly with the cutter, being spring loaded with respect thereto by spring 315.

After the cutter has come to rest, auxiliary plunger 316 (Fig. 11*a*), moving in the direction indicated by the arrow, pushes the slug out of the notch in the cutter and into axial hole 312 in the carrier disc. The carrier disc is fast on shaft 317 and is indexed, by suitable means such as an auxiliary Geneva mechanism similar to that previously described, at each index of the main turret. It rotates in the direction indicated by curved arrow 318 and the wire pieces are prevented from falling out of the axial holes by lateral shrouds 319 on either side.

After a number of intermediate indexes, the carrier disc indexes the slug into lateral slot 321 in the forward end of heading sleeve 322 and in alignment with axial hole 323 in the nose of the sleeve. The carrier disc is positively located in the required angular position to insure alignment of the pin with the axial hole in the heading sleeve, by slide bar 324. This bar is horizontally reciprocable in the direction indicated by arrow 325 and has a sized offset end portion 326 which enters one of the radial slots 327 in the periphery of the carrier disc.

Heading punch 328 then moves inwardly and its reduced end portion 329 pushes the slug out of the carrier disc and into axial hole 323 of the heading sleeve. Heading sleeve 322 and heading punch 328 then move in together. The former comes to rest against the side of the shell which has meanwhile been lifted up onto heading stud 331. The continued inward movement of the latter forces the slug up against the stud and forms it into a radial pin staked to the shell in the manner previously described.

It will be appreciated that in this alternative construction of a heading unit, the wire piece or slug is completely enclosed in one of the axial holes of the carrier disc during the course of its transfer into the heading sleeve. This feature is particularly advantageous in the handling of relatively long narrow pins, as contrasted with short squat slugs such as the embodiment of Figs. 10*a* *to* 10*b* is more adaptable to handling.

Conclusion

The specific embodiments which have been described aptly illustrate the application of the principles underlying the invention, to a pinning machine which stakes the radial pins onto the cylindrical shells of bayonet-type bases for electric lamps. In general, these principles involve feeding the work piece, in this case the shell, into successive holders such as collet-type chucks supported in the rim of an indexing turret. The work pieces are held firmly in the collets, and the only relative movement allowed between the collets and the turret is a vertical reciprocation whereby the work piece may be raised above the plane of the turret in order to become accessible to the operating units at the various stations. At the piercing station, the work piece is pierced in the appropriate places where the metal pins are to be staked to it. At the heading station, the pins, and the term pin as used here is meant in its broadest sense namely a small metal part, are formed directly from continuous stock such as rolls of wire by means of cutters which shear off an appropriate length thereof to form a slug. This slug is carried into a heading sleeve which encloses it circumferentially and carries it up against the work piece. Thereupon a punch slides through a channel within the sleeve and heads up the slug against a heading stud onto which the work piece has been lifted. Thus the material including the work pieces and the wire stock is kept continually moving, the latter being synchronized to the former, to produce the desired product.

While the invention is most readily applicable to the making of pinned shells for bayonet bases, it will be appreciated that with slight modifications which will readily occur to those skilled in the art, it may be used in producing other articles wherein it is desired to attach a small metal piece or slug to a work piece of regular form, the slug being of the type such that it can be sheared off from continuous stock. The illustrated arrangements of a pinning machine wherein the invention finds expression are accordingly to be taken as illustrative examples and not as limitations upon the invention. The scope of the invention is to be determined by the following claims which are intended to cover any modifications coming within its true spirit and scope.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. A heading unit for cutting short pieces from wire stock to form slugs and for staking the slugs into openings in the side of hollow shells to form lateral pins thereon, comprising a stud having an end adapted to enter said shells, a body having a channel therethrough lateral to said stud, an opening through said body approximately normal to said channel and terminating thereat, means for feeding wire through said opening into said channel and for pressing the end of said wire against the wall of said channel opposite said opening, a cutter movable through said shannel for shearing off the portion of said wire projecting thereinto to form a slug, a heading sleeve reciprocable in a direction toward and away from said slug and having a sized passageway therethrough with a lateral aperture opening into said channel, means for advancing said cutter through said channel to shear off a slug and transfer it through said aperture into said passageway, means for advancing said heading sleeve against said shell on said stud, a heading punch reciprocable through said passageway, and means for advancing said heading punch through said passageway to force said slug into the opening in said work piece and to head it up therethrough against said heading stud whereby to stake said slug to said shell.

2. A heading unit for cutting short pieces from wire stock to form slugs and for staking the slugs into openings in the side of hollow shells to form lateral pins thereon, comprising a stud having an end adapted to enter said shells, a body having a channel therethrough lateral to said stud, an opening through said body approximately normal to said channel and terminating thereat, means for feeding wire through said opening transversely into said channel and for pressing the end of said wire against the wall thereof opposite said opening, a cutter slidable through said channel for shearing off the portion of said wire projecting thereinto to form a slug, a heading sleeve reciprocable in a direction toward and away from said stud and having a sized passageway therethrough with a lateral aperture opening into said channel, said aperture being aligned with said opening along the path of movement of said cutter, means for sliding said cutter through said channel to shear off a slug and drive it through said aperture and deposit it in said passageway, means for advancing said heading sleeve against said shell on said stud, a heading punch reciprocable through said passageway, and means for advancing said punch through said passageway to force said slug into the opening in said shell and head it up therethrough against said stud whereby to stake said slug to said shell.

3. A heading unit for cutting short pieces from wire stock to form slugs and for staking the slugs into openings in the side of hollow shells to form lateral pins thereon, comprising a stud having an end adapted to enter said shells, a body having a channel therethrough lateral to said stud, an opening through said body approximately normal to said channel and terminating thereat, means for feeding wire through said opening transversely into said channel and for presing the end of said wire against the wall thereof opposite said opening, a cutter pivotable through said channel for shearing off the portion of said wire projecting thereinto to form a slug, an indexable transfer disc having cavities for receiving said slugs, means for pivoting said cutter to shear off a slug and carry it into registry with a cavity in said disc, a reciprocable plunger for transferring said slug from said cutter into said cavity, a heading sleeve reciprocable in a direction toward and away from said stud and having a sized passageway therethrough with a lateral aperture accommodating the edge of said transfer disc, means for rotating said disc to index said slug into said lateral aperture and into registry with said passageway therethrough, means for advancing said heading sleeve against said shell on said stud, a heading punch reciprocable through said passageway, and means for advancing said heading punch through said passageway whereby to drive said slug into the opening in said shell and head it up therethrough against said heading stud whereby to stake it to said shell.

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