

Aug. 5, 1947.

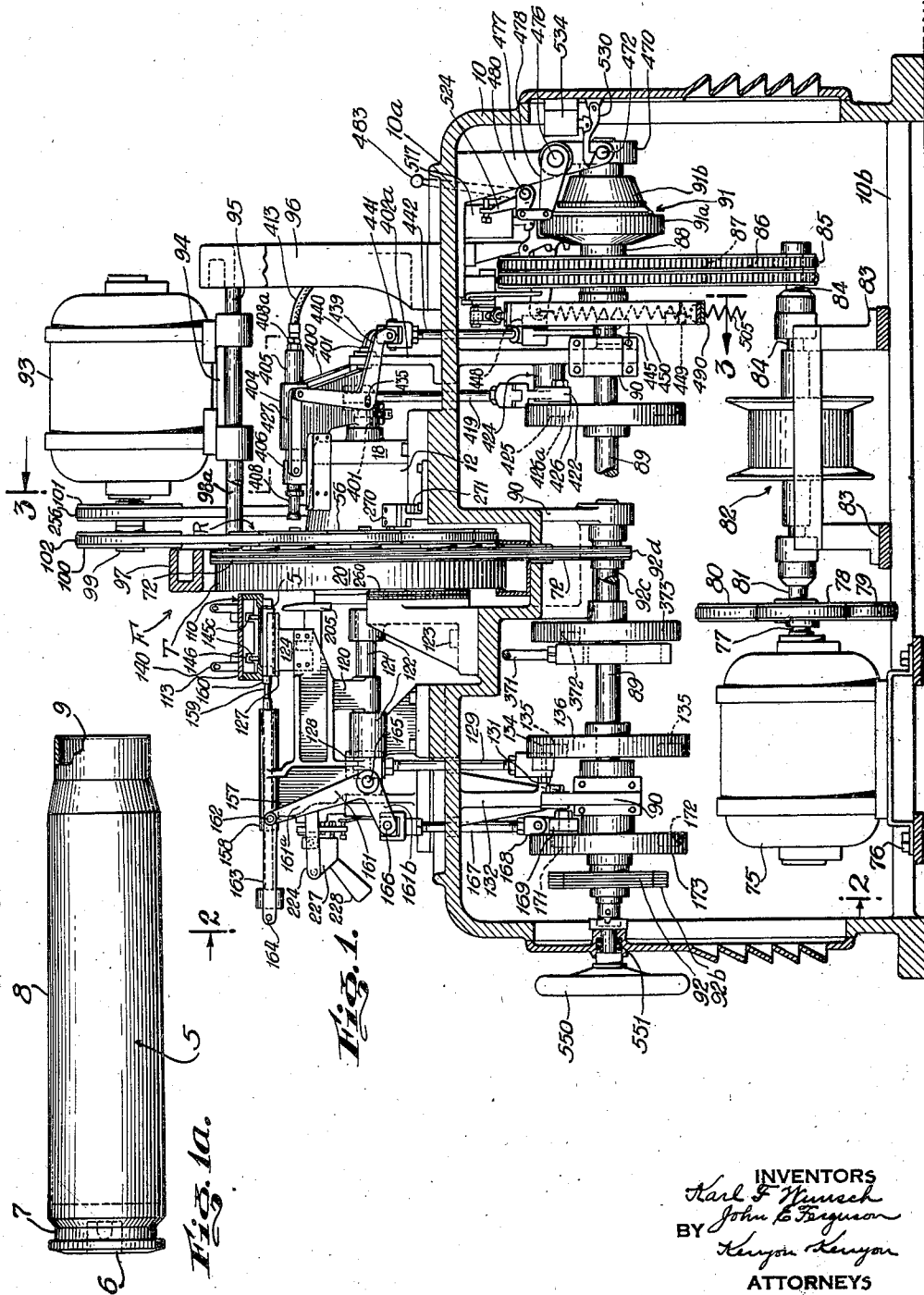
K. F. WUNSCH ET AL

2,425,170

CONTINUOUS HEAD TURNING MACHINE

Filed June 4, 1942

13 Sheets-Sheet 1



INVENTORS  
*Karl F. Wunsch*  
BY *John L. Ferguson*  
*Kenyon Kenyon*  
ATTORNEYS

Aug. 5, 1947.

K. F. WUNSCH ET AL

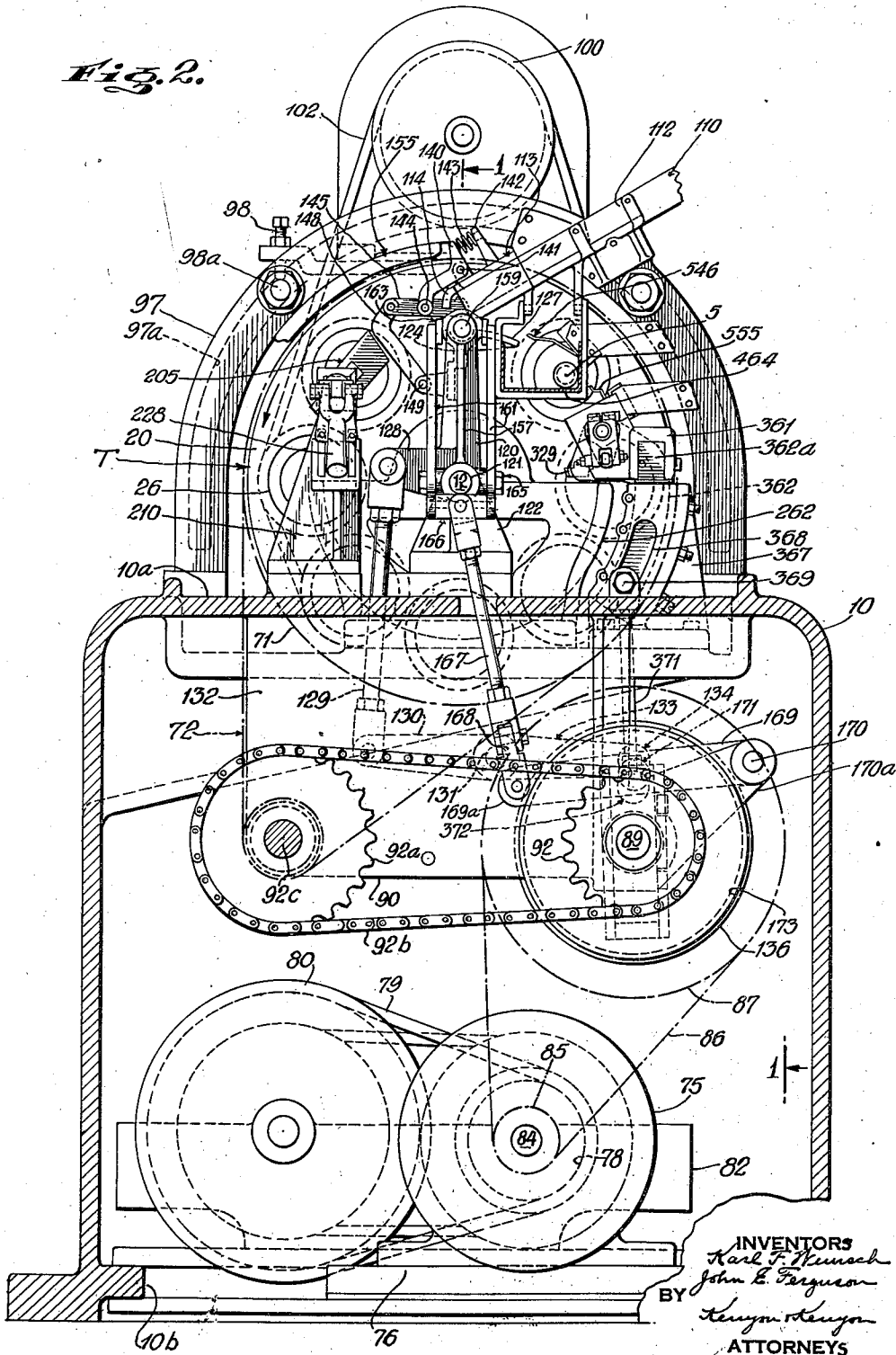
2,425,170

CONTINUOUS HEAD TURNING MACHINE

Filed June 4, 1942

13 Sheets-Sheet 2

Fig. 2.



INVENTORS  
Karl F. Wunsch  
John E. Ferguson  
BY  
Kenyon Kenyon  
ATTORNEYS

Aug. 5, 1947.

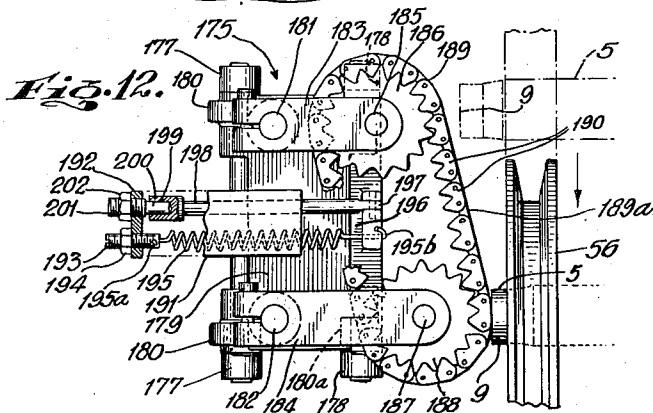
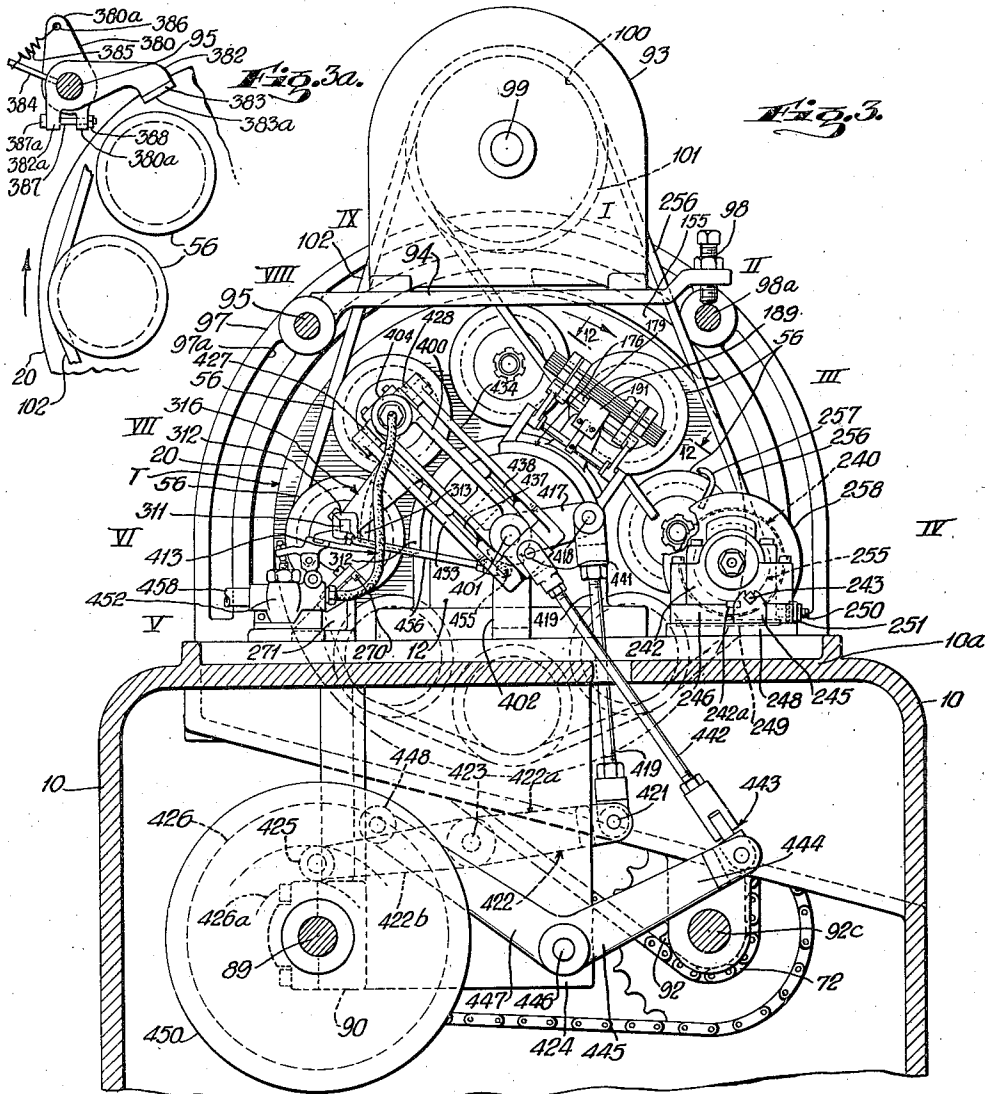
K. F. WUNSCH ET AL

2,425,170

CONTINUOUS HEAD TURNING MACHINE

Filed June 4, 1942

13 Sheets-Sheet 3



INVENTORS  
Karl F. Wunsch  
John E. Ferguson  
BY  
Karyon Karyon  
ATTORNEYS

Aug. 5, 1947.

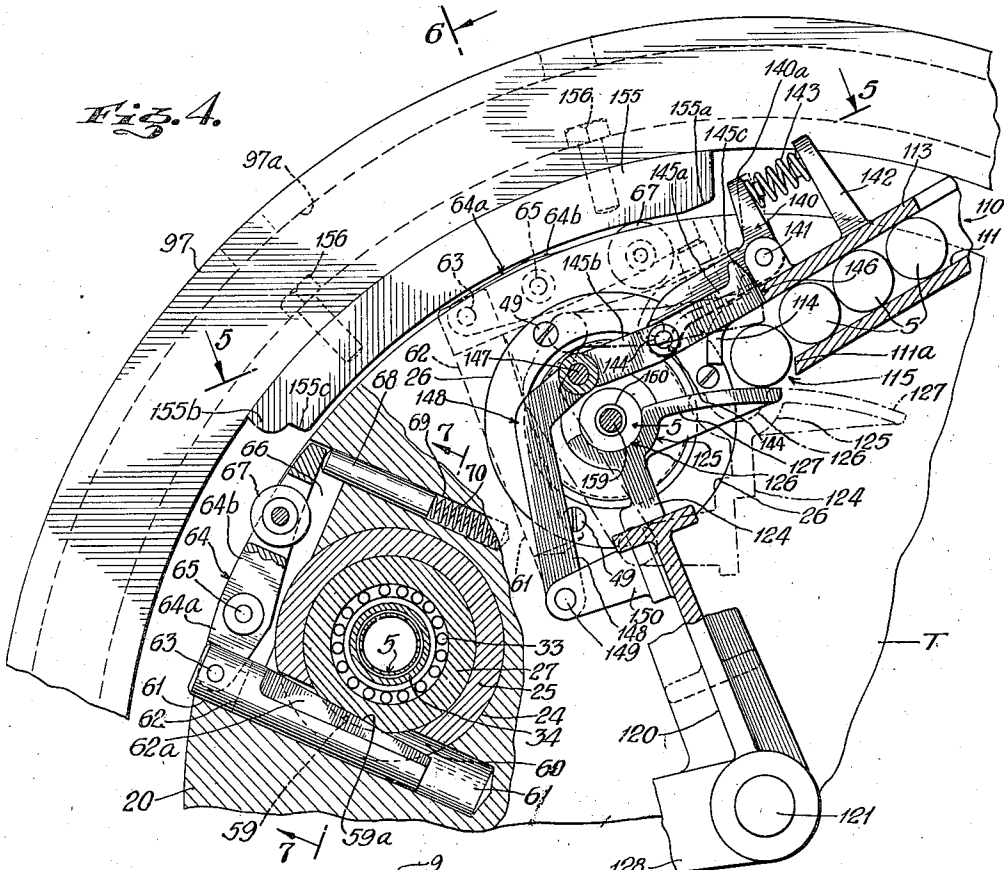
K. F. WUNSCH ET AL

2,425,170

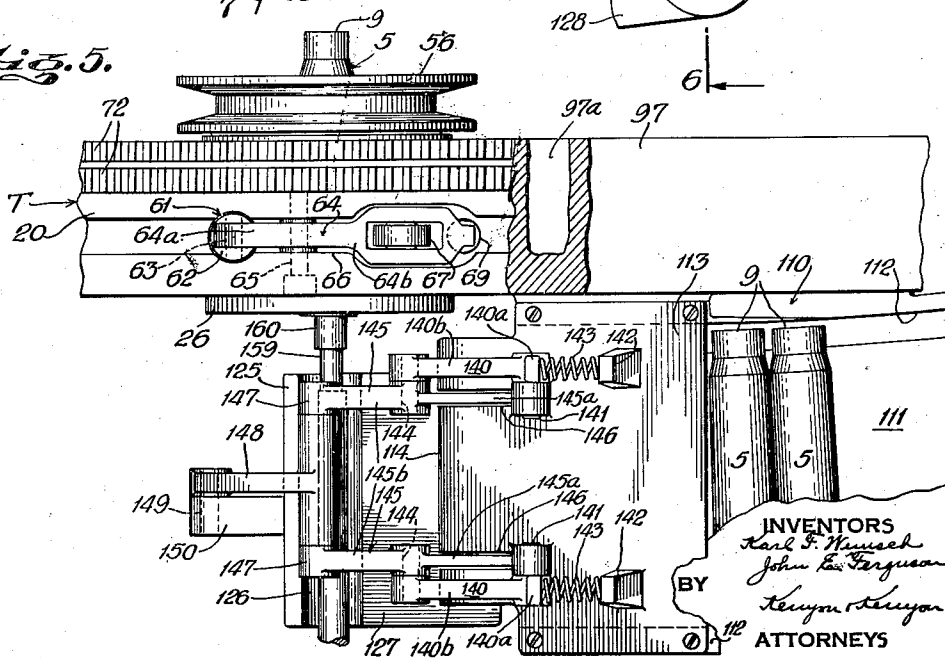
CONTINUOUS HEAD TURNING MACHINE

Filed June 4, 1942

13 Sheets-Sheet 4



*Fig. 5.*



INVENTORS  
Karl F. Wunsch  
John E. Ferguson  
BY  
Kerby & Kerby  
ATTORNEYS

Aug. 5, 1947.

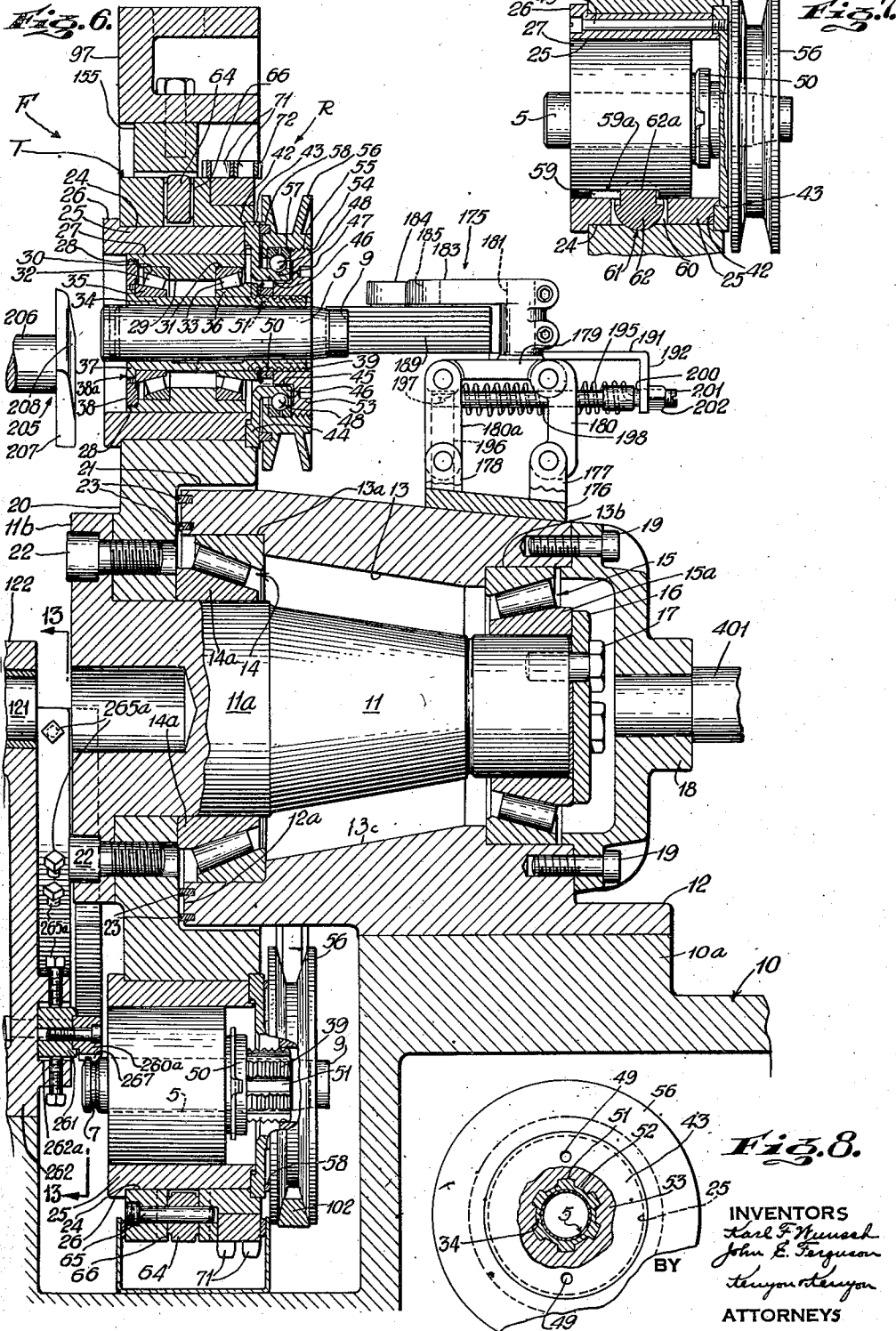
K. F. WUNSCH ET AL

2,425,170

CONTINUOUS HEAD TURNING MACHINE

Filed June 4, 1942

13 Sheets-Sheet 5



INVENTORS  
Karl F. Wunsch  
John E. Ferguson  
BY  
Stuyvesant  
ATTORNEYS

Aug. 5, 1947.

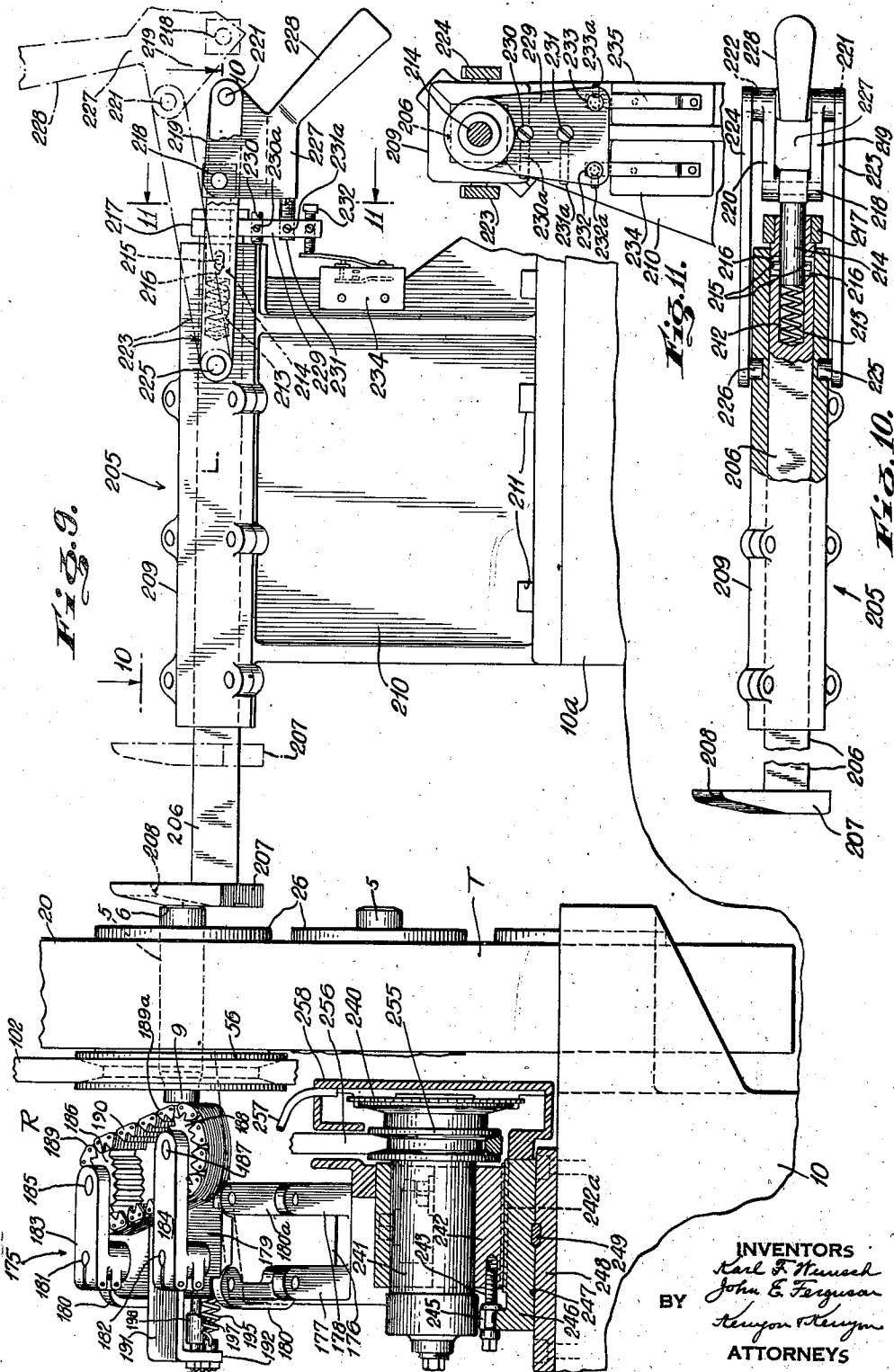
K. F. WUNSCH ET AL

2,425,170

CONTINUOUS HEAD TURNING MACHINE

Filed June 4, 1942

13 Sheets-Sheet 6



INVENTORS  
 Karl F. Wunsch  
 John E. Ferguson  
 Raymond Ferguson  
 ATTORNEYS

Aug. 5, 1947.

K. F. WUNSCH ET AL

2,425,170

CONTINUOUS HEAD TURNING MACHINE

Filed June 4, 1942

13 Sheets-Sheet 7

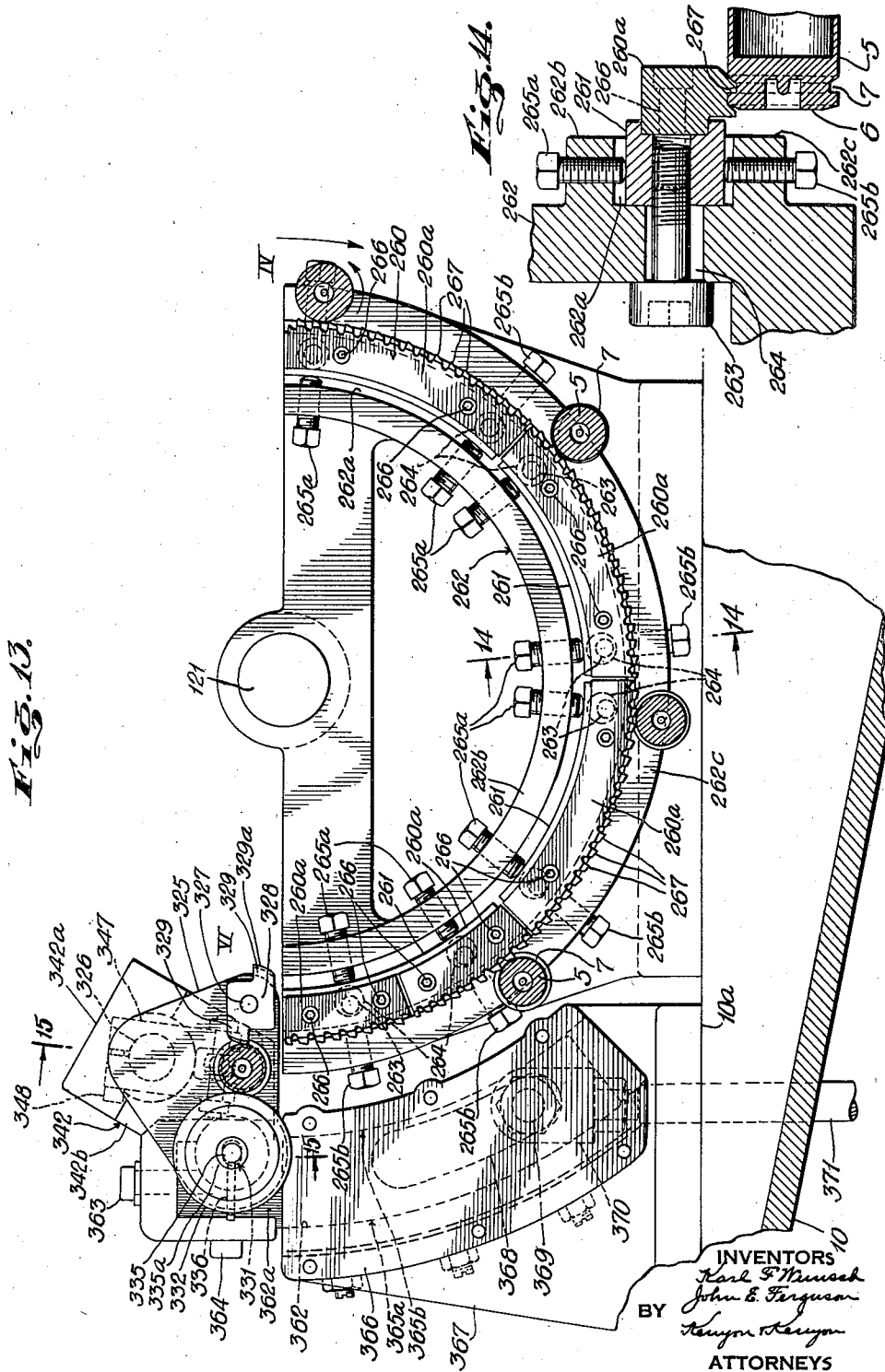


Fig. 13.

Fig. 14.

INVENTORS  
Karl F. Wunsch  
John E. Ferguson  
BY  
Rayon Rayon  
ATTORNEYS

Aug. 5, 1947.

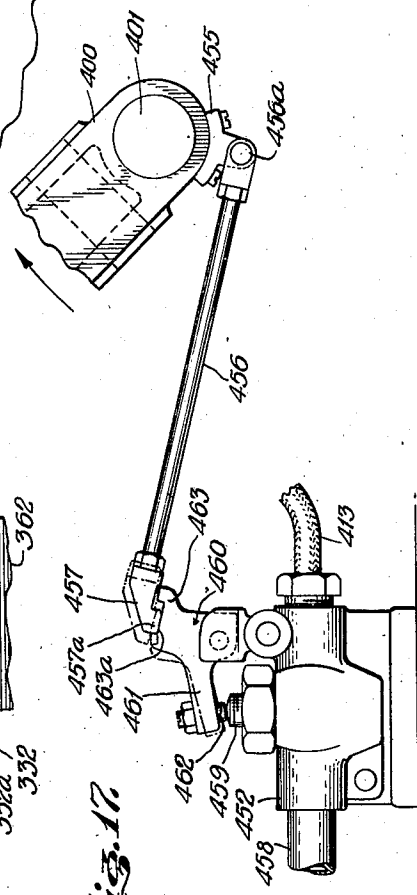
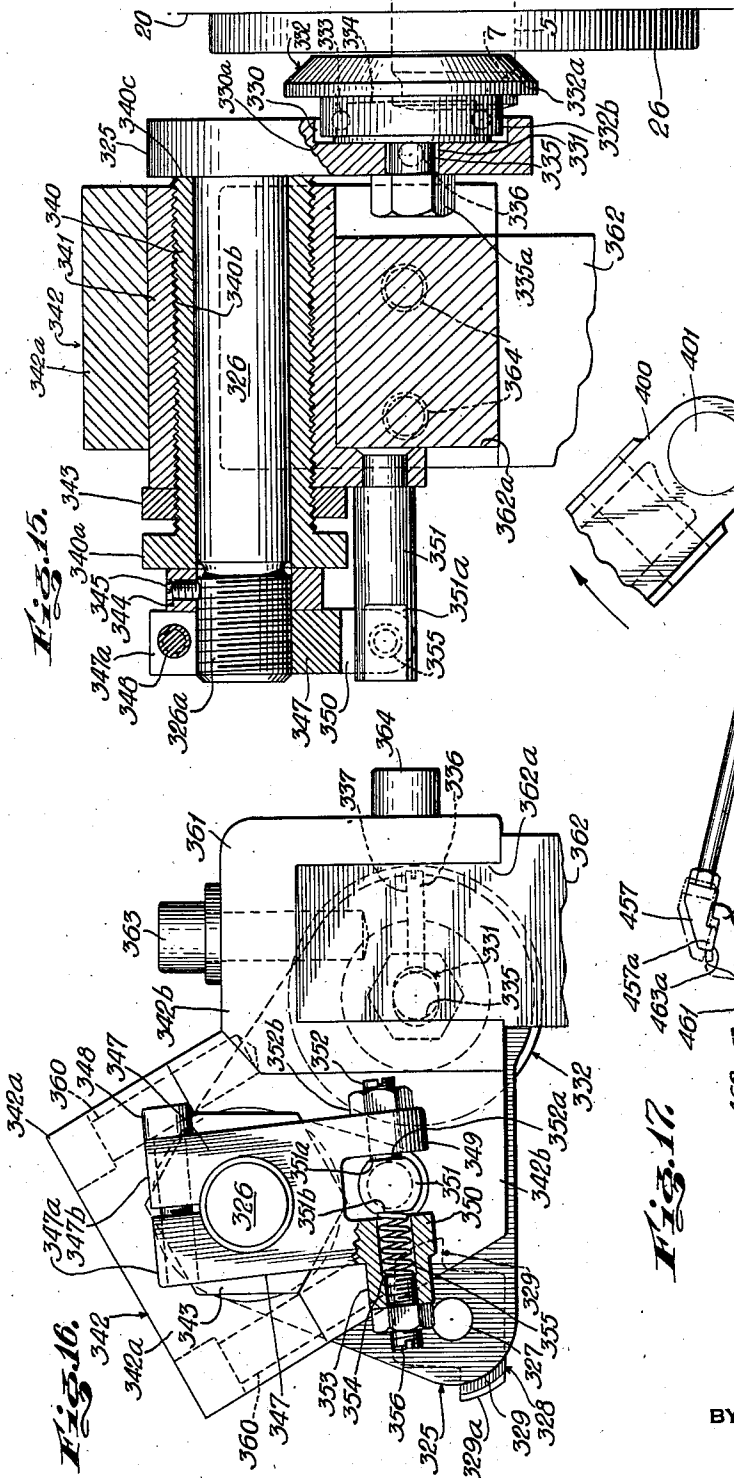
K. F. WUNSCH ET AL

2,425,170

CONTINUOUS HEAD TURNING MACHINE

Filed June 4, 1942

13 Sheets-Sheet 8



INVENTORS  
Karl F. Wunsch  
John E. Ferguson  
BY  
Kemp Kemp  
ATTORNEYS

Aug. 5, 1947.

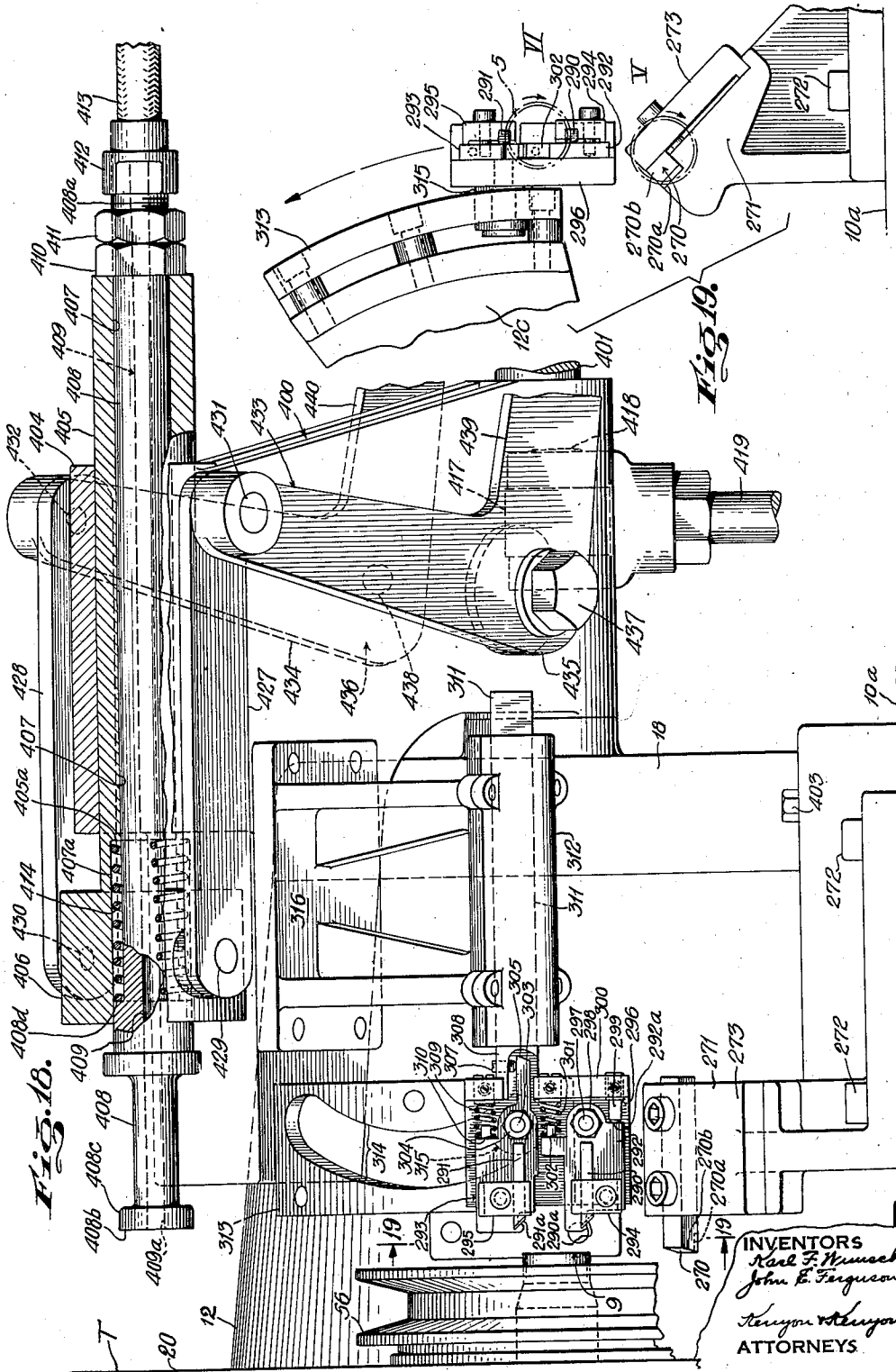
K. F. WUNSCH ET AL

2,425,170

CONTINUOUS HEAD TURNING MACHINE

Filed June 4, 1942

13 Sheets-Sheet 9



INVENTORS  
Karl F. Wunsch  
John E. Ferguson  
Kerison Kerison  
ATTORNEYS

Aug. 5, 1947.

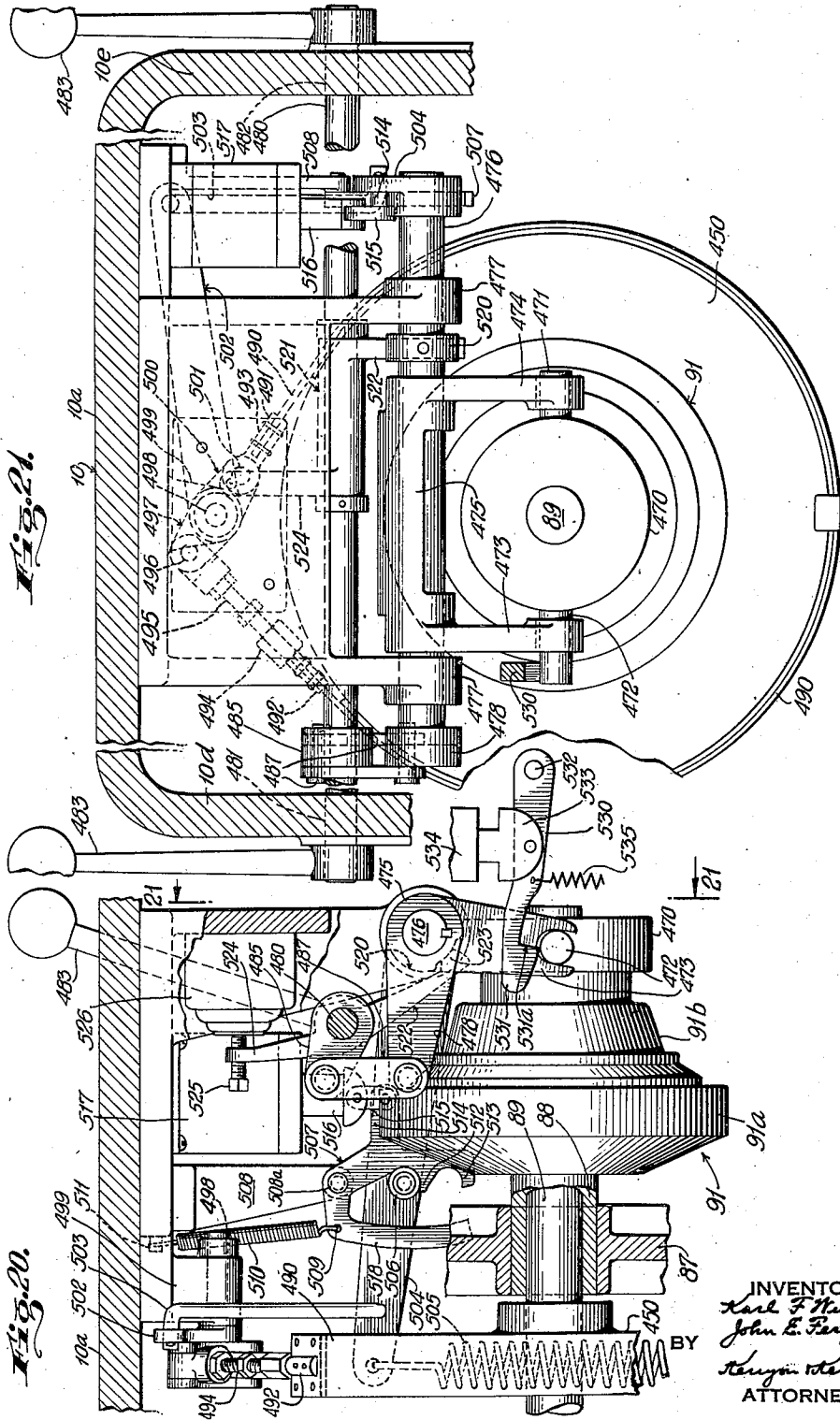
K. F. WUNSCH ET AL

2,425,170

CONTINUOUS HEAD TURNING MACHINE

Filed June 4, 1942

13 Sheets-Sheet 10



INVENTORS  
Karl F. Wunsch  
John E. Ferguson  
BY  
Raymond W. Wray  
ATTORNEYS

Aug. 5, 1947.

K. F. WUNSCH ET AL

2,425,170

CONTINUOUS HEAD TURNING MACHINE

Filed June 4, 1942

13 Sheets-Sheet 11

Fig. 22.

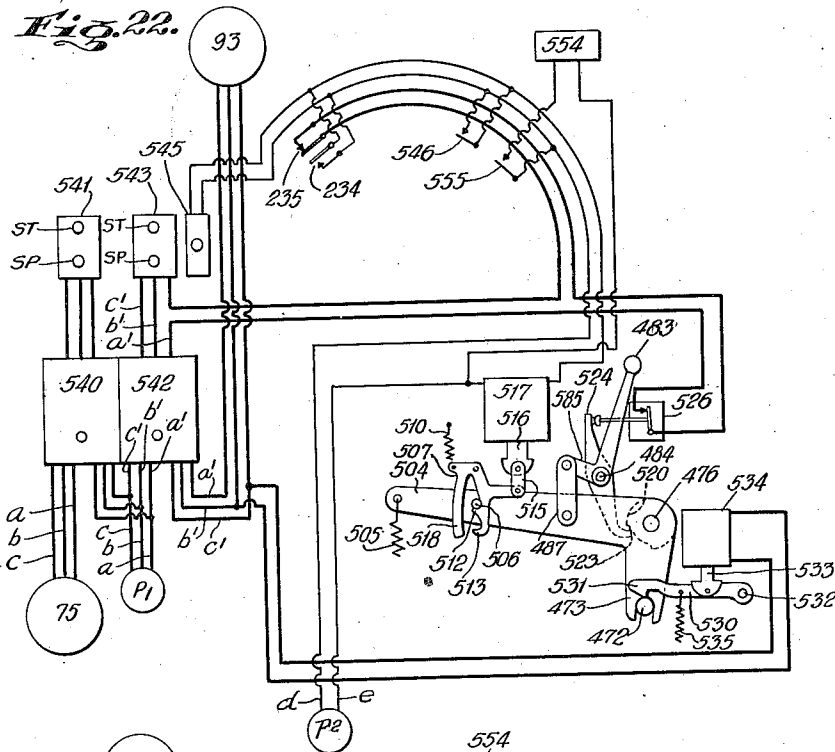
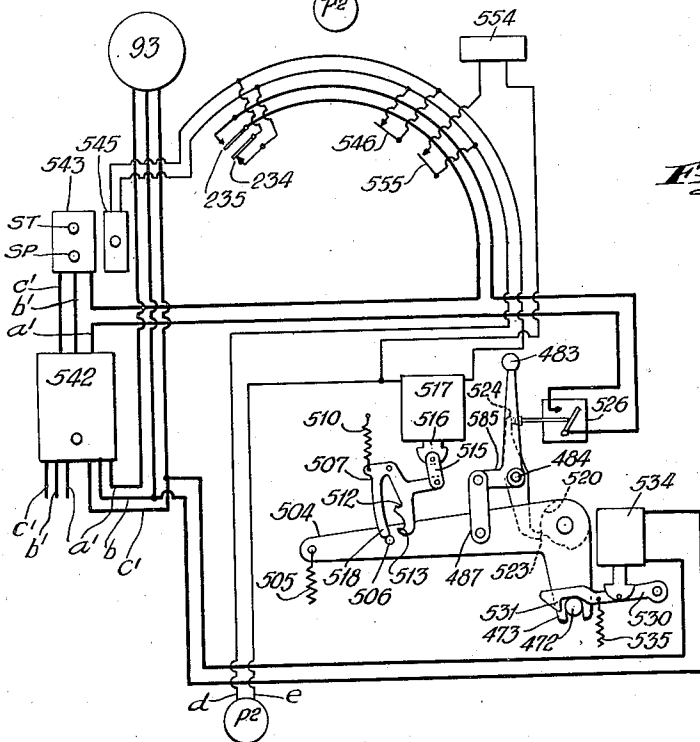


Fig. 23.



INVENTORS  
Karl F. Wunsch  
John E. Ferguson  
BY *Henry Kenyon*  
ATTORNEYS

Aug. 5, 1947.

K. F. WUNSCH ET AL

2,425,170

CONTINUOUS HEAD TURNING MACHINE

Filed June 4, 1942

13 Sheets-Sheet 12

Fig. 24.

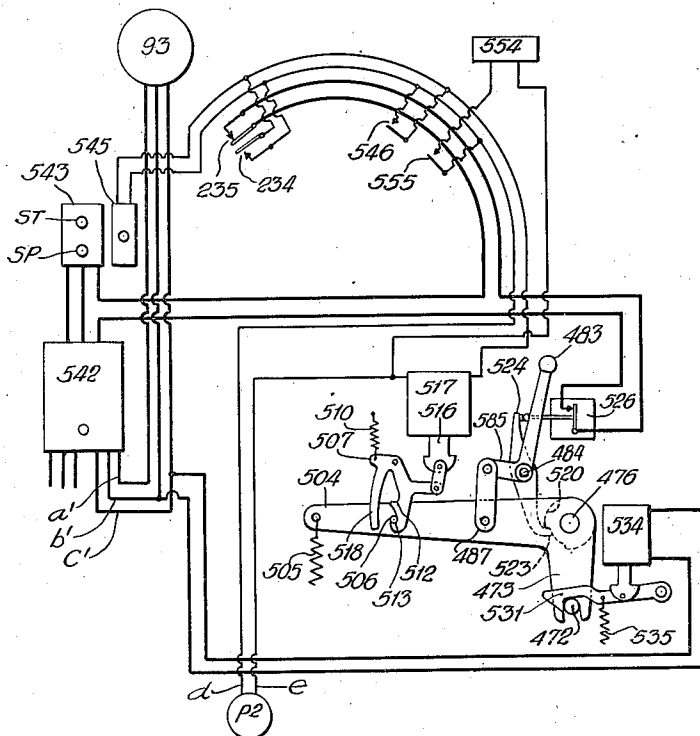
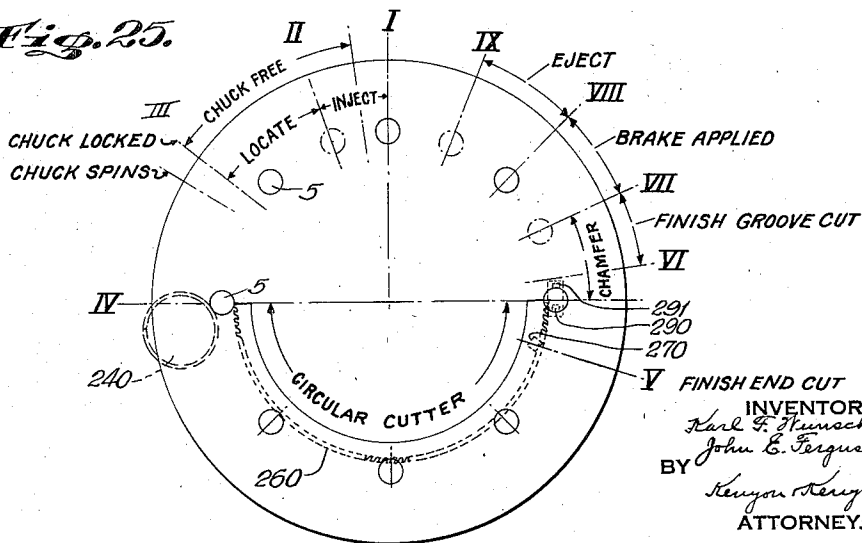


Fig. 25.



Aug. 5, 1947.

K. F. WUNSCH ET AL

2,425,170

CONTINUOUS HEAD TURNING MACHINE

Filed June 4, 1942

13 Sheets-Sheet 13

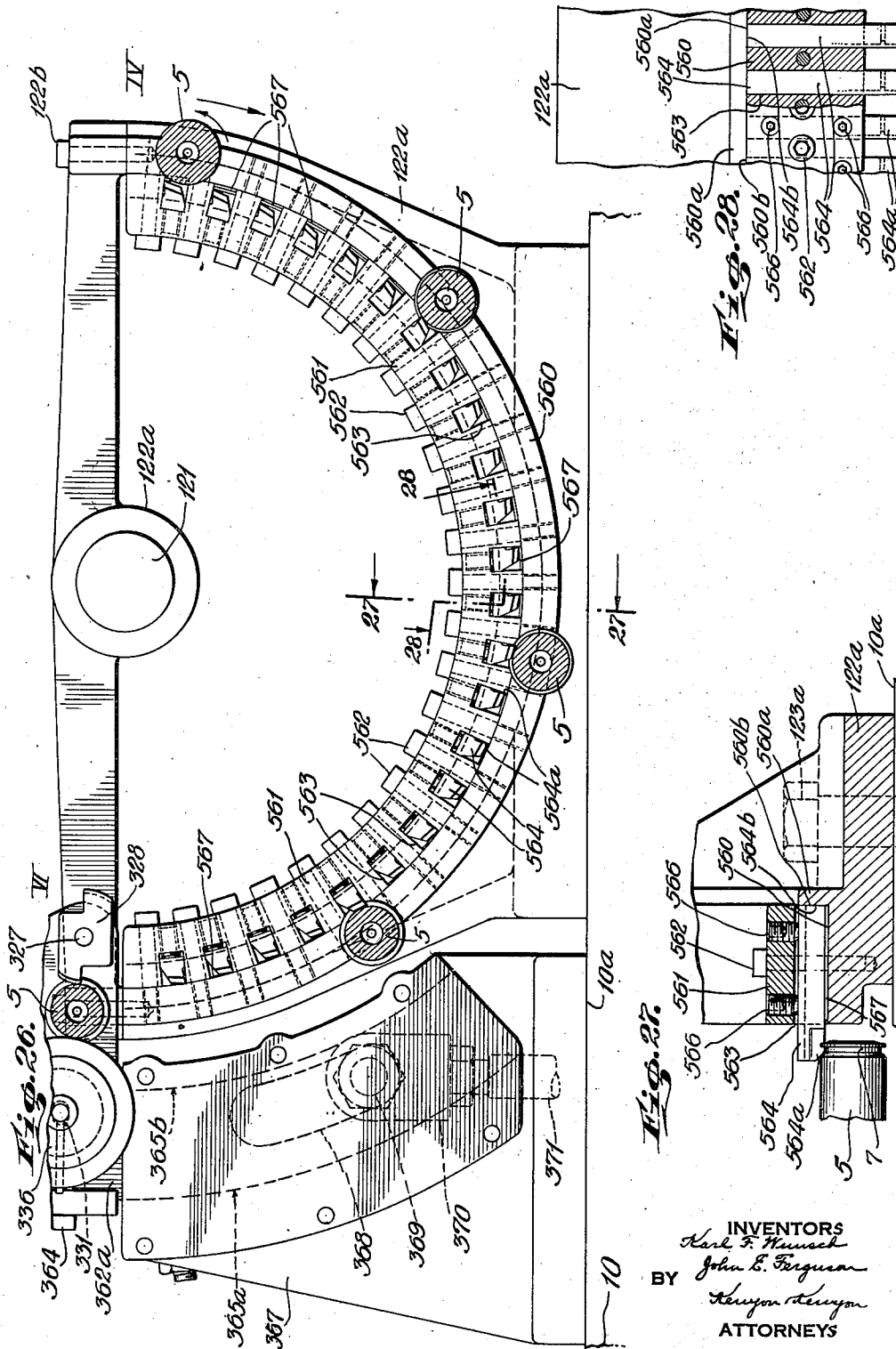


Fig. 26.

Fig. 27.

Fig. 28.

INVENTORS  
 Karl F. Wunsch  
 John E. Ferguson  
 Henryon Ferguson  
 ATTORNEYS

# UNITED STATES PATENT OFFICE

2,425,170

## CONTINUOUS HEAD TURNING MACHINE

Karl F. Wunsch, Bridgeport, and John E. Ferguson, Southbury, Conn., assignors to Bridgeport Brass Company, Bridgeport, Conn., a corporation of Connecticut

Application June 4, 1942, Serial No. 445,722

32 Claims. (Cl. 29—33)

1

The present invention relates to a continuous head turning machine for work pieces adapted particularly for the manufacture of ordnance equipment or the like. More particularly, it relates to a continuous head turning machine for broaching and other finishing operations upon a cartridge casing or other work piece, for example, for the application to such casing of the usual ejector groove, also, for the final trimming on one end of the casing to reduce it to exact longitudinal dimensions and for the chamfering of said end.

One of the principal objects of the invention is to provide a machine of this character for the rapid quantitative production of cartridge casings or the like. This machine is adapted to finish as many as 3600 casings or more per hour.

Another object of the present invention is the provision in the machine of a turret carrier adapted to carry each shell casing or other work piece in a continuous manner along an orbital path successively through a series of tooling operations. In such operations broadly, the following sequence of operations occur: At a first station I the casings or pieces are delivered to a transfer mechanism one by one. Between the first station I and a second station II, the cartridge casings are by injector mechanism injected one by one into orbitally moving work holders in the turret structure from the transfer mechanism. Between station II and a third station III, each injected casing or work piece and its work holder or chuck, which at the moment is free for longitudinal movement, is properly located in the longitudinal direction for the purpose of putting the various portions of each work piece or cartridge casing in a proper position for the subsequent tooling operations thereon. On leaving the third station III, each work holder is locked in located position against longitudinal displacement. After being so locked on leaving the third station each work holder or chuck is coupled to a driving means for rotating it on its own axis at high speed (approximately 3600 R. P. M.). The turret member or carrier then carries or moves each rotating chuck in the orbital path successively to a fourth station IV where, simultaneously a rotary end saw or severing means cuts off excess of the length of the rear end of each work piece or shell casing passing that station to give the particular piece or casing approximately its correct length. At the same time at this fourth station, the front end of each piece or casing arriving there is brought into contact with the starting end of a stationary arcuate groove cut-

2

ting or broaching tool which serves to cut the annular ejector groove into the external surface of each succeeding casing. The arcuate tool extends substantially through 180° of the orbital path travel of the work holders on turret member and is stationary. Each of the individual casings, rapidly rotated in its driven rotary chuck or work holder, is moved in the orbital path past the stationary arcuate tool to a fifth station V located shortly ahead of the end of the arcuate tool at a sixth station VI.

At the fifth station V, a finishing end cut is applied by an appropriate tool to the rear end of each casing or work piece. This trims each casing to its required length. Each trimmed casing, still being acted upon by the arcuate broaching or cutting tool is then carried to the sixth station VI of the orbital path at the terminal end of the said arcuate tool where suitable tools are provided that begin operation on the rear end of each trimmed work piece or casing to provide an internal and external chamfer. These chamfering tools operate on said trimmed piece or casing in its travel from the sixth station to a seventh station VII. Also, in its traverse from the sixth station VI to station VII, a finishing groove cut is effected on each trimmed piece or casing by a suitable tool acting in each groove previously cut by the arcuate broaching tool. Each finished piece or casing then is carried to an eighth station VIII, wherein ejection of each piece or casing from its holder or chuck is started. The ejection is completed in the traverse from the eighth station VIII to a ninth station IX where the ejection operation is completed.

It is another object of the invention to provide novel means effecting the required operations on each casing or work piece in turn at each of the aforementioned stations as each moves in the orbital path described by its work holder.

Still another object is to provide novel groove cutting or broaching means for cutting the required ejector groove in each of the casings or work pieces during orbital movement of such casings.

A further object is to provide novel means for delivering the casings or work pieces to said machine and for transferring and injecting them one by one to receiving work holders while the latter are in orbital motion.

Still a further object is to provide novel means in said machine for locating the injected casings or work pieces properly with their work holders while orbital movement of said work holders is maintained.

3

Yet another object is to provide novel means in said machine for finishing the required groove cut into each casing or work piece while orbital motion of such casings or work pieces continues.

A further object is to provide means in said machine for ejecting finished casings or work pieces from their holders while orbital motion of the latter continues.

An additional object is to provide testing means arranged at various of the stations, and safety controls in conjunction with operating parts of the machine to prevent its operation either in the event of improper location of a work piece or casing, or in the event of a failure of ejection of a finished casing or work piece from the machine.

To the accomplishment of the foregoing and such other objects as may hereinafter appear, this invention consists in the novel construction and arrangement of parts hereinafter described and then sought to be defined in the appended claims, reference being had to the accompanying drawings forming a part hereof, which show merely for the purposes of illustrative disclosure a preferred embodiment of the invention, it being expressly understood, however, that various changes may be made in practice within the scope of the appended claims, without digressing from the inventive idea.

In the accompanying drawings in which similar reference characters denote corresponding parts and in which the sectional views are viewed in the directions of the indicating arrows:

Fig. 1 is a vertical side sectional elevation of the general assembly of the machine taken along line 1—1 of Fig. 2.

Fig. 1a illustrates a shell casing finished by the tooling operations of the machine of this invention;

Fig. 2 is a vertical front section taken along line 2—2 of Fig. 1;

Fig. 3 is a vertical section taken along line 3—3 of Fig. 1 and illustrating, also, details of mechanisms at the rear side of the turret structure;

Fig. 3a is a fragmentary view illustrating details of the chuck brake.

Fig. 4 is an enlarged fragmentary section illustrating details of the feed mechanisms;

Fig. 5 is a view taken along line 5—5 of Fig. 4, illustrating further details of construction;

Fig. 6 is an enlarged section taken along lines 6—6 of Fig. 4, illustrating details of the locating mechanisms and spindle chucks;

Fig. 7 is a section taken along lines 7—7 of Fig. 4 illustrating details of a mechanism for locking the chuck or work holder after a shell casing has been located therewith;

Fig. 8 is a fragmentary end view of Fig. 7, viewed from the right of Fig. 7;

Fig. 9 is an enlarged detail view of the rear and front locating mechanisms of the machine;

Fig. 10 is a section taken along line 10—10 of Fig. 9 illustrating further details of the front locator mechanism;

Fig. 11 is a sectional view taken along line 11—11 of Fig. 9, illustrating details of the automatic cut-off switching mechanisms provided for stopping the machine in the event of improper location of a shell casing in a work holder;

Fig. 12 (on sheet 3) is a fragmentary plan view of the rear locator mechanism shown in Fig. 9;

Fig. 13 is a sectional view taken along line 13—13 of Fig. 6 illustrating the location of the groove cutting or broaching tool and its application to a shell casing during the movement of the

4

latter from station III to IV, and, also, illustrating partially the mechanism at station VI for applying the finishing cut to the groove formed by the cutting or broaching tool;

Fig. 14 is a fragmentary section taken along line 14—14 of Fig. 13 illustrating the action of the groove cutting or broaching tool with respect to the surface of a casing and, also, illustrating the means for adjusting the depth of cut of the tool;

Fig. 15 is a sectional view taken along line 15—15 of Fig. 13 illustrating details of the mechanism for applying the finishing cut to the groove cut in a casing by the cutting or broaching tool;

Fig. 16 is a side view of the mechanism shown in Fig. 15 viewed from the left thereof;

Fig. 17 is a fragmentary view of the valve and its control mechanism associated with the ejector mechanism for providing auxiliary fluid blast ejection in conjunction with the mechanical ejector mechanism operating from station VIII to station IX.

Fig. 18 illustrates details of the ejector mechanism operating from station VIII to station IX;

Fig. 19 is a view taken along line 19—19 of Fig. 18 illustrating the relative position and manner of application of both the end finish cutting tool located at station V and of the outside and inside chamfering tools which begin operation at station VI;

Fig. 20 is an enlarged detail view of the manually operated starting or coupling mechanism for the machine;

Fig. 21 is a view taken along line 21—21 of Fig. 20 illustrating further details of the said coupling mechanism;

Fig. 22 is a simplified wiring diagram of the electrical circuits for controlling the electric motors driving various parts of the machine, and of the safety controls in circuits in the running condition of the machine;

Fig. 23 illustrates a portion of the circuits and manually operated coupling mechanism in the stopped, locked position of the machine;

Fig. 24 illustrates the same features as in Fig. 23 in the neutral position of the machine;

Fig. 25 is a schematic diagram indicating the various stations of operation and the tooling operations effected at each station;

Fig. 26 is a view similar to Fig. 13 on an enlarged scale illustrating a modified form of groove cutting or broaching tool, which may be substituted in the machine for that of Fig. 13;

Fig. 27 is a sectional view taken along line 27—27 of Fig. 26 illustrating details of construction of the said modified form of groove cutting or broaching tool; and

Fig. 28 is a sectional view taken along line 28—28 of Fig. 27 illustrating further details of construction of said modified form of groove cutting or broaching tool.

Referring generally to the drawing, and particularly to Fig. 1a, 5 denotes a shell or cartridge casing. This casing adjacent its front or closed end 6 is provided with an annular surface groove 7 which cooperates in well known manner with the usual ejecting mechanism of a cannon or gun for the removal of the casings after discharge. The wall 8 of this casing has a slight taper from its front end 6 towards its rear end 9. The longitudinal dimension of the casing 5 must be very accurately determined. The rear end 9 is chamfered both internally and externally.

The machine constituting the subject matter of this invention is adapted to trim the casing 5

to exact length by operation on the rear end 9, to provide the annular ejector groove 7, and to provide the chamfers on the said rear end 9.

*The turret member (Figs. 1-6)*

Referring further to the drawings, and first, to Figs. 1 to 6, 10 denotes a frame or housing designed to carry the working parts of the machine. This housing over its top carries a suitably supported horizontally extending turret axle 11 which is designed to carry the rotating turret T.

This turret T is supported as will now be described.

In the embodiment shown (Fig. 6), an axle bearing block 12 is carried and attached suitably to the top 13a of the frame or housing 10. This bearing block has a horizontally extending bore 13 which has differently diametered portions 13a and 13b at opposite ends joined by a tapered portion 13c. Roller bearings 14 and 15 are mounted in the respective portions 13a and 13b and these serve to rotatably support the axle 11 within the bearing block bore 13. Axle 11 is maintained in proper lateral position by means of the bearings 14 and 15 being spaced in the housing block 12 and by the lock plate 16. This plate 16 is suitably secured as by the bolts 17 to the axle 11. A suitable end closure 18 secured suitably at 19 to the bearing block 12 serves as a dust cover.

The opposite end of the axle 11 on a portion 11a thereof carries the turret T. This turret comprises a large diametered plate-like member 20, which on one face is provided with a concentric recess 21 to provide free clearance for the bearing block 12. The axle member 11 is provided with an annular flange 11b against which the opposite face of the turret plate member 20 abuts. The said plate member is secured suitably to the flange 11b as by bolts 22 or the like so that rotation of the axle 11, as will be presently described, causes corresponding rotation of the turret plate member 20. The member 20 is suitably spaced from the inner end 12a of the bearing block 12 by a suitable extension on the rotary race block 14a of the roller bearing 14. Suitable sealing rings 23 may be provided to prevent the access of dust and dirt to the roller bearings 14.

*The work holders or chuck members (Figs. 6-8 inc.)*

The turret member 20 is provided with a plurality of equi-spaced horizontally extending chuck bores 24. Each of these bores contains identical structural members and that in one bore only will be described. Each chuck bore 24 has a sleeve 25 fitted therein. This sleeve at one end has an annular flange 26 which abuts a face of the turret plate member 20 and limits the depth of its insertion into the bore 24. Fitting within the sleeve 25 is an annular ring 27. This ring is internally threaded at 28 and provided also with an internally extending annular rib 29. Stationary race blocks 30 and 31 of the respective roller bearings 32, 33 are carried on the ring 27 on opposite sides of the rib 29. A chuck sleeve or work holder 34 is fitted internally of the movable race blocks 35, 36 of the roller bearings 32, 33. The chuck sleeve 34 tapers internally from the front F toward the rear R of the turret plate member 20 for purposes to be presently described. At its front end, the chuck sleeve or work holder 34 has an annular flange 37 which abuts an end of the race block 35. A suitable sealing ring 38 having a bored-out portion 38a to fit the annular flange 37 threadedly

engages the threaded portion 28 of the annular ring 27. This ring prevents access of dirt to the bearings 32 and 33. At its opposite end the chuck sleeve 34 is externally threaded at 39. So arranged, the chuck sleeve 34 can rotate freely within the ring 27 on the roller bearings 32, 33.

The rear end of the sleeve 25 and the rear face of the turret member 20 are cut away or suitably recessed to provide an annular groove 42. A bearing support member 43 is provided. This support 43 has an annular flange 44 shaped to fit within the annular groove 42. It also has an opening 45 concentric with and of considerably larger diameter than the chuck sleeve 34 which extends therethrough. The support 43 also has a horizontally extending flange 46 provided on its external surface with a race-way 47 for ball bearings 48. The support 43 is secured suitably to the sleeve 25 as by the bolts 49 (Fig. 7) and, when so secured, serves to rigidly position the ring 25 against rotational or axial displacement in the turret plate member 20.

The chuck sleeve 34 is rigidly secured between the race blocks 35, 36 of the roller bearings 32, 33 by a suitable clamping nut 50, which is screwed over the threaded portion 39 of the chuck sleeve 34 into abutting relationship with the race block 35. When so mounted, the race blocks 35 and 36 and the chuck sleeve 34 are rotatable as a unit about the non-rotatable race blocks 30 and 31 and at the same time the sleeve 34 is movable with the movable annular ring 27 longitudinally with respect to the fixed sleeve 25.

The surface of the sleeve 34 in its threaded portion 39 is provided with suitable longitudinally extending grooves 51 which slidably receive splines 52 on a pulley part 53. This pulley part is threaded externally at 54 and threadedly engages a threaded portion 55 provided in an internal bored-out portion of a sheave or pulley 56. The latter is rotatably carried on the ball bearings 48 by the race way 57. A suitable sealing ring 58 extending from a face of the pulley 56 into abutment with the support 43 prevents the access of dirt to the ball bearings 48.

The pulley 56 is adapted to be driven in a manner to be presently described, being freely rotatable on the ball bearings 48 and serving when driven to rotate the chuck sleeve 34. While the pulley 56 is locked against longitudinal movement by its ball bearing support on the support 43, the sleeve 34, being slidably keyed thereto through the splines 52 and key-ways 51, may move longitudinally independently of the pulley 56 for the purpose to be presently described.

Means are provided for locking the work holder or chuck sleeve 34 in any predetermined position of longitudinal displacement. To this end, as shown in Figs. 4 and 7, the annular ring 27 is provided with a cut-out or recess 59. This recess has a flat bottom face 59a which extends as a chord of the arc defining the outer surface of the ring 27 and is located below said surface. This recess has considerable width in the axial direction of the ring 27. A similarly extending slot 60 is provided in the sleeve 25. This slot or recess 60, however, is of smaller width than the slot 59. A bore 61 extending inwardly from the periphery of the plate member 20 and forming an entrance to and a continuation of the slot 60 is provided in the turret member 20. This bore 61 receives slidably a wedging pin 62, which in a portion 62a thereof has a flat surface adapted to engage and abut the bottom 59a of the slot 59. When so engaged it serves simultaneously to pre-

vent rotation of the ring 27 and also to wedge it against longitudinal displacement.

The wedging member 62 is pivotally joined at 63 (Figs. 4 and 5) to one arm 64a of a lever 64 pivoted at 65 to the turret plate member 20 within a suitably provided recess 66 located in the circumferential face of said plate 20. The other arm 64b of this lever 64 which normally lies below the peripheral surface of the member 20 carries a suitable cam roller 67 whose diameter is so admeasured as to protrude from the peripheral surface of the member 20. The extreme end of arm 64b engages a plunger pin 68, extending into a bore 69 within the plate 20. This plunger is normally urged outwardly by a compression spring 70. Since the spring 70 is sufficiently powerful to normally urge the arm 64b outwardly, because of the pivoting arrangement at 65 it tends to urge the wedging surface 62a of the wedging pin 62 into locking engagement with the ring 27. The cam roller operates on a suitable cam to be presently described to operate the wedging pin 62 in a manner also to be presently described.

As indicated hereinbefore, each of the chuck bores 24 of the turret plate 20 is provided with a chuck sleeve and sheave or pulley drive construction identical with that just described. In an actual embodiment and as shown in these drawings, eight chuck sleeves or work holders of such construction are provided in the turret member 20. More or fewer such chuck sleeves may be provided.

The peripheral surface of the turret plate member 20 is provided with an annular set of teeth 71 which are adapted to be engaged by a suitable driving chain 72 which is driven as will be presently described. Any other suitable drive may be provided.

#### *The turret member drive (Figs. 1-4 inc.)*

In the embodiment shown, the drive mechanism for the turret plate member 20 comprises the following:

A main motor 75 (Fig. 1) (in this embodiment a 3 phase electric motor) is suitably supported at 76 on the base 10b of the housing 10. The output shaft 77 of this motor is provided with a suitable pulley wheel 78. The latter in turn is coupled by a suitable belt 79 to a pulley 80 on the input shaft 81 of a suitable variable speed transmission device 82. The latter, in the embodiment shown, is a well known variable speed transmission device known as "Reeves" variable speed transmission. It may be any other suitable type.

This transmission device 82 is suitably fixed at 83 on the base 10b. The output shaft 84 of this transmission device is provided with a chain sprocket wheel 85. This wheel 85 in turn is coupled by suitable endless chain 86 or any other type of transmission coupling with a chain sprocket wheel 87. The wheel 87 is suitably keyed to or integral with a sleeve 88 which in turn is rotatably carried on a main drive shaft 89. The latter is suitably carried in the housing 10 by suitable hanging bearings 90 depending from the top 10a of the frame of the housing 10. The main drive shaft 89 extends horizontally and carries thereon various driving cams for various of the operating parts of the machine, all, as will be presently described. The sleeve 88 is adapted to be mechanically coupled to the driving shaft 89 by a suitable clutch 91 also in a manner to be presently described.

On shaft 89 is another sprocket 92 which drives a sprocket 92a by means of a chain 92b. Sprocket

92a is mounted on a shaft 92c parallel to shaft 89. This shaft 92c has thereon a sprocket 92d which through the medium of the chain 72 drives the turret 20. Of course gearing or any other type of drive may be substituted if desirable.

#### *The chuck or work holder drive (Figs. 1-3 inc.)*

A second driving motor 93 for rotating the chuck sheaves or pulleys 56 is provided. This motor is supported on a plate 94 (Figs. 1 and 3). The plate is pivoted along one transverse edge on a horizontal rod 95 whose opposite ends are suitably supported between an upright bracket 96 and hood-like member 97 arranged concentrically in spaced relationship about the turret plate 20. Both the bracket and member 97 are supported suitably from the top 10a of the frame or housing 10. The opposite edge of plate 94 is provided with suitable adjusting bolts 98 which cooperate with a transversely supported rod 98a to facilitate angular adjustment of the plate 94 for a purpose to be presently described.

The driving shaft 99 of the motor 93 is equipped with two pulley wheels 100 and 101. An endless band or belt 102 is passed around pulley wheel 100 and various of the pulley wheels 56 as shown in Fig. 3. The diameter of pulley wheel 100 is smaller than the over-all diameter of the turret member 20 so that the belt 102 assumes a substantially triangular shape shown in Fig. 3. With such shape, the pulley wheels 56 do not always engage the belt 102. The angular range of disengagement is approximately 90° extending about 45° on each side of the uppermost orbital position. This angle, however, may vary to suit any particular required condition. In this manner, rotation of the turret member 20 will cause successive of the pulley wheels 56 to ride into engagement with the belt 102 in their orbital travel in the direction of rotation of the plate member 20 and, also, cause the chuck driving sheaves or pulley wheels 56 at another point in the rotation of the member 20 to ride off the belt 102 so that alternately the pulleys 56 are uncoupled, driven and again uncoupled from the drive belt 102 in each complete revolution of the turret member 20. It is important to provide for such an arrangement because it is necessary during certain periods of operations on each shell casing 5 to have its particular chuck or work holder stationary while at other points it must be rotated. In the embodiment shown, the arrangement of the belt 102 is such that the chuck pulleys 56 are not coupled to it from the first to the third stations I to III of the orbital path, become coupled thereto between the third and fourth stations III and IV, and remain coupled to the belt until just before they reach the station VIII, and then become uncoupled again in their traverse from station VIII back to station I.

The plate 94 is made adjustable to loosen or tighten the engagement of the belt 102 around pulley 100 and the sheaves 56.

#### *The loading station I (Figs. 1 to 5 inc.)*

The shell casings 5 which are operated upon in the machine are delivered to it at a loading station I. This loading station I is located at the uppermost point in the orbital path described by the various work holders or chucks 34 in their rotation with the turret plate member 20. At this station I the various shell casings 5 are delivered one by one to transfer mechanism of the machine. From the transfer mechanism each casing 5 is injected into a particular chuck 34,

while such particular chuck moves from station I toward station II along the orbital path.

The delivery mechanism comprises a gravity feed chute 110. This chute in the embodiment shown has a sloping channeled slide 111 open at the top and whose guiding vertical side walls 112 are curved on large radii of curvature so that as the work pieces or casings 5 roll down the slide 111, their natural tendency to follow a curved path because of their slight taper is permitted. The walls 112 are parallel and spaced from each other sufficiently to permit casings 5 to roll freely toward the bottom or delivery end of the chute 110. In the embodiment shown, the casings 5 are placed in the chute 110 manually at its uppermost end (not shown). They may, however, be delivered mechanically if desired. It is essential, however, that the casings all extend in the same direction, that is, with their rear ends 9 in proper direction for insertion into the chucks 34 of the machine.

At the delivery end of the chute 110 a cover plate 113 (Figs. 4-5) which extends across the top of the walls 112 of the chute is suitably secured to them. An end 114 of this cover plate is curved downwardly substantially as shown, providing with the end 114a of the bottom plate 111, a discharge opening 115 from which the casings 5 may drop one by one vertically on to transferring mechanism now to be described.

#### The transferring mechanism (Figs. 1, 2, 4, 5)

The transferring mechanism comprises an arm 120, one end of which is rotatably supported on a suitable rock shaft 121. The rock shaft 121 in turn is carried on suitable bearings 122 supported at 123 from the top 10a of the housing 10. These bearings support the rock shaft 121 in axial alignment with the turret axle 11. The arm 120 is provided with an upright extension 124. This extension at its outermost end has a receiving socket 125 which in the embodiment shown is provided with a substantially semi-circular, recessed channel 126 shaped substantially complementary to the curvature of the surface of casing 5. A plate-like arm 127 extends from one side of the channel 126. This arm is provided with a surface having a radius of curvature equal substantially to that of the distance between the axis of the rock shaft 121 and the pitch circle of the chucks 126. The arm 120 is adapted to have oscillatory motion about the rock shaft 121 so that its socket member 126 oscillates in an orbit parallel to the orbital path of the casings or work pieces 5. At one extreme of its oscillations, the channel 126 of the socket 125 will be positioned directly below the outlet opening 115 to receive a shell casing 5. In its motion toward other extreme positions of its oscillations, the socket 125 will carry its contained shell casing 5 from station I toward station II for the injection into a synchronously moving chuck sleeve 34 then opposite said socket 125. At the same time the flange 127 will be moved and will lie below the outlet 115 to effectively prevent other casings 5 from falling out of the delivery chute 110.

The arm 120 is adapted to be oscillated on the rock shaft 121 as just described by a crank 128 (Fig. 2) which may be integral therewith. The crank is pivotally coupled to a link 129. The latter is pivotally coupled to one arm 130 of a lever which is pivoted suitably at 131 to a suitably fixed dependent member 132 (Fig. 1) carried by the housing top 10a. A second arm 133 of the

same lever is provided with a suitable cam follower 134 which engages in a cam groove 135 provided on a cam member 136. This cam member 136 is keyed or otherwise suitably fixed to the main drive shaft 39. In this way, rotation of the shaft 39 is translated into oscillatory motion of the arm 120 on the rock shaft 121 in a plane that is parallel to the plane of the front F of the turret member 29 for the purpose just described. The cam groove 135 is so shaped that when arm 120 is moved in the same direction of rotation as plate member 29, it has a speed synchronous therewith. The cam groove effects opposite movement of arm 120 more rapidly, so that during each period of synchronous motion the socket 125 and a work holder 34 will be axially aligned before they arrive at station II, and remain so to station II for the injection of the casing on the recess 126 into a work holder 34, as will be presently described.

Means are also provided in conjunction with this transferring mechanism to insure a quick, positive delivery of a shell casing 5 into the channel 126 each time the latter lies below the outlet 115 and at the same time to positively block the feeding of successive casings 5 while the arm 120 is travelling from its receiving position to the injecting position. To this end, the cover plate 113 carries a pair of bell crank levers 140. The latter are suitably pivoted at 141 to the said cover member 113. Uprights 142 extending from the cover member 113 serve as abutments for compression springs 143, one lying between each of the said abutments and the corresponding upright arm 140a of the bell crank levers 140. These springs 143 serve normally to tend to urge the lever arms 140a away from the abutments 142, and in Fig. 4, tend to give them counter-clockwise rotation about the pivots 141. The other arms 140b are each pivoted at 144 to one of a pair of levers 145. One arm 145a of each of the levers extends through suitably provided slots 146 in the outermost end 114 of the cover plate 113. Each of these arms 145a is adapted when rotated in one direction to extend into the chute 110 as shown in dot-dash lines in Fig. 4 and to overlie the casing 5 lying directly over the opening 115 and to push such casing into the recess 126 of the socket 125. At the same time, these arms 145a have noses 145c which then lie in front of the casing 5 next adjacent that in the opening 115 and hold it and all the other casings behind it back in the chute 110.

These levers 145 are articulated during and by the oscillatory motion of the arm 120. For this purpose they each have an arm 145b. These arms 145b are pivotally joined at 147 to a link 148 which is pivoted suitably at 149 to a suitable bracket member 150 extending from and attached to or integral with the arm 120.

On rotation of the arm 120 in the clockwise direction of Fig. 4, link 148 tends to rotate lever arms 145a in the same direction about pivot points 144. This rotation is resisted because the arms 145a abut the surface of the casing 5 which lies in opening 115 on the surface of flange 127. As a result, the pivot points 144 rotate in clockwise direction and in such rotation rotate the bell crank levers 140 in clockwise direction about the fixed pivots 141. The arms 140a of these levers then compress the springs 143. As soon, however, as the oscillating movement of arm 120 carries its socket 125 and channel 126 directly below the opening 115, the said casing 5 can move into the channel. This releases the arms 145a. The

11

springs 143 then snap back to uncompressed position causing counterclockwise movement of the bell crank levers 140. This snaps the arms 145a downwardly and positively pushes the said casing 5 into the channel 126. At the same time, the noses 145c on the arms 145a extend into the chute 110 and bar the succeeding casing 5 from moving over opening 115. When the oscillating arm 120 begins its stroke toward the injection position, the arm 127 arrives under the opening 115 before the noses 145c clear the channel 110 to permit the next succeeding casing to roll to the opening 115. The movement of the arm 145 for the clearing action is controlled by the linkage 149, as hereinabove described. The transferred casing 5 carried by the arm 120 is moved as above described, toward the injecting station II.

*Station II (Figs. 1 to 4 inc.)*

It will be remembered that during the transfer the turret member 20 continuously rotates. The transfer stroke of the arm 120 at a time must, therefore, be at the same angular speed. Also the shape of the groove in its operating cam 136 must be such that the channel 126 and a chuck sleeve 34 are aligned while moving from station I to station II and arrive at the station II simultaneously so that the casing carried in the channel may be pushed from channel 126 longitudinally directly into the sleeve 34 while moving from stations I to II. Further, the injector mechanism carried by the arm 120 must rotate synchronously with the angular speed of turret member 20 during the injection operation. This is also controlled by the groove in cam 136.

Station II toward which each casing 5 is transferred individually from station I by the arm 120 is shown to the left of the vertical center line in Fig. 2. It lies at or about  $22\frac{1}{2}^\circ$  angularly beyond station I in the direction of rotation of the turret member 20.

It is necessary that the chuck sleeve 34 be uncoupled at this time from the driving belt 102 and also that each annular ring 27 be unlocked for free longitudinal movement in its sleeve 25 during their orbital travel from just beyond station I to just beyond station III, so that transfer, injection and proper location of each casing in its chuck can be effected. To this end the hood 97 which is substantially concentric about the rotary turret member 20 and spaced therefrom is provided on its internal surface with a cam 155. This cam is a suitable arcuate segment which is suitably secured to the inner face of the hood 97 as by the bolts 156 extending from an annular groove 97a of the hood (Fig. 4). The cam is positioned to lie within the rolling path of the cam rollers 67 which operate the wedging or locking members 62a as hereinbefore described. The cam 155 is so positioned on the hood 97 and so admeasured that substantially between a point just beyond station I to a point just beyond station III any cam roller 67 moving on it is pressed inwardly as shown in dotted position in Fig. 4. While such position of such a cam roller 67 is maintained its associated wedge member 62a is retracted and disengaged from its annular ring member 27 sufficiently to permit free axial movement thereof with respect to the sleeve 25. The starting end 155a of the cam 155 is slightly tapered so that each roller 67 will easily ride onto it. The leaving end 155b of the cam 155 is provided with an abrupt shoulder 155c so that when any roller 67 leaves this end it snaps off quickly so that its associated spring 70 can ram its associated wedg-

12

ing member 62a into tight locking relationship with respect to its ring 27. While a roller 67 engages the cam 155 its wedging member is in retracted or unlocked position and its chuck sleeve 34 with its ring 27 are free to move longitudinally. Also at this time its sheave or pulley 56 is not engaged by the belt 102 so that its chuck sleeve 34 is not rotated on its own axis.

The timing relationship between the angular speed of arm 120 in its transferring stroke and the speed of rotation of the turret member 20 is such that before the arm 120 reaches station II a freely movable chuck sleeve 34 becomes aligned with this casing carried in channel 126 and continues so in motion toward station II. On alignment, injecting mechanism is actuated to push the casing 5 carried in the channel 126 into the chuck sleeve 34.

*Injecting mechanism (Figs. 1 and 2)*

The injecting mechanism is illustrated in Figs. 1 and 2. It comprises an arm member 157, which in the embodiment shown, is integral with the arm 120 and is located in radial alignment therewith and in front of the latter (Fig. 1). The arm member 157 is provided with a sleeve portion 158 in axial alignment with the channel 126. A pushed or plunger 159 is reciprocally movable in the horizontal direction within the sleeve 158. The forward end of the plunger has a head 160. When the plunger is moved toward the turret plate member 20 the head 160 serves to push the shell casing 5 lying on the socket 125 into the chuck sleeve 34. It also serves to move the injected casing and the chuck sleeve 34 from the front F toward the rear R of the turret plate member 20 to the limit permitted by the width of the recess or slot 59, in the member 27 and then to exert sufficient pressure on the end 6 of the casing to wedge the casing into the internally tapered sleeve 34 so that the so-wedged casing will be rotated with said sleeve when the latter is driven. In its opposite or retracted position, the plunger 159 is moved away far enough from the arm 120 so as not to interfere with the insertion of casings into the channel 126 at the loading station I.

Reciprocal motion of the plunger 159 for the injecting action and a return stroke is effected through a pair of bell crank levers 161. One arm 161a of each is pivotally coupled at 162 to a link 163. Each link 163 is attached pivotally at 164 to the plunger 159. Each of the bell crank levers 161 is suitably pivoted at 165 to a portion of the arm member 157. A second arm 161b of each bell crank lever 161 is coupled through a universal joint at 166 to crank rod 167. This rod is coupled through a second universal joint at 168 to a lever 169. The lever 169 is suitably fulcrumed at 170 to the stationary bracket 170a. This lever 169 is provided with a cam follower or roller 171 which latter engages in a suitable cam groove 172 provided in a cam member 173 also carried on and keyed to the drive shaft 89. In this way, rotation of the shaft 89 is translated into longitudinal reciprocal motion of the pusher plunger 159. By reason of the universal joint connections 166 and 168, the said reciprocal longitudinal motion of the pusher head 160 is effected during the oscillatory orbital motion of the arm 120 and of the arm member 157 which is a part thereof.

The pusher member 159 is timed with respect to the movement of the arms 120, 157 and the turret plate member 20 so that it starts its pushing or injecting movement on the front end 6 of the

casing 5 at the instant that such casing (carried in channel 126) and a work holder chuck sleeve 34 on the turret member come into registry. This will occur after the particular chuck sleeve has left station I and some time before it arrives at station II so that upon arrival at station II the casing will have been completely pushed into the chuck sleeve 34 by the pusher head 160 and also moved with the chuck 34 and its sleeve member 27 to the most rearward position of the latter with respect to the turret member 20 permitted by the width of slot 59 and member 62. Immediately after this injection operation is completed by the pusher head 160, the cam 173 operates crank rod 167 to retract the plunger 159 quickly. Cam 136 also then operates crank rod 129 to return oscillating arm 129 quickly to the loading station I so that the next succeeding shell casing 5 from chute 110 can be injected into the next succeeding chuck sleeve 34 arriving at station I.

It is now necessary to start proper location of the injected shell casing at station II for the tooling operations to follow. To this end, front and rear locating devices are provided in the locating region which exists between stations II and III. These locating mechanisms are illustrated in Figs. 6 to 12 inclusive. Since the rear end 9 of the casing 5 is in the first position to be operated upon by a rear locator, the latter will be first described. It is shown in Figs. 6, 9 and 12.

*The rear locator mechanism (Figs. 6, 9 and 12)*

In Fig. 6 an injected shell casing 5 is shown in its most rearward position with respect to the turret member 20. This is its position just after leaving station II after injection has been completed. At this time its rear end 9 is furthest to the right of Fig. 6. Before any tooling operations can be properly undertaken with respect to the shell casing it must be shifted longitudinally in the opposite direction to a predetermined point. To this end the rear locator 175 is provided. This rear locator is positioned between the stations II and III at the rear side R of the turret member 20.

The rear locator 175 comprises a bracket member 176 which is suitably supported on the bearing block 12 as shown in Fig. 6. This bracket member has two pairs of upwardly extending arms 177, 178. A horizontally extending plate member 179 is pivotally secured to pairs of suitable link members 180, 180a, which in turn are pivotally connected to the respective arms 177, 178. The linkage resulting is such that the plate member 179 is always maintained horizontally for the purpose to be presently described while it is capable of adjustment toward and away from the turret plate member 20.

Upright studs 181, 182 extend from the top surface of the plate member 179. A longitudinally extending arm 183 is removably and adjustably supported on the stud 181. A similar arm 184 which is longer than arm 183 is similarly supported on the stud 182. The arms are arranged parallelly and extend toward the rear face R of the turret plate member 20. Arm 183 has a downwardly extending axle stud 185, which carries a freely rotatable sprocket wheel 186. Arm 184 has a similar downwardly extending axle stud 187 which carries a rotatable sprocket wheel 188 which is identical in construction with sprocket wheel 186. Both sprocket wheels rotate freely on vertical axes of rotation about their respective axle studs 185 and 187. These sprocket wheels are so constructed as to receive an endless chain 189 of silent link chain type whose links 190 pro-

vide a substantially plane, vertical external surface to the chain. The chain is stretched comparatively tightly between the two sprocket wheels 186, 188 and because of the relative difference in lengths between the two arms 183 and 184, is angularly disposed with respect to the plane of the rear face of the turret member 20 (Fig. 12). The portion of chain 189 in the region of sprocket 186 is further away from the turret member 20 than that in the region of sprocket 188 because arm 184 is longer than arm 183. The latter is located approximately opposite or just beyond station II in the direction of rotation of the turret member 20, while arm 184 is located approximately in the region of station III.

The supporting plate member 179 is normally positioned as shown in Fig. 6. Means are provided tending to maintain it in this position. In the embodiment shown, this means comprises an arm member 191 suitably attached to the plate 179 and having a depending part 192. A suitable adjustment bolt 193 provided with locking nut 194 is threadedly supported in the part 192. A tension spring 195 is attached at one end 195a to the bolt 193. Its other end 195b is attached to a fixed member 196 extending upwardly from the bracket member 176. Also pivotally supported at 197 from the fixed member 196 is a rod member 198. This rod member 198 is provided with a longitudinal bore 199 at its opposite end which slidably engages a pin 200. The pin is threaded at 201 for adjustable engagement in the flange 192 and is provided with a locking nut 202. With the construction just described, the spring 195 tends to maintain the pin 200 in its innermost position within the longitudinal bore or socket 199. Such engagement provides a stop which limits the movement under spring actuation of the plate member 179 and, consequently, of the chain 189 toward the rear face of the turret plate member 20 to a particular position determined by the adjustment of the pin 200. Changes in the setting of the pin 200, of course effect corresponding changes in the limit of approach of the chain to the rear face of the turret member 20. The chain 189, however, may be moved rearwardly away from the face of the turret 20 against the opposition of spring 195. This permissible rearward movement is a safety means to take care of a situation wherein the casing 5 may be of undue length or of improper diameter so that it projects too deeply in the work holder or chuck sleeve 34. In such event the rear edge 9 of a defective casing 5 when engaging the chain will move the entire rear locator mechanism backward against the opposition of the spring 195.

On the other hand, if successive of shell casings are of proper length each will begin to engage the vertical face of the chain 189 with its rear end 9 just as it leaves station II and adjacent that front portion of the chain which is furthest away from the rear surface of the turret member 20. As the latter rotates toward station III the angular disposition of the front face 129a of the chain will act as a cam which pushes back the particular shell casing 5 in its longitudinal direction toward the front face of the turret member 20. Since the chuck sleeve 34 carrying this particular shell casing and its annular member 27 are then still freely slidable in the longitudinal direction, they, too, will be pushed backward longitudinally to a corresponding degree so that when a particular shell casing arrives at station III, it and the other parts just men-

15

tioned will have been pushed back toward the front of the turret member 20 to a proper position, that is, the particular shell casing will then be properly located for subsequent tooling operations. Since the chain 189 rotates freely on its sprockets there is no wearing frictional effect between a casing edge 9 and the chain.

As the particular shell casing 5 arrives at station III its front end 6 moves into engagement with a front locator 205 which is positioned at the front R of the turret plate member 20 adjacent to station III.

*The front locator (Figs. 1, 6, 9 and 10)*

The front locator 205 which is positioned as described adjacent to the station III, comprises a horizontally supported rod 205 provided at one end with a cross head 207. The leading edge of the cross head is rounded at 208 and then slightly tapered on its outer face so that the front end 6 of the particular shell casing 5 may slide over the chamfered portion 208 and on to the balance of the cross head surface as it becomes aligned with said locator 205. The rod 205 is slidably supported in horizontal sleeve 209 which is carried on a suitable bracket 210. This bracket is supported at 211 from the top 10a of the frame or housing 10. The opposite end of the rod 205 is provided with a longitudinal bore 212 (Fig. 10) which receives a compression spring 213 and a plunger member 214. This plunger member 214 is provided with stroke limiting pins 215 which project laterally from it into suitable slots 216 in the wall of the rod 205. The rod 205 is also equipped adjacent its bored end with a collar member 217 which limits the movement of the rod 205 in the sleeve 209 in a direction toward the front face of the turret member 20.

The plunger member 214 is pivotally joined at 218 to the two sides 219 and 220 of a yoke operating lever 221. These sides are pivoted respectively at 221, 222 to lever arms 223, 224. These lever arms in turn are fulcrumed or pivoted at 225, 226 to the stationary sleeve 209. The operating lever 221 is pivotally connected to each of the pivotal joints 218, 221 and 222. This lever is provided with a suitable handle 228. The operation of this linkage construction is as follows:

Referring to Fig. 9, rotation of the handle 228 in the counterclockwise direction of that figure causes the levers 223, 224 to be rotated counterclockwise about their respective fulcrums 225, 226 and at the same time causes the sides 219, 220 to retract or draw the plunger 206 backwardly in the sleeve 209. At the same time sides 219, 220 rotate in counterclockwise direction. This retracts plunger 214 which is pivoted at 218. The pins 215 on the plunger engaged in the slots 216 then cause retraction of rod 206 so that when the handle 228 and lever 221 reach the dot-dash line position of Fig. 9, the plunger 206 completely is retracted and the cross head 207 has been moved to the dot-dash line position of Fig. 9. In such position sufficient space exists between the cross head 207 and the front face of the turret plate member 20 to permit any necessary withdrawal of a casing 5 from its chuck sleeve 34. This retracted position of the cross head 207, however, is not effected unless it is necessary to withdraw a shell casing. The normal position of the cross head 207 is the full line position of Fig. 9. At that time the operating lever 221 and handle 228 are in the full line positions there shown.

The provision of the compression spring 213 in

16

the plunger 206 and the pin and slot engagement of the plunger member 214 with the rod 206 permits slight resilient movement or lost motion of the rod 206 in its longitudinal direction. This movement is utilized to control switch mechanisms presently to be described. To this end the collar member 217 has a depending arm 229. This arm is provided with an adjustable stop 230 which is normally in abutment with the end of the sleeve 209 to limit the movement of rod 206 toward the front surface of the turret plate member 20. The stop 230 is adjustable in any desired position and set by a suitable set screw 230a.

A second adjustable stop 231 is threadedly engaged in the arm 229 and extends in the opposite direction to stop 230 for adjustable engagement with a shoulder of the operating lever 227 so that the latter in the full line position of Fig. 9 will abut the stop 231 at the same time that the stop 230 engages the sleeve 209. A set screw 231a fixes the position of stop 231. A pair of additional switch controlling pins 232, 233 (Figs. 9 and 11) set by screws 232a, 233a serve to operate a pair of control switches 234, 235. The lost motion permitted the rod 206 permits collar 217 to be moved in the axial direction of rod 206 sufficiently to cause said pins 232, 233 to operate said switches 234, 235 which act as safety controls for the driving operations of the turret member 20 and other parts in a manner to be presently described.

Assuming for the time being that the particular shell casing is of approximately proper length and diameter and has been properly injected and located in its orbital traverse to station III, it will arrive at station III with its rear end 9 engaging chain 189 and its front end 6 engaging cross head 207. Continued rotation of the turret member 20 then carries the particular casing 5 from station III toward station IV. Immediately as it leaves station III, the cam roller 67 (Fig. 4) associated with the chuck sleeve 34 holding the particular casing 5 rides off the cam end 155c and locks the associated annular ring 27 against any further longitudinal displacement by the action of wedge 62a. A little further along in traverse from station III to station IV the associated sheave or pulley 56 engages the pulley driving belt 102 as shown in Figs. 2 and 3. This engagement starts high speed rotation of said chuck sleeve 34 leaving station III. The said sheave or pulley 56 remains in driving engagement with the belt 102 until it reaches station VIII. Station III is approximately 45° beyond station I.

At station IV, which is approximately 90° beyond station I, the first cutting or tooling operations on the particular casing 5 are effected. These operations, in this embodiment, are a severing or sawing off of any excess length from the rear end 9 of the casing and, simultaneously, the application of the groove cutting or broaching tool to the surface 8 adjacent the front end 6 of the particular casing 5.

*The end severing mechanism (Figs. 3 and 9)*

The severing of the rear end 9 of the particular casing 5 to reduce the latter to approximately its required length is effected by a rotary saw 240 located at station IV at the rear side of the turret member 20 in the path of travel of the said casing 5. This saw 240 is supported on a horizontal axle 241 so that its plane is substantially parallel to the plane of the rear face of the turret member 20. The axle 241 is rotatably

supported in a bearing block 242 which is movable on a suitable guide rail 242a in the axial direction of the axle 241 toward and away from the rear face of the turret plate member 20. This axial movement of the bearing block 242 is controlled by suitable adjustment bolts 243 which threadedly engage the said block 242 and are themselves fixed against longitudinal movement in the flanges 245 extending from a supporting slide block 246 which carries the block 242. The slide block 246 is guidedly movable at right angles to the direction of movement of the bearing block 242 on a bearing surface 247 of a plate member 248 which is suitably secured to the top 10a of the housing 10. A suitable guiding rail 249 serves for the purpose of permitting the aforementioned motion of the slide block 246. The slide block 246 in turn is adjustably movable by an adjustment bolt 250 which threadedly engages said block 246. The bolt 250 is threadedly supported in the upwardly extending flange 251 extending from the bearing block 248 (Fig. 3). With the construction just described, the saw axle 241 is movable both toward and away from the surface of the turret member 20 and also movable in a direction parallel to the plane of said surface so as to permit adjustment of the position and the depth of the saw cut on the particular casing 5.

The saw is adapted to be rotatably driven from the second motor 93. To this end, a sheave or pulley wheel 255 is keyed or otherwise fixed on the axle 241. This sheave 255 is connected by suitable belting 256 with the sheave or pulley wheel 101 (Figs. 1, 3 and 9) on the driving shaft of the motor 93. The saw 240 is rotated continuously at high speed (about 2200 R. P. M.) as long as the motor 93 has power supplied to it. Belt 256 causes rotation of the saw 240 on its axle 241 in opposite direction to the direction of rotation imparted to the chuck sleeve sheave 56. A suitable air blast from a source (not shown) is delivered in the sawing region by a suitable nozzle 257. This blows the saw chips away from the work and a suitable hood 258 is arranged about the saw. The chips are withdrawn in any suitable manner.

#### *The groove cutting or broaching tool arrangement (Figs. 13 and 14)*

As mentioned above, the groove cutting or broaching tool operations also begin at station IV. They, however, continue through to station VI and are effected by the use of a series of arcuate cutting or broaching tools 260 suitably arranged in the path of travel of the surface of the casing 5 adjacent to its front end. As shown in Figs. 13 and 14, these broaching tools 260 comprise a plurality of hardened steel segmental cutting tool members 260a arranged end to end. Each of the segments 260a is supported on a segmental tool carrier member 261 carried by top 10a of the bed casting. Each of the arcuate segments 261 is adjustably mounted in a groove 262a of the tool holder 262 which is part of the aforementioned bearing casting 122. These arcuate members 261 are held in adjusted position by bolts 263 extending through slots 264 which are of substantially larger diameter than the bolts to permit adjusting movement of the segments 261. Such adjustment of these segments is effected by radially arranged adjusting bolts 265a, 265b threadedly engaged in the opposite walls 262b and 262c of the groove 262a. Adjustment of the bolts 265a, 265b in these walls permits a

radial shifting either toward or away from the center of rotation of the turret member 20 of each carrier member 261. The segmental groove cutting or broaching tools 260a are secured to respective segmental carrier members 261 so that radial adjustment of the latter effects corresponding radial adjustment of the tools 260a. These tools 260a are suitably secured to the bed members 261 as by bolts 266.

The groove cutting or broaching tools 260a are provided with a plurality of cutting teeth 267 along their outer peripheral surfaces. In transverse cross section (i. e., in profile) these teeth are shaped as shown in Fig. 14 to cut the required shape of the ejection groove 7 in the particular shell casing 5 so that as the latter is carried in spinning condition by the turret member 20 from station IV through to station VI the ejection groove 7 is cut in the spinning casing by the said teeth 267. In practice the groove 7 is gradually cut to its required depth in the progress of the particular casing 5 from station IV to station VI by arranging the segmental beds 261 slightly eccentrically with respect to the axis of rotation of the turret plate member 20 so that there is a gradual increase in depth of penetration of the teeth 267 on successive of the segmental tools 260a from station IV to station VI. This simulates a proper cutting feed of the teeth 267 into the spinning casing 5. It also insures a smoother cutting action of the tools 260a and a better appearing groove 7.

In the machine shown, the extent of the traverse of the turret member 20 from station IV to station VI is substantially 180° or half a revolution. In the traverse from station IV to station VI the particular casing 5 still spinning is carried past a station V at which a finishing end cut is provided for the rear end 9 of the casing which trims the said casing to its exact required longitudinal dimensions.

#### *Rear end finishing cut mechanism (Figs. 3, 18 and 19)*

The rear end finishing cut is effected by a rear end finish cutting tool 270 located at station V at the rear of the turret member 20. In the embodiment shown, this tool has polygonal cross section and is provided at its cutting end with a suitable cutting edge 270a. The end of the tool is beveled at 270b to provide clearance for the chips removed from the casing 5 and permit the passage of the finished end 9 of the trimmed casing 5 beyond the cutting edge. The tool body 270 is supported on a suitable tool holder 271 which is fixedly supported at 272 to the top 10a of the frame or housing 10. The tool holder 271 has a removable clamping plate 273 for the adjustable positioning of the tool 270 thereon. The tool holder 271 is so positioned that the cutting edge 270 of the cutting tool may be positioned properly to effectively trim the end 9 of the particular casing 5 to final longitudinal dimensions at station V as the rotating casing moves past that station in its orbital path with the turning turret member 20.

As hereinabove described the cutting or broaching tools 260a continue cutting action of the groove 7 on the casing 5 until the station VI is reached. This is not effected until after the finishing end cut at station V. It now becomes necessary to provide internal and external chamfering cuts on the finished rear end 9. These cuts commence at station VI and are completed in

the traverse of the particular casing 5 from station VI toward station VII.

*The rear end chamfer cutting mechanism*  
(Figs. 3, 18 and 19)

The rear end chamfering cuts are effected by an inside chamfering tool 290 and an outside chamfering tool 291, the first of which is so located as to provide the inside chamfering cut and the second of which is so located as to provide the outside chamfer on the rear end 9 of the casing 5 in its traverse from station VI to station VII. These tools have appropriate cutting edges 290a, 291a. The bodies of these tools 290, 291 are supported suitably in separate tool holders 292, 293. Suitable clamping plates 294, 295 serve for clamping the respective tools 290, 291 to the respective tool holders 292, 293.

Tool holder 292 is pivotally supported on a base block or plate 296 about the threaded pivot stud 297 which is provided with a locking nut 298, so that the tool holder 292 may be angularly adjusted about the said stud and locked in adjusted position. A suitable adjustment bolt 299 threadedly engaging an arm 300 extending from the base block 296 is adapted to engage an arm or wing 292a of the tool holder 292 to effect angular adjustment of the latter against the opposition of a compression spring 301 located between the arm 300 and a shoulder 302 on the tool holder 292. As shown in Fig. 18, the spring 301 tends to rotate the tool holder 292 in counterclockwise direction until the wing 292a abuts the adjustment bolt 299. The compression of spring 301 may be made adjustable in any suitable way.

The tool holder 293 is similarly supported on the base member 296 about the threaded pivot stud 303. A suitable clamping nut 304 is provided on the stud 303. The tool holder 293 has an arm 305 which is adapted to engage with a suitable adjustment bolt 307 carried from an extension 308 of the arm 300. A suitable compression spring 309 extending between the arm 300 and a shoulder 310 of the holder 293 serves to urge the holder 293 in counterclockwise manner until the arm 305 abuts the adjustment bolt 307. The compression of spring 309 likewise may be made adjustable in any suitable way.

The base member 296 is provided with a slide rod extension 311 having polygonal cross section. This rod is slidably carried in a sleeve 312 and is capable of reciprocal motion in its longitudinal direction. A fixed cam member 313 is suitably supported in a fixed position from a suitable portion 12c of the bearing member 12. This cam member 313 is in the form of an arcuate plate arranged so that its arc of curvature is concentric about the axis of the shaft 11 of the turret plate member 20. In its surface the cam member 313 is provided with an arcuate cam slot 314. A cam roller 315 is rotatably supported and depends from the base member 296. It is adapted to roll in the cam slot 314. The cam slot 314 is so positioned on member 313 that the movement of the cam roller 315 in it will effect reciprocal motion of the rod 311 and its base plate 296 toward and away from the finished end 9 of the particular shell casing 5 passing from station VI to VII so that the chamfering tools 290 and 291 are moved from a non-engaging position into a cutting position with respect to the inside and outside of the said end 9 and are then moved to a clearing position away from said end after the inside and outside chamfering cuts have been made and before the casing reaches

station VII. This reciprocal motion is effected by orbital movement of the sleeve 312 parallel to that of the work piece or casing 5. The sleeve is so moved by its connection through the bracket 316 to the movable ejecting mechanism presently to be described. The orbital movement of the sleeve 312 parallel to the direction of movement of the work piece or casing 5 in its orbital path is at a speed of motion which is synchronous with that of said work piece or casing 5. Return movement of the sleeve 312 may be at a faster rate or anything desired. These speeds are effected with corresponding motions of the ejecting mechanism as will be described presently. If desired, either or both of the chamfering cuts may be eliminated by removing the corresponding chamfering tool or tools from the tool holders 292, 293.

While the chamfering cuts are being effected on the rear end 9 and still in the traverse of the particular casing 5 from station VI to station VII, a finishing groove cut is applied to the groove 7. This groove finishing cut is effected by an appropriate finishing tool and associated mechanism now to be described.

*The groove finishing cut and associated mechanisms*  
(Figs. 13, 15 and 16)

The groove finishing cut must be very accurately performed so as to avoid any likelihood of the jamming of a casing 5 in a gun or cannon because of failure of the ejecting mechanism thereof to engage the groove and remove the casing prior to the injection of an undischarged cartridge. To this end, the groove finishing tool must be very accurately applied to the shell casing in the machine of this invention. Also it is advisable and preferable during the operation of such a groove finishing tool that counter pressure be applied to the surface of the casing at a diametrically opposite point with respect to the finishing tool so as to prevent distortion of the casing during the finishing cut thereon.

Both the groove finishing tool and the backing mechanism for applying counter pressure are supported from a common plate member 325. This plate, as shown in Figs. 13 and 16, is substantially triangular in shape and is provided adjacent its apex with a rearwardly extending shaft 326. On its front face adjacent one of the base apices, the plate carries a forwardly projecting stud 327 on which a groove finishing cutting or milling tool 328 is removably carried. This tool as shown in Figs. 13 and 16 has a pair of oppositely extending blades 329 each of which has an appropriate arcuate cutting edge 329a. The blades have a profile or transverse cross section (not shown) which is substantially similar to that of the broaching tools 267 as shown in Fig. 14 so that the entire groove 7 is finished as the particular rotating shell casing 5 sweeps past that of the groove finishing cutting edges 329a in its path.

The plate member 325 adjacent the other of its base apices is provided in its front face with a cylindrical recess 330 (Fig. 15) extending part way through the plate member. A slot 331 extends from the recess base 330a to the rear face of the plate 325. A backing member roller 332 is provided, this roller has a head portion 332a whose outer configuration is complementary in shape to that of the groove 7 and is adapted to fit freely in such groove. Rearwardly of the head portion 332a the roller is provided with a cylindrical portion 332b of reduced diameter, a por-

tion of which extends into the bore 330. The portion 332 is supported by suitable roller or ball bearings 333 from a bearing axle 334. This axle has a rearwardly extending stud 335 which projects through the slot 334 and is threadedly engaged by a suitable locking nut 335a so that the stud may be clamped at any adjusted position in the slot 334. Shifting of the stud 335 and consequently with it of the roller 332 is effected by the set screw 336 extending transversely of the stud through a suitably threaded bore 337 in the plate 325. This set screw provides for adjustment of the roller 332 transversely of the longitudinal axis of the shell casing and regulates its distance from the cutting edge 329a of the cutting tool 329 facing it so that proper adjustment may be made for different desired depths of finishing cuts on the groove 7.

It is necessary, too, to provide for axial adjustment of the backing roller and the cutting tool closer to or further away from the front face of the turret plate member 20. This is effected by axial adjustment of the shaft 326 that carries plate member 325. As shown in Fig. 15, this shaft 326 extends through a sleeve 340 and is provided at its protruding end with a threaded head portion 326a. The sleeve 340 has a flange 340a at one end which serves as a manipulating head. The sleeve is externally threaded at 340b for threaded engagement in a bearing 341 which in turn is carried in a suitable support 342. A suitable lock nut 343 is provided on the threaded portion 340b of the sleeve 340 and serves to lock the member 340 in any adjusted position relative to the bearing 341. The inner face of the plate member 325 normally abuts an end 340c of the sleeve 340. End play of the shaft or spindle 326 is eliminated by the lock nut 343 which engages threadedly on the threaded portion 326a of the spindle and is tightened to abut the flange 340a of the sleeve 340. It may be locked in place by a suitable means as a set screw 345.

The spindle 326 is rotatable within the sleeve 340 to permit angular adjustment of the plate 325 on the axis of its spindle 326 so that both the backing wheel 332 and the milling tool 329 may be properly positioned with respect to the fixed orbit of the particular shell casing as it moves in the orbital path from station VI to station VII during rotation of the turret member 20. In this way the said casing is made to pass properly between the tool 329 and backing roller 332 which then engage it at opposite sides.

The adjustment mechanism for varying the angular position of the plate comprises a split nut 347 which engages threadedly on the threaded portion 326a of the spindle 326. This nut 347 has a suitable clamping screw 348 extending between the wings 347a, 347b of the nut 347 to lock the latter in any adjusted position on the spindle 326. Extending laterally in spaced relationship from the nut 347 are the arms 349, 350 (Fig. 16) forming tines of a fork-like portion. These two tines 349, 350 extend respectively on opposite sides of a fixed post 351, which is carried suitably by the bearing 341. This post has a pair of parallel flattened faces 351a, 351b which extend parallel to the inner faces of the tines 349, 350 and are spaced therefrom sufficiently to permit some rotary movement of the nut 347 and, consequently of the spindle 326, i. e., the spacing is such as to permit some lost motion between the tines and the fixed post 351.

One tine 349 is provided with a transversely extending adjustment stud or bolt 352 whose inner

end 352a is normally positioned to abut the flattened face 351a of the fixed post 351. The other tine 350 is provided with an extension 353 having a bore 354. This bore receives a compression spring 355 and a pressure adjustment screw 356 for adjusting the relative compression of the spring 355. The spring 355 engages between the face 351b of the fixed post 351 and the inner end of the screw 356 and tends to urge the face 351a into engagement with the end 352a of the adjustment bolt 352.

With the described construction, coarse angular adjustment of the plate 325 is first effected by loosening the split nut 347 and rotating the plate to the approximate required angular position and then again tightening the split nut. Thereafter fine adjustment of the angular position is effected by manipulation of the adjustment bolt 352, and tightening of its associated locking nut 352b.

The support or bracket 342 which carries the mechanism just described is split for assembly purposes into two portions 342a and 342b which are removably secured together by suitable means such as bolts 360. The portion 342b is provided with a substantially inverted U-shaped yoke portion 361. An arcuate slide member 362, Figs. 13 and 16, is shaped at one end 362a to fit within the yoke member 361 and is secured therein both by the longitudinally extending bolt 363 and the transversely extending bolts 364. These bolts 363 and 364 serve to support the yoke member 361 and consequently the bracket 342 rigidly on the slide member 362.

The slide member 362 is guidedly supported in suitable manner as by the guide surfaces 365a—365b (Fig. 13) formed in the plate member 366 attached to the bracket 367 fixedly supported in turn from the top 10a of the frame or housing 10. The curvature of the slide member 362 as well as of the guide surfaces 365a, 365b and their positioning is such that their radii of curvatures are concentric with the center of rotation of the turret axle 11.

An arcuate slot 368 (Figs. 2 and 13) is provided in the bracket 367. A pivot pin 369 which is fixed to the slide member 362 extends laterally therefrom into and through the slot 368. A coupling member 370 is rotatably attached to the pivot pin 369. This coupling member 370 in turn is attached to a crank rod 371. The crank rod 371 is coupled at its opposite end to a cam roller 372 (Figs. 1 and 2) which operates on a cam 373 (Fig. 1). The latter is keyed or otherwise fixed to the main drive shaft 69. Thus rotation of the drive shaft 69 and the cam 373 will effect oscillatory motion of the bracket 362 in parallel to the orbit of movement of the work holder on the turret member 20. The purpose of the orbital motion of bracket 362 is to permit engagement both of the cutting edge 329a of a blade 329 of the groove cutting tool 328 and of the backing roller 332, with the particular shell casing 5 at opposite sides during a sufficient period of the orbital traverse of the particular casing 5 from station VI to station VII to insure a complete finishing cut on the entire circumferential surface of the groove 7.

During a period of the traverse of the particular casing 5 from station VI to station VII, both the groove finishing tool 328 and the end chamfering tools 290, 291 act upon the particular casing 5. However, the chamfering tools start to act in advance of the groove finishing tool 328.

The particular shell casing 5 leaves the groove finishing tool 328 and backing roller 332 just

about at its arrival at station VII. At such time the sheave or pulley 56 driving the chuck sleeve 34 holding this casing rides off the driving belt 102 disconnecting the rotational drive of the particular chuck sleeve 34. At this point it becomes necessary to brake the disconnected pulley or sheave 56 to completely stop its rotation. This is effected by braking mechanism now to be described.

#### *Chuck sheave braking mechanism (Fig. 3a)*

While any suitable type of braking mechanism may be employed, a very simple device is shown in Fig. 3a. Therein, a member 330 is fixedly supported on the motor suspension rod 95 being suitably secured thereto in the region of station VII. Adjacent the arm 330 is a loosely mounted arm 382. The arm is provided at its outer end with a brake shoe 383. The brake arm 382 is of such length that the shoe 382 will contact the peripheral surface of the sheave or pulley 56 directly as it leaves contact with the belt 102 thus exerting a braking action to the spin of that sheave. A suitable pin 384 projecting from the arm 382 is connected by a tension spring 385 to a stationary pin 386 carried by the arm 380. The spring 385 thus tends to impart rotation to the arm 382 so as to apply the braking surface 383a of its shoe 383 to the said leaving sheave 56. A suitable adjustable stop for the arm 382 is provided. This comprises a lug 380a depending from the arm 380 which has threaded therein a limiting bolt 387 which is locked in any desired adjusted position thereto by the nut 388. This bolt passes through a hole in lug 382a which is part of the arm 382 and in alignment with the lug 380a. The head of the bolt 387a thus acts as the stop for the arm 382. By means of this adjustable feature the pressure of the braking surface of the shoe 383 on the leaving sheave 56 may be adjusted as desired, notwithstanding the strength of the spring 385.

It is important that this brake act upon the leaving sheave 56 before the ejector mechanism presently to be described engages the casing 5 of the chuck sleeve 34 associated with said leaving sheave 56. If the braking mechanism were not incorporated, the leaving sheave 56 would continue in free rotation because of the inertia and carry the particular casing 5 in a spinning condition into position for the engagement of its chamfered end 9 with the ejecting mechanism. This would spin over the chamfered end 9 and vitiate the previous end cutting and chamfering tooling operations. The brake mechanism just described, however, effectively brakes the rotation of the particular casing 5 in the chuck sleeve 34 associated with the leaving sheave and avoids destructive spinning over of the end 9. After the braking has been effected, the continuously rotating turret plate member 20 carries the particular braked casing 5 to the start of ejection at station VIII. The ejecting mechanism will now be described.

#### *Ejecting mechanism (Figs. 1, 2, 3 and 18)*

The ejecting mechanism is arranged at the rear R of the turret plate member 20. It comprises a lever 400 carried rotatably at one end on a stud shaft 401. This stud shaft is supported between suitable bracket members, one of which is the end plate 18. The other 402 is attached suitably to the top 10a of the frame or housing 10. The lever 400 is provided at its opposite end with a horizontally disposed bearing member 404. This

bearing member carries a longitudinally movable sleeve 405 (Fig. 18). The sleeve in turn is provided at one end with an enlarged head 406 and with an internal longitudinal bore 407. The bore is enlarged in a portion 407a thereof for a purpose to be presently described. A longitudinally movable plunger member 408 is supported within the bore 407 of the sleeve and extends outwardly from each of its ends. The plunger member also has a longitudinal passage-way 409 extending through its entire length. The end 408a is suitably threaded to receive a positioning nut 410, a locking nut 411 and a hose coupling member 412. The latter is attached to a suitable hose 413 from a valve controlled fluid pressure source (not shown) which delivers fluid under pressure through the passage way 409 to the other end 408b of the plunger 408 for the purpose to be presently described. The ejector end 408b of the plunger 408 is headed at 408c. The headed portion 408c is preferably larger in diameter than the diameter of the end 9 of the casing 5. A suitable compression spring 414 is carried in the enlarged portion of the bore 407a. This spring engages between shoulders 405a on the sleeve 405 and a shoulder 408d on the plunger 408. The spring serves as a cushioning member between the plunger 408 and the sleeve 405.

The lever or arm 400 is required to be oscillated about the stud 401 on a path substantially parallel to and concentric with the orbit of the path of the work holders on the turning turret plate member 20. To this end, the stud shaft 401 to which the lever 400 is keyed or otherwise fixed is in axial alignment with shaft 11 of the turret member. The lever 400 is provided with a crank arm 417 (Fig. 3). The latter is pivotally coupled at 418 to a crank rod 419. The latter in turn extends downwardly through a suitable opening in the top 10a of the housing and is pivotally joined or coupled at 421 to one arm 422a of a lever 422 which is pivoted suitably at 423 to a suitably fixed support 424 (Fig. 1) carried from the top 10a of the housing 10. A second arm 422b of the lever 422 (Fig. 3) is provided with a cam follower 425 which engages in a cam groove 426a provided in a face of a cam disc 426. This cam disc in turn is keyed or otherwise fixed to the drive shaft 89. Thus rotation of the shaft 89 imparts an oscillatory rotary motion to the ejector carrying arm or lever 400 about an axis of rotation which is in axial alignment with the axis of rotation of the turret member axle 11.

During the rotary oscillatory motion of the lever 400 just described, reciprocal longitudinal movement toward and away from the turret member 20 is required of the sleeve 405 and of the ejector plunger 408. To effect this reciprocatory motion a pair of links 427, 423 (Fig. 18) are pivoted respectively at 429, 430 to opposite sides of the part or head 406. These links 427, 428 are pivotally coupled at 431, 432 to the respective arms 433, 434 of the bell crank levers 435, 436 which are located on opposite sides of the arm or lever 400. These levers 435, 436 in turn are pivoted respectively at 437 and 438 to the lever 400. The other arms 439, 440 of the two bell crank levers are pivotally attached at their outermost ends 439a, 400a (Fig. 1) through a universal joint 441 to a crank rod 442. This rod 442 in turn is coupled pivotally through a universal joint 443 to an arm 444 of a bell crank lever 445 (Fig. 3). This lever is rotatably pivoted at 446 to the hanging stationary support 424. The other arm 447 of this bell crank lever

445 is provided with a cam follower 448 that engages in a cam groove 449 provided in a cam disc 450 (Fig. 1). This disc 450 is keyed or otherwise fixed to the drive shaft 89 so that rotary motion of the latter will impart reciprocal motion to the ejector plunger 408 and to its supporting sleeve 405, in the axial direction toward and away from the turret member 20 during the orbital oscillatory motion of the arm or lever 400 in the direction of rotation of the turret member 20.

The timing of the cams 426 and 450 is such that in the traverse of a shell casing from station VIII to station IX, the arm 400 will rotate in the same direction at the same speed as the turret member 20. During this traverse the ejector plunger 408 and its sleeve 405 would be given a complete cyclic or to and fro motion so that the head 408c will push the casing 5 then aligned with it completely out of the chuck sleeve 34 and then be retracted sufficiently to clear the chuck sleeve before the limit of the orbital oscillatory rotation of the arm 400 is completed. This is necessary to avoid damage to the parts and to provide for continuous operation of the turret member 20.

During the ejecting movement of the plunger 408 a fluid blast directed from the outlet 409a of the passageway 409 serves as an auxiliary aid to the ejection of the particular finished casing 5 from its supporting chuck sleeve 34.

A valve 452 (Fig. 17) for controlling the fluid blast supplied to the passage-way 409 through the hose or conduit 413 is conveniently controlled by the movement of the arm 400. To this end, the lever or arm 400 is provided with a fixed pivot member 455. A crank rod or link 456 is pivotally joined at 456a to the pivot member 455. This rod 456 is provided at its opposite end with a cam head 457 for the purpose presently to be described. The valve 452 is connected to the hose or conduit 413. It is of the normally closed type and serves as a control for the fluid pressure in the feed line 458 which is connected to a pressure source (not shown). This valve is adapted to be opened by inward pressure upon its operating plunger 459 to admit pressure from feed line 458 to conduit 413. The internal construction of the valve itself is well known and need not be described. The plunger 459 is adapted to be operated upon by a rotatably supported bell crank lever 460. One of the arms 461 of this lever is provided with an adjustable abutment 462, which is adapted to engage the plunger 459. The other arm 463 of the lever 460 is provided with a tined portion 463a. The cam head 457 of the crank rod 456 has a flange or nose 457a which engages within the tined portion 463a. Longitudinal motion of the crank rod 456 causes engagement of the flange 457a in the tined portion to effect rotation of the bell crank lever 460 in such a direction as to cause inward pressure of the plunger 459 opening the valve 452. Continued movement of the crank rod 456 in the same direction causes the flange 457a to ride up and out of the tines 463a and release lever 460. This permits the latter to return to its original full line position shown in Fig. 17, notwithstanding continued motion of the crank rod 456 in the opening direction of the valve. Thus the valve can close after a short period of time delivering only a short ejection blast in its open position notwithstanding the fact that the ejector arm 400 has not yet completed its oscillating cycle.

Any other suitable type of valve control could be used.

The combined action of the ejector plunger 408 and the air blast from nozzle 409a serve to eject the particular finished shell casing 5 at station IX completely from its chuck sleeve 34 and move it to a delivery chute receiving mechanism 464. The emptied chuck sleeve 34 continues to travel with turret member 20 from station IX back to station I where it receives a fresh unfinished casing on which the described cycle of operations from station I to IX is repeated. Each chuck sleeve 34 in its movement past these stations carries with it a casing 5 for identical operations thereon.

*Mechanical operation control mechanism (Figs. 1, 20 and 21)*

As hereinbefore pointed out, the main drive shaft 89 is adapted to be coupled through the clutch 91 to the driving sprocket 87 which is connected by the chain 86 to the output pulley 85 of the variable speed mechanism 82. To effect such coupling, the clutch 91 is of any suitable type. In the embodiment shown, it is a frictional clutch and comprises one frictional member 91a keyed or otherwise attached to the sleeve 88, which carries the pulley 87, and a second frictional engaging member 91b slidably keyed on the main drive shaft 89 and movable into and out of frictional engagement with the member 91a for clutch coupling, in well known manner, of the shaft 89 to the sleeve 88 of the driving pulley 87.

The member 91b is moved into and out of such coupling engagement by a slidable collar 470 which is provided with oppositely projecting studs 471, 472. These studs are pivotally engaged by the respective yoke arms 473, 474 of a yoke member 475 which is secured suitably on a rotatable shaft 476. This shaft 476 is supported suitably in the bearings 477 which depend from the frame or housing top 10a. Suitably fixed to the shaft 476 is a crank lever 478. This lever is suitably keyed or otherwise attached on the shaft 476.

A shaft 480 is rotatably supported parallel to the shaft 476 between suitable bearings 481, 482 provided in opposite walls 10d, 10e of the frame or housing 10. The shaft 480 extends outwardly of each of side walls and has one of a pair of manually operable levers 483 suitably fixed to each end so that the shaft 480 may be rotated.

Suitably keyed or otherwise fixed on the shaft 480 is the crank 485. This crank is pivotally connected to link 487. This link, in turn, is pivotally connected to the crank 478. Through the agency of the lever and linkage system just described, rotation of the operating levers 483 in one direction will cause corresponding rotation of the yoke arms 473, 474 in the same direction to push the collar 470 against the clutch member 91b and thus move it into coupling engagement with the other member 91a of the clutch. Rotation of the operating levers 483 in the opposite direction will correspondingly uncouple the clutch member 91b from the clutch member 91a.

It is desirable to instantaneously brake rotation of the main drive shaft 89 when the clutch 91 is uncoupled. To this end, suitable braking mechanism is associated with a part connected to the drive shaft. In the embodiment shown, a suitable brake band 490 is provided. This band is adapted to operate on the peripheral surface of the cam disc 450. The opposite ends 491, 492 of the band are attached to suitable connecting

members 493, 494. Connecting member 494 is adjustably attached to a coupling member 495 which, in turn, is pivotally connected at 496 to one arm 497 of a brake lever. This lever is carried on a stud shaft 498 which is borne rotatably in a suitable bearing 499 carried from the top 10a of the frame or housing 10. The oppositely extending other arm 500 of the brake lever is pivotally connected at 501 to the connecting member 493. Thus, rotation of the lever arms 497, 500 in one direction with the shaft 498 causes the brake band 490 to be tightened about the cam disc 450 for braking action. Rotation of these arms in the opposite direction loosens the brake band freeing the cam disc 450 for rotation.

The required rotation of the aforementioned brake lever arms 497, 500 is effected by the manipulation of the operating levers 483. To effect such operation, a crank lever 502 is keyed to or otherwise secured on the shaft 498. This lever is pivotally connected to a link 503. The link 503 in turn is pivotally connected to a crank lever 504 which is suitably keyed or otherwise fixed on the shaft 476. A suitable tensioning spring 505 is attached at one end to the crank lever 504. The opposite end of this spring is attached to any suitable fixed part as to the frame or housing 10. The action of the spring is such as normally to urge the lever 504 into such direction of rotation as to cause braking action of the band brake 490 and to urge the clutch part 91b into its disengaged position.

The lever arm 504 is provided with a pin or roller member 506 which may be suitably engaged by a holding pawl member 507 pivotally supported at 508a from a fixed support 508 depending from the frame or housing top 10a. The pawl member 507 has an arm 509 which is attached to one end of a suitable tension spring 510. The other end 511 of the spring is fixedly attached to the frame or housing 10. The holding pawl member 507 is provided, too, with two hook-like engaging noses 512, 513, either of which may engage the pin or roller 506 and hold the arm 504 against the retractive rotary motion which is urged by the spring 505. The pawl member 507 is also provided with an arm 514 which is pivotally connected to a link 515. The link in turn is connected pivotally to a solenoid plunger 516 of a controlling or releasing solenoid 517, whose purpose will be hereinafter described. The pawl member 507 is also provided with a safety arm member 518 which is so admeasured in length and positioned that, in one position of rotation of the pawl member, the end of the arm 518 lies in the path of travel of the roller member 506. When it does it prevents rotary movement of the crank lever 504 to a brake releasing and clutch coupling position. This safety arm is provided for a purpose to be presently described.

Besides the safety arm member 518, additional safety means are provided. Such means includes a switch operating cam member 520 keyed to or otherwise fixed on and rotatable with the shaft 476. Rotatably supported on the shaft 480 is a bell crank lever 521. This lever has one arm 522 provided with a cam follower 523 that is adapted to engage the surface of cam 520. The other arm 524 is provided with an adjustable engaging stud 525, which is adapted to operate a normally closed circuit controlling switch 526. This switch is of conventional form and is of the normally closed circuit type, being connected in the power circuit of the chuck driving motor

93 as will be presently described. The circuit through this switch is adapted to be opened and closed on cam actuation of the bell crank lever 521 by the cam 520. The latter is so shaped and positioned on the shaft 476 that in a locked position of the latter wherein braking is effective and the clutch 91 is uncoupled, the arm 524 is maintained so that its abutment stud 525 is in engagement with the switch 526. Thus the circuit through the switch 526 is then open to prevent power from being applied to the chuck motor 93 for a purpose to be presently described. Upon rotation of the shaft 476 to a second or neutral position wherein the clutch still is uncoupled but the brake released for manual manipulation (Fig. 24) and also to the third or driving position (Fig. 22) wherein the brake is released and the clutch is coupled, the cam follower moves into the cam recess 520a and arm 524 rotates away from the switch permitting the latter to close, closing the electric circuit to said motor 93 at this switch. The motor 93 then will run provided other switches in its circuit also are then closed as will be described presently.

An additional safety locking member is provided for the purpose of preventing recoupling of the clutch element 91b with element 91a in the event that the clutch 91 becomes uncoupled by reason of an improper location of a shell casing 5 in its traverse from stations II to III or of the detection of a defective casing during such traverse as will be presently described. This locking mechanism comprises a pawl member 530, provided with an engaging head 531 adapted to be engageable with the stud 472 on the collar 470. The member 530 is pivotally attached to a fixed stud 532 carried suitably from the frame or housing 10. The member 530 also is pivotally attached to a solenoid plunger 533 of a controlling solenoid 534. The arrangement of pawl member 530 on its pivot stud 532 and its length are such that while the solenoid 534 remains energized as will be presently described, the member 530 is lifted so that the shoulder 531a on its head 531 can not engage the stud 472. This permits necessary movement of the collar 470 by lever 483 for effecting clutch coupling. On the other hand, immediately that the solenoid 534 becomes deenergized the pawl member 530 is moved by a suitable spring 535 into such a position that its shoulder 531a lies in the path of the stud 472 on collar 470. Thus, when the latter is released for movement to its retracted or uncoupled position, the shoulder 531a will limit further movement of stud 472. The recoupling of the clutch will then be prevented until the solenoid 534 is again energized. The shoulder 531a on head 531 is so located, however, that the limited movement permitted stud 472 permits switch 526 to be closed by a limited movement of arm 483 as soon as either an improperly located or an unejected finished casing are removed from the carrying work holder, as will be presently described. The position of the lever 483 and other movable parts shown in Figs. 20, 21, and 22 is the running position, i. e., with the clutch 91 coupled and the brake band 490 released. Fig. 23 shows the uncoupled and locked position of these parts and Fig. 24 shows the neutral position of the parts.

*The electric control circuits (Figs. 22, 23 and 24)*

In the embodiment shown, the turret motor 75 and the chuck driving or spindle motor 93 are each adapted to be energized from a 440 volt three-phase power circuit while certain of the

controls and safety devices are adapted to be energized from a 110 volt 1-phase power circuit. The 3-phase lines *a*, *b*, *c* from the 440 volt source  $P_1$  are connected through a starting box 540 of conventional construction and a start and stop switch 541 also of conventional construction to the turret turning motor 75. The switch 541 constitutes the sole start and stop control for the motor 75. Pressure of the starting button *St* of the switch 541 closes the circuit from the power lines *a*, *b* and *c* to the motor 75 and starts it. Pressure of the stop button *Sp* of the switch 541 opens the power circuit and stops this motor.

By a parallel connection to the lines *a*, *b* and *c*, lines *a'*, *b'* and *c'* respectively connect the power source  $P_1$  to a starting box 542 similar in construction to starting box 540. The starting box 542 is also connected through a start and stop switch 543 to the spindle motor 93. One of the three phase lines *a'* has the normally closed control switch 235 (Figs. 9 and 11) [associated with the locator mechanism], and the normally closed switch 526 (Fig. 20) [associated with the manual coupling mechanism] in series with it. Thus the power circuit from the source  $P_1$  to the spindle motor 93 may be interrupted either by an opening of the switch 235 or switch 526. Such opening of either switch opens the power line *a'*. This causes the start and stop switch 543 of a conventional type to shift automatically to its stop position. This removes power from the lines *a'*, *b'*, *c'*, leading to the spindle motor 93. As long as either switch 235 or switch 526 remains open, line *a'* remains open and no power can be supplied to spindle motor 93.

The solenoid 534 which controls the pawl member 530 is connected in parallel across two of the three phase lines *b'* and *c'* between the starting box 542 and the spindle motor 93. Thus solenoid 534 only has electric energy supplied to it while electric energy is supplied to the spindle motor 93.

The single phase power source  $P_2$  has one of its lines *d* connected directly to a normally open push button type stop switch 545. The other line *e* is also connected to the switch 545 but has the solenoid 517 connected in series with it. The lines *d* and *e* have the normally open switch 234 connected across them in parallel with the switch 545. An ejector safety switch 546 is also connected in parallel across the lines *d* and *e*. Closure either of switch 545, switch 234 or switch 546 will energize the solenoid 517 causing its plunger to actuate the holding pawl member 507 to release the roller 506 and permit uncoupling of the clutch 91 and braking action of the band 490. Normally the switches 545, 234 and 546 are open so that the solenoid 517 normally is deenergized.

In such condition a holding pawl member 507 is urged by its spring 510 into such a position that the nose 513 can engage the roller 506 and maintains the arm 504 in the neutral position shown in Fig. 24. In this neutral position the clutch 91 is uncoupled, the band brake 590 is loose on the disc 450 and the switches 235 and 526 both are closed. This neutral position represents the normal condition of the entire machine at the outset of operations.

Assuming the aforesaid neutral position, the sequence of operations on the machine is as follows:

The starting button *St* of starting switch 541 is pressed, closing the power circuit to the main driving motor 75 causing it to rotate. The ro-

tating motor 75 does not then supply driving power to the main drive shaft 89 because the clutch 91 is uncoupled. The starting button *St* of switch 543 is then closed. Since the switches 235 and 526 are then closed the circuit to the spindle motor 93 is complete and the latter starts to rotate. The completion of the spindle motor circuit causes energization of the solenoid 534 lifting the latch member 531 to permit free movement of the clutch collar 470. Then the manual coupling lever 483 is rotated to the position shown in Figs. 20 to 22. This causes the arm 504 to be rotated until its roller 506 engages behind the nose 512 of the holding pawl member 507 which then holds it in this position. At the same time the said rotation of the arm 504 couples the clutch part 91b with clutch part 91a, thus coupling the main drive shaft 89 to driving power from the motor 75, so that the entire sequence of operations of the machine at the various stations can now commence and be carried out so long as the clutch 91 remains coupled. Should a casing 5 be improperly located in its work holder 34 during the traverse from stations II to III, the front end 6 of the casing will push the cross head 207 of the rear locator 205 (Fig. 9) backwardly to the limit of lost motion permitted the rod 206. This will move collar member 217 and its pins 232, 233 accordingly causing the switch 235 to be opened and simultaneously causing the switch 234 to be closed.

Opening of the switch 235 will immediately break the circuit through the starting switch 543 removing power supply to the spindle motor 93 and thus deenergizing the solenoid 534. Such breaking of the circuit through the starting switch 543 returns the latter to its open position. Simultaneously, closure of switch 234 will energize the solenoid 517 through the single phase power circuit lines *d*, *e* and cause the holding pawl 507 to be rotated and release the roller 506 from its engagement with the nose 512. This will permit the spring 505 to rotate the arm 504 to the position shown in Fig. 23. In such position the clutch 91 is uncoupled and the brake band 490 then is tightened and immediately brakes rotation of the drive shaft 89. The whole machine then stops operating without, however, stopping rotation of the main drive motor 75, whose power, however, has no effect because of the uncoupling of the clutch 91.

At this time the locking arm 518 is located in the path of the roller 506 so that it is impossible to shift the manual lever 483 from its locked position (Fig. 23) either to the neutral position of Fig. 24 of the running position of Figs. 20 to 22, so long as the solenoid 517 remains energized.

To start or continue operations in the machine, it is necessary for the operator to remove the improperly located shell at station III, by retraction of the head 207 of the rear locator 205 to the dot-dash line position of Fig. 9, through the manipulation of the operating lever 228. While the head 207 is in such retracted position, the operator withdraws the improperly located casing 5 and then again moves lever 228 to its full line position of Fig. 9. This permits the switches 234 and 235 to return to their normal open and closed positions respectively. The opening of the switch 234 immediately deenergizes the solenoid 517. Closing of the switch 235 completes the break in the power circuit to the spindle motor at this switch but the said power circuit still is open both at the switch 526 and at the starting switch 543. Since power is not

yet supplied to the spindle motor 93, the solenoid 534 is deenergized and the arm 483 is only capable of limited motion to the neutral position of Fig. 24.

Movement to this neutral position is, therefore, now effected causing closure of the switch 526. Thus the only open portion of the spindle motor circuit is now at the starting switch 543. Its starting button *St* then is pushed to complete the circuit to the spindle motor causing the latter to start rotating while the arm 483 is in its neutral position. Such energization of the spindle motor causes energization of the solenoid 534 freeing the stud 472 from engagement with the shoulder 531*a* of the member 530. It is then possible to move the arm 483 from the neutral position of Fig. 23 to the operating position of Figs. 20 to 22 so that the machine starts operating again. Such operation will continue until another improperly located casing appears at station III.

The same type of stoppage will occur in the event that a finished casing 5 reaching station IX of the machine has not been ejected from its work holder. Such operation is effected by the closure of switch 546 which is connected in parallel across the same single phase lines *d* and *e* as the switch 234. The switch 546 is so positioned that it will be closed by any non-ejected casing moving just beyond station IX. This closure will energize solenoid 517 causing release of the holding pawl 507 and instantaneous return of both the lever 504 and the manual lever 483 to the locking position of Fig. 23. At this time, since the switch 235 has not been affected, the circuit of the spindle motor is broken only at the switch 526 and at the starting switch 543. As soon as the non-ejected casing is removed from its holder manually, the solenoid 517 is deenergized. It is then possible to move the arm 483 first to its neutral position, Fig. 24, closing the circuit to the spindle motor at the switch 526. Thereafter pressure of the starting button of the switch 543 energizes the spindle motor and the solenoid 534 and permits movement of the manually operable lever 483 to its operating position of Figs. 20 to 22 inclusive.

The machine may be stopped quickly at any time by pressing the button of switch 545 to close the single phase circuit *d*, *e* and energize the solenoid 517. This has the same effect as a closure of the switch 546.

With the circuits, the switches and the solenoids just described herein, it is impossible to run the machine with an improperly located casing in a work holder or with an unejected finished casing in a work holder. It is also impossible to couple the clutch 91 to apply power from the driving motor 75 unless the spindle motor 92 is running. It is, also, unnecessary to stop the driving motor 75 once the same has been started, notwithstanding the fact that the sequential station operations of the machine cannot be continued while an improperly located shell or an unejected finished casing remains in its work holder.

A hand wheel 550 (Fig. 1) may be provided for turning the shaft 89 manually for adjustment purposes. This wheel is normally urged into uncoupled relationship with said shaft 89 by a spring 551.

An electric counter 554 of any well known type may be provided. This counter has its electric circuit connected in parallel across the single phase lines *d* and *e*. A switch 555 is connected

in series with one of the lines of this circuit and is normally open. The switch is so located in the orbital path of travel of the casings that it will be closed momentarily by each finished casing passing it just before ejection from the machine to actuate the counter. The counter is connected across the lines *d* and *e* ahead of the solenoid 517 so that closure of the switch 555 will not actuate the said solenoid.

#### General operation

The general operation of the machine itself briefly recapitulated is as follows:

Casings 5 are delivered one by one from a chute 110 on to the receiving trough 126 at station I. In the traverse of the delivered casing 5 in the receiving trough 126 to station II, this casing is moved longitudinally and injected by the injector 159 into the work holder or chuck sleeve 34. In such injection both the casing 5 and its work holder 34 are moved axially to the limit of movement in one direction permitted the holder 34. The so injected and positioned casing 5 in its traverse along the orbital path of its work holder from station II to station III is moved longitudinally in the opposite direction by the rear locator 175 to position shown in Fig. 9. As said casing arrives at station III, its position is tested by the front locator head 207 which engages its front end 6. If the casing is properly located at station III, operation of the machine continues. If it is improperly located, the electric circuits hereinbefore described stop operation of the machine.

Assuming proper location, the located casing 5 travels along the orbital path from station III to station IV. In such traverse the sheave 56 of its work holder 34 engages the driving belt 102 and starts to rotate the said holder and spin its contained casing on their own axis. The spinning or rotating casing 5 moving along the orbital path of its work holder 34 arrives at station IV where the rotary saw 240 cuts off excess of its rear end 9. At the same time the surface of the rotating casing 5 adjacent to its front end 6 commences engagement with the teeth 207 of the stationary broaching or groove cutting tool 260*a*. The said casing 5 still in a rotation or spinning condition continues moving the orbital path from station IV to station VI and during such traverse remains in cutting contact with the teeth 267 of the groove cutting or broaching tools 260*a* which progressively cut deeper into said surface cutting the groove 7 therein. While in the orbital traverse from stations IV to VI, the rear end 9 of the spinning casing 5 moves past the stationary end finishing tool 270 which trims the said end of the casing to its final dimensions.

Upon completion of the groove cutting at station VI and in its orbital movement from station VI to station VII, the finished rear end 9 of the rotating or spinning casing is engaged by the internal and external chamfering tools 290, 291. Also the cut groove 7 adjacent to the front end of the casing moves between the groove finishing cutter 329 and the backing member 332 so that a finishing cut is applied to the groove 7 while said spinning casing 5 is traveling orbitally from station VI to station VII. As the spinning casing 5 leaves station VII, the sheave 56 of its work holder is disengaged from the belt 102 and moves into braking engagement with the brake spring 383*a*. This brakes the pulley sheave 56 and spinning of casing 5 without, however, stopping the orbital movement of the casing 5 and its work

holder 34 on the turret plate member 20. The now braked casing 5 continues in its motion to station VIII whereat the ejector mechanism 408 begins to operate on the casing and to push it longitudinally out of its work holder. Ejecting action is supplemented by the fluid blast which is controlled by the valve 452 and ejection is completed by the time the work holder arrives at station IX.

Should ejection not be accomplished by such time, a non-ejected finished casing leaving station IX with its work holder 34 would operate the ejector safety switch 546 and cause stoppage of the machine by operation of the electric circuits as hereinbefore described. If the casing has been properly ejected, its work holder moves from station IX back to station I for a repetition of the cycle. The same cycle of operation takes place in each work holder 34 and on each shell casing injected into such work holder as each moves along the orbital path from stations I to IX and back to station I as just described.

*Alternative groove cutting or broaching arrangement (Figs. 26-28)*

An alternative form of groove cutting or broaching tool arrangement which may be used in the machine in place of that shown in Figs. 13 and 14 without requiring any changes as to other parts or functions of the machine is shown in Figs. 26 to 28 inclusive. In the latter unchanged parts identical with those shown in Figs. 13 and 14 have the same reference characters as in the earlier figures.

In Figs. 26-28 inclusive the bearing casting 122a replaces bearing casting 122 of Figs. 13 and 14. This bearing casting 122a has similar shape and serves the same purposes as bearing casting 122, namely, to support rock shaft 121. It also serves to support a modified form of cutting or broaching tool. It for convenience is made in two parts suitably bolted together at 122b and is secured suitably to the top 16a of the frame or housing 10 at 123a.

The bearing casting 122a has an arcuately arranged bed 560 whose center is concentric with the axis of rock shaft 121, and consequently with the orbital path of travel of the shell casings 5. A tool clamping member 561 is associated with the bed 560 and is adapted to be clamped thereto. This member 561 also has arcuate shape and it is clamped to the bed by suitable means as the bolts 562. The clamping ring or member 561 is provided in its surface facing the bed 560 with a plurality of equi-spaced slots 563. These slots extend parallel to the axial direction of rock shaft 121 and each serves to receive an individual cutter 564. All of the cutters 564 are identical and each has a cutting edge 564a whose profile is as shown in Fig. 27. These edges 564a are so shaped and positioned that as the shell casings 5 sweep past successive of the arcuately arranged cutters in traversing from station IV to station VI, the required annular surface grooves 7 are cut in said casings.

To provide for accurate axial alignment of the cutting edges 564a in the path of travel of the casings 5, the bed 560 has an annular upstanding flange 560a. This flange for accuracy may have a machined inner surface 560b against which the ends 564b of the cutters all are adapted to abut. The flange 560a serves, therefore, as a stop gage for properly locating the individual cutters 564. Suitable clamping bolts 566 extend from the clamping member 561 into the slots 563 to clamp

the cutters in their located positions against the bed 560.

In order to provide varying depth of cut, i. e., to provide progressively increasing depth of cut into grooves 7 by the individual cutters as the shell casings 5 progress from station IV to station VI, the slots 563 are each deep enough to permit the placing of one or more suitable shims 567 between the cutters 564 and the bed 560 before the clamping bolts 566 are tightened.

The use of such shims serves to permit radial positioning of the individual cutting edge 564a of any cutter. As shown in Fig. 26 more shims are used with the cutters near station IV while progressively fewer and thinner shims are used with the cutters as the slots progress toward station VI. Thus the cutting edges 564a of the respective cutters gradually and progressively cut deeper into the spinning casings 5 as they progress from station IV to station VI. This arrangement as with the segmental tools 260a of Figs. 13 and 14 provides collectively a slightly eccentric arcuate arrangement of the cutting edges 564a of the cutters with respect to the orbital path of travel of the shell casings 5 so that there is a gradual increase in depth of penetration into the spinning casings 5 by the cutting edges 564a from station IV to station VI. This simulates a proper cutting feed of the said edges 564a into the spinning casing 5. It will be noted that in effect the individual cutters assembled on bed 560 constitute an arcuate broaching means.

As with the modification of Figs. 13 and 14, the extent of traverse of the shell casings 5 from station IV to station VI past the arcuately arranged cutters 564 is substantially 180° or half a revolution. All other parts of the machine are exactly the same and in the same relationship and perform the same functions.

An advantage of substituting individual cutters 564 for segmental tools 260a is that if a single cutter 564 breaks it can be replaced quickly and cheaply. On the other hand, if a tooth 267 of one of the segmental tools 260a breaks, the whole segment must be replaced. Individual cutters are, therefore, more economical under conditions where breakage is likely.

While the sequence of operations in this application has been described most particularly with respect to shell casings, it is to be understood that the machine in either of its forms is adapted for operation on many other types of work pieces. Likewise, it is to be understood that variations in details of construction and in arrangement of parts within the scope of the claims is contemplated. There is no intention, therefore, of limitation to the exact details shown and described.

What is claimed is:

1. In apparatus of the character described, means for moving a work piece in a rotating condition along an orbital path, means operative on said work piece during its traverse along said path for effecting cutting operations thereon, means for braking rotation of said work piece during a period of its orbital travel subsequent to said cutting operations and means movable synchronously with said first-named means along a portion only of said orbital path after the rotation of said work piece has been braked for then ejecting said work piece from said first-named means while motion in said orbital path continues.

2. In apparatus of the character described, supporting means for a work piece, means for

moving said supporting means along a closed orbital path, means for rotating said supporting means on an axis of rotation independent of said orbital path in a coupled period of movement along said orbital path and means for maintaining said supporting means uncoupled from said rotating means in uncoupled periods of movement of said supporting means along said orbital path, means movable synchronously with said supporting means along a portion of its orbital path and operative during one of said uncoupled periods for transferring and injecting said work piece into said supporting means, mechanisms operative during said coupled period for effecting cutting operations on said work piece, and means for the ejection of said work piece from its supporting means after completion of said cutting operations and during another of said uncoupled periods of movement of said supporting means along said orbital path.

3. In apparatus of the character described, individual supporting means for a plurality of work pieces, means for moving successive of said supporting means continuously along a closed orbital path, means for rotating each said supporting means on an axis of rotation independent of said orbital path in a coupled period of movement of each successive supporting means along said orbital path, means for maintaining each successive supporting means uncoupled from said rotating means in prescribed uncoupled periods of the movement of said supporting means along said path, means movable synchronously in turn with each of said supporting means along a portion of its orbital path and operative during one of said uncoupled periods of each said supporting means for injecting a work piece to each successive supporting means, mechanisms operative during said coupled periods for cutting operations on each successive work piece, and means for the ejection from its supporting means of each successive work piece after completion of said cutting operations and during another of said uncoupled periods of movement of each successive supporting means along said orbital path.

4. In apparatus of the character described, means for moving work pieces continuously along an orbital path, means for inserting said work pieces one by one into said first-named means while the latter is in motion, locator means operative on opposite ends of each inserted work piece while it is in motion along a portion of said orbital path for locating each said inserted work piece properly for tooling operations on its ends and surface, means for spinning each said inserted work piece after operation on it by said locator means has been completed, and means operative on each said inserted work piece while the latter is spinning and being moved along other portions of said orbital path for effecting said tooling operations thereon.

5. In apparatus of the character described, means for moving work pieces continuously along an orbital path, means movable synchronously with said first-named means along a portion of said orbital path for feeding said work pieces one by one to said first-named means while the latter is in motion, locator means operative on ends of each inserted work piece while it is in motion with said first-named means along a portion of said orbital path for locating each said inserted work piece properly for tooling operations on its ends and surface, means operative while motion of each said work piece continues along said orbital path for rotating each said inserted work

piece on an axis of its own after operation on it by said locator means has been completed, means operative on each said inserted work piece while the latter is being rotated and being moved along other portions of said orbital path for effecting tooling operations thereon, means operative to brake rotation on its own axis of each work piece upon which tooling operations have been completed while motion along said orbital path continues, and means then operative on each work piece whose rotation on its own axis has been braked but while motion along said orbital path continues for ejecting it from said first-named means.

6. In apparatus of the character described, means for moving work pieces continuously along an orbital path, means for inserting said work pieces into said first-named means while the latter is in motion, locator means operative on an end of each inserted work piece while it is in motion along a portion of said orbital path for shifting each work piece in one direction, additional locator means operative on an opposite end of each work piece while motion continues along said orbital path for shifting each work piece in the opposite direction, said two locator means serving to position each work piece properly for subsequent tooling operations thereon, means for preventing further longitudinal displacement of each located work piece, means for rotating each located work piece on its own axis while it continues in motion on said orbital path, and means for effecting tooling operations on each work piece while it is rotating and moving along a further portion of said orbital path.

7. In apparatus of the character described, means for moving a work piece continuously along an orbital path, an endless locator band member positioned at a bias to said first-named means and in the path of travel of an end of said work piece for shifting said work piece in one direction as it moves along a portion of said orbital path, a locator member positioned to engage an opposite end of said work piece for shifting it in an opposite direction while it continues along said orbital path, said band member and said locator member serving to locate said work piece properly in said first-named means for subsequent tooling operations thereon, means for locking a located work piece against further shifting in said first-named means, means for rotating said located work piece on its own axis, means for effecting tooling operations on the located, rotating work piece, means for braking rotation of the work piece after completion of tooling operations thereon, and means for ejecting the tooled work piece whose rotation has been braked from said first-named means, said locking means, said rotating means, said tooling means and said rotation braking means all being effective while said work piece moves continuously along said orbital path.

8. In apparatus of the character described, means for moving successive work pieces continuously along an orbital path, an endless, freely movable locator band member positioned at a bias to said first-named means and along a portion of said orbital path in the path of travel of an end of each work piece as it moves along said portion of said orbital path for shifting each such work piece in one direction, a locator member positioned to engage an opposite end of each work piece during its movement along said portion of said orbital path, said band member and said locator member serving to locate each successive

work piece properly in said first-named means for subsequent tooling operations thereon, means for locking each located work piece against further shifting in said first-named means, means for spinning each located work piece on its own axis, means for tooling each located, spinning work piece, means for braking the spinning of each tooling work piece, and means for ejecting each tooling work piece whose spinning has been braked from said first-named means, said locking means, said spinning means, said tooling means, and said spin braking means, each being effective while the work pieces move continuously along said orbital path.

9. A machine for cutting an ejection groove into the surface of each of a plurality of successive cartridge casings and for trimming an end of each said casing to reduce each casing to required length comprising, a turret member, a plurality of axially movable, rotatably supported casing holders in said turret member, means for turning said turret member to move said casing holders continuously along an orbital path, means for delivering said casings to said machine, transfer means movable synchronously with each of said holders in turn along a portion only of its orbital path for receiving said casings one by one from said delivery means, means movable with said transfer means, and reciprocally transversely of said orbital path for injecting each casing received by said transfer means into a work holder, locator means operative on each injected casing for positioning it and its work holder properly in said turret member for subsequent trimming and grooving of said casing, means for locking each located casing-bearing work holder after such positioning, means for rotating each located casing-bearing work holder while it moves in a portion of said orbital path, severing means for trimming an end of each rotating casing, groove cutting means for cutting a groove into a surface of each rotating casing, end finishing means operative on said end of each said rotating casing, groove finishing means operative in each groove cut into each said rotating casing, means for braking rotation of each said so-treated casing, and means for ejecting each said so-treated casing from its work holder after its rotation has been braked, said transfer means, injector means, locator means, locking means, rotating means, severing means, groove cutting means, end finishing means, groove finishing means, rotation braking means and ejection means all being operative while the casings are moving with their work holders in said orbital path.

10. In apparatus of the character described, supporting means for a work piece, means for moving said supporting means in a closed orbital path, mechanism for rotating said supporting means on an axis of its own during a period of its travel in said orbital path, means for braking rotation of said supporting means on its said axis in another period of its travel in said orbital path, mechanism movable synchronously with said supporting means along a portion of its orbital path for feeding said work piece to said supporting means while it moves in its orbital path but while it is braked against rotation on its said axis, severing mechanism arranged with respect to the orbital path of said supporting means in the period when the supporting means is rotating on its own axis for operating on an end of said work piece to trim the latter to a required length, stationary groove cutting mechanism also arranged with respect to said orbital

path in the period while said work piece-supporting means is rotating on its own axis to cut a groove into said work piece, mechanisms also operative on said work piece during said last-named period for effecting finishing operations on said end and on said groove of said work piece, and mechanism operative for ejection of said work piece after said supporting means has been braked from rotating upon its own axis, said mechanisms being operative on said work piece during continuous orbital travel of said supporting means along its orbital path.

11. A machine of the character described comprising, a plurality of work holders, means for moving said work holders along an orbital path, means movable synchronously with each said work holder in turn as it moves along a portion of said orbital path for feeding a work piece to each work holder as it moves in said portion of said orbital path, means in a successive portion of said orbital path for locating each injected work piece and its work holder at a predetermined position with respect to said moving means, means in another successive portion of said orbital path to lock each successive work holder in its predetermined position, means in the orbital path of said holder then effective for rotating each successive work holder axially, and severing means, groove cutting means, trimming means, end chamfering means, and groove finishing means each effective along portions of the orbital path upon each succeeding orbitally-moving, rotating work piece, means for braking the rotation of each succeeding orbitally-moving, rotating work piece, and ejecting means operative on successive of the orbitally-moving work pieces the rotation of whose work holders has been braked to remove each such work piece from its work holder while orbital motion of said work holders continues.

12. A machine of the character described comprising, a plurality of work holders, means for moving successive work holders continuously along an orbital path, means movable synchronously with each said work holder in turn as it moves along a portion of said orbital path for feeding a work piece to each successive work holder as it moves in said portion of said orbital path, means for locating each so fed work piece and its work holder at a predetermined position with respect to said moving means as each work piece is moved in a successive portion of said orbital path, means for locking each work holder against shift of location as it moves in another portion of said orbital path, means for effecting axial rotation of each work holder and its contained work piece as they move in the next portion of said orbital path, severing means operative on an end of each rotating work piece in a next portion of said orbital path, groove cutting means also then operative on a surface of each of said orbitally-moving, rotating work pieces to cut a groove therein, trimming means operative on said end of each of said orbitally-moving, rotating work pieces after completion of operation of said severing means thereon but prior to completion of operation of said groove cutting means thereon, chamfering means operative on said end of each of said orbitally-moving, rotating work pieces upon completion of operation of said groove cutting means thereon, groove finishing means operative in the groove cut in each work piece on completion of the operation of said chamfering means on each said work piece, each successive work holder being

adapted then to become uncoupled from said rotating means, means for then braking rotation of the so uncoupled work holder, and ejection means operative on each orbitally-moving work piece the rotation of whose work holder has been braked to remove each such work piece from its work holder.

13. A machine of the character described comprising, a plurality of work holders, a turret member supporting said work holders, means for rotating said turret member so as to move said work holders successively along an orbital path, means movable synchronously with each said work holder in turn as it moves along a portion of said orbital path for feeding a work piece to each work holder as it moves in said portion of said orbital path, means for locating each so fed work piece and its work holder at a predetermined position with respect to said turret member as each work holder moves in a successive portion of said orbital path, means for locking each work holder against displacement from its located position as it moves in a second successive portion of said orbital path, means for effecting rotation of each successive work holder as it moves in a third successive portion of said orbital path, severing means operative on an end of each successive work piece as each moves with its holder in a fourth successive portion of said orbital path, groove cutting means operative on a surface of each successive work piece for cutting a groove therein as each moves with its work holder in said fourth successive portion and in a fifth successive portion of said orbital path, trimming means operative on said end of each successive work piece as each moves with its holder in said fifth successive portion of said orbital path, chamfering means operative on said end of each successive work piece as each moves with its holder in a sixth successive portion of said orbital path, groove finishing means operative in the cut groove of each successive work piece as it moves with its work holder in said sixth successive portion and in a seventh successive portion of said orbital path, each successive work holder completing said seventh successive portion being then uncoupled from said work holder rotating means, means for braking rotation of each successive work holder after it becomes uncoupled, and ejection means operative on each successive work piece the rotation of whose work holder has been braked as each such work piece moves in an eighth successive portion of said orbital path to then remove each such work piece from its holder.

14. In apparatus of the character described, means for moving a work piece in a spinning condition along an orbital path, stationary cutting means for cutting a groove into a surface of said work piece while said spinning work piece moves along a portion of said orbital path, and means for finishing said groove during movement of said spinning work piece along another portion of said orbital path, said last-named means comprising a finishing tool and a backing member positioned to engage in said groove respectively at opposite sides of said spinning work piece during the travel of the work piece in said last-named portion of said orbital path, means for moving said finishing tool and said backing member reciprocally as a unit, and, during their engagement with said work piece, at a speed of motion synchronous with that of the orbital speed motion of said spinning work piece and means for ejecting

said work piece from said first-named means while motion in said orbital path continues.

15. In apparatus of the character described, means for moving successive work pieces in a rotating condition along an orbital path, stationary cutting means for cutting a groove into a surface of each successive rotating work piece while the successive work pieces move along a portion of said orbital path, and means for finishing the cut groove in each successive rotating work piece during movement of said work pieces along another portion of said orbital path, said last-named means comprising a finishing tool and a backing member positioned respectively to engage successively in the cut grooves at opposite sides of the successive rotating work pieces during their travel in said last-named portion of said orbital path, means for moving said finishing tool and said backing member reciprocally as a unit, and, during their engagement with each successive work piece, at a speed of motion synchronous with that of the orbital speed of motion of said work pieces and means for ejecting said work piece from said first-named means while motion in said orbital path continues.

16. In apparatus of the character described, means for moving a work piece in a spinning condition along an orbital path, cutting means for cutting a groove in a surface of said work piece while said spinning work piece moves along a portion of said orbital path, and means for finishing said groove during movement of said spinning work piece along another portion of said orbital path, said last-named means comprising, a finishing tool and a backing member adjustably positioned to engage in said groove respectively at opposite sides of said spinning work piece during the travel of the work piece in the last-named portion of said orbital path, means for mutually adjusting the positions of said finishing tool and backing member for variations desired in the finishing of said groove, means for moving said finishing tool and said backing member as a unit during their engagement in said groove at a speed of motion synchronous with that of the speed of orbital motion of said spinning work piece and means for ejecting said work piece from said first-named means while motion in said orbital path continues.

17. In apparatus of the character described, means for moving a work piece in a rotating condition along an orbital path, means for grooving a surface of said work piece while said rotating work piece moves along a portion of said orbital path, and means for finishing said groove during movement of said rotating work piece along another portion of said orbital path said last-named means comprising, a finishing tool, a freely rotatable backing member, a common support for said tool and said member, adjustable means for positioning said support so as to permit engagement in said groove of said tool and backing member respectively on opposite sides of said rotating work piece during the travel of the latter in said last-named portion of its orbital path, adjustment means for spacing said backing member with respect to said finishing member, means for oscillating said support to provide going and return motion thereof over said last-named portion of said orbital path, said last-named means being adapted to move said support in the going motion and during the engagement in said groove by the finishing tool and said backing member at a speed of motion synchronous with that of the speed of orbital motion of

said rotating work piece and means for ejecting said work piece from said first-named means while motion in said orbital path continues.

18. In apparatus of the character described, means for moving a work piece in a spinning condition along an orbital path, means movable synchronously with said first-named means along a portion of said orbital path for inserting work pieces one by one into said first-named means while the latter moves in said orbital path, means operative on said spinning work piece for effecting chamfering at an end of said work piece during its motion along a portion of said orbital path, said chamfering means being movable in the direction of travel of said spinning work piece along said orbital path at a speed synchronous with that of said work piece, and, also, reciprocally into and out of cutting engagement with said end of said spinning work piece during said synchronous motion, means for effecting said synchronous motion, and means for effecting said reciprocal motion, means for effecting other tooling operations on each work piece as it is moved in said orbital path and means for ejecting each said work piece from said first-named means thereafter while motion in said orbital path continues.

19. In apparatus of the character described, means for moving a work piece in a rotating condition along an orbital path, means movable synchronously with said first-named means along a portion of said orbital path for inserting work pieces one by one into said first-named means while the latter moves in said orbital path, means operative on said work piece for effecting internal and external chamfering at an end of said rotating work piece during its motion along a portion of said orbital path, said chamfering means being movable in the direction of travel of said work piece along said orbital path at a speed synchronous with that of said work piece, and, also, reciprocally into and out of cutting engagement with said end of said rotating work piece during said synchronous motion, means for effecting other tooling operations on each work piece as it is moved in said orbital path and means for ejecting each said work piece from said first-named means thereafter while motion in said orbital path continues.

20. In apparatus of the character described, means for moving a hollow work piece in a rotating condition along an orbital path, means movable synchronously with said first-named means along a portion of said orbital path for inserting work pieces one by one into said first-named means while the latter moves in said orbital path, means operative on said rotating work piece for effecting internal and external chamfering at an end of said work piece during its motion along a portion of said orbital path, said chamfering means comprising, chamfering tools adapted for effecting chamfering cuts internally and externally of said end, means for moving said tools reciprocally along a path parallel to the orbital path of said rotating work piece and while moving in the direction of orbital movement of said work piece at a speed of motion synchronous with that of said work piece, and means for moving the respective tools reciprocally into and out of engagement with the internal and external portions of said end during said synchronous motion, means for effecting other tooling operations on each work piece as it is moved in said orbital path and means for ejecting each said work

piece from said first-named means thereafter while motion in said orbital path continues.

21. In apparatus of the character described, means for moving a work piece in a rotating condition along an orbital path, means movable synchronously with said first-named means along a portion of said orbital path for inserting work pieces one by one into said first-named means while the latter moves in said orbital path, means for chamfering a part of said work piece during its motion along a portion of said orbital path, said chamfering means comprising tool supporting means, at least one cutting tool carried by said supporting means, means for moving said tool supporting means reciprocally over an orbital path parallel with the said orbital path of said work piece and, while moving said supporting means in the same direction of orbital motion as that of said rotating work piece, moving it at a speed of motion synchronous therewith, and means for moving said supporting means reciprocally toward and away from said part of said rotating work piece during said synchronous motion whereby the cutting tool will effect a chamfering cut on said part of said rotating work piece while said work piece is in motion on its orbital path, means for effecting other tooling operations on each work piece as it is moved in said orbital path and means for ejecting each said work piece from said first-named means thereafter while motion in said orbital path continues.

22. In apparatus of the character described, means for moving a work piece in a rotating condition along an orbital path, means movable synchronously with said first-named means along a portion of said orbital path for inserting work pieces one by one into said first-named means while the latter moves in said orbital path, means for chamfering a part of said work piece during its motion along a portion of said orbital path, said chamfering means comprising, tool supporting means, cutting tools yieldingly carried in spaced relationship by said supporting means, cam means for moving said tool supporting means reciprocally over an orbital path parallel with the said orbital path of said rotating work piece, said cam means being so adapted that while moving said supporting means in the same direction of motion as that of said work piece, it will move said supporting means at a speed of motion synchronous with the speed of orbital movement of said work piece, a stationary cam, and cam follower means associated with said supporting means for engaging said stationary cam whereby the said stationary cam will effect reciprocal movement of said supporting means and the tools carried thereon toward and away from said part of said rotating work piece during the said synchronous motion and whereby the said tools will be brought into and out of cutting engagement with said part during said last-named reciprocal movement, means for effecting other tooling operations on each work piece as it is moved in said orbital path and means for ejecting each said work piece from said first-named means thereafter while motion in said orbital path continues.

23. In apparatus of the character described, means for moving a work piece in a spinning condition along an orbital path, means stationed for operation along successive portions of said path for effecting tooling operations on said spinning work piece, means for braking the spinning of said work piece upon completion of the tooling operations thereon without stopping its

movement along said orbital path, and means for ejecting said orbitally moving work piece after its spinning has been braked comprising, means movable reciprocally along an orbital path parallel to said first-named orbital path in a portion thereof wherein the spin of said work piece has been braked, cam controlled means for so moving said reciprocally movable means, said cam controlled means being adapted to move said reciprocally movable means during a part of its reciprocatory motion along its own orbital path at a speed of motion synchronous with that of the orbital motion of the work piece, a pusher member, and cam controlled means for reciprocating said pusher member transversely of the orbital path of said work piece whose spin has been braked for pushing said work piece out of said first-named means.

24. In apparatus of the character described, means for moving a work piece in a rotating condition along an orbital path, means for performing a plurality of tooling operations thereon during its traverse along said orbital path, and means for ejecting said work piece from said apparatus while said work piece is in motion along a portion of said orbital path comprising, mechanical pusher means for ejecting said work piece, means for imparting orbital oscillatory motion to said pusher means, means for imparting reciprocal motion to said pusher means transversely of said orbital path, means for providing an auxiliary fluid blast ejecting action upon said work piece to supplement the ejecting action of said pusher means, and means for controlling said fluid blast ejecting action.

25. In apparatus of the character described, means for moving a work piece in a rotating condition along an orbital path, means for performing a plurality of tooling operations thereon during the traverse of said orbital path, and means for ejecting said work piece from said apparatus while in motion along a portion of said orbital path comprising, means movable with the speed of movement of said work piece along a portion of said path, a member carried by said last-named means and movable reciprocally transversely of said orbital path for pushing said work piece out of said machine while it is in motion along said orbital path, and auxiliary fluid blast means in conjunction with said last-named member to assist the ejecting action of said member.

26. A machine of the character described comprising, a turret member, movable work holders rotatably supported in said turret member, means for turning said turret member to move said work holders along an orbital path, electrically operated driving means for operating said turning means, manually movable means for coupling said driving means to said turning means, holding means for maintaining the said coupling, means for locating work pieces in said holders, means for rotating said work holders as each travels over a part only of said orbital path, an independent electrically operated driving means for operating said rotating means, means for effecting tooling operations on each work piece in its traverse over said part of said orbital path, means for thereafter ejecting each work piece from its holder, electrical circuits connecting said two driving means to a power source, an electrical control means associated with said manually movable means for maintaining the electrical circuit to said independent electrically operated driving means open while said first-named driving means

is uncoupled from said turning means, an electrical control means also in the circuit to said independent electrically-operated driving means for breaking the latter circuit upon improper location of a work piece in a work holder, and electrical means for releasing said holding means upon failure of ejection of a work piece from its holder.

27. A machine of the character described comprising, a turret member, a work holder rotatably supported in said turret member, means for turning said turret member to move said work holder along an orbital path, electrically operated driving means for operating said turning means, manually movable means for coupling said driving means to said turning means, electrically-controlled holding means for maintaining the said coupling, means for rotating said work holder as it travels over a part only of said orbital path, an independent electrically operated driving means for operating said rotating means, means for effecting tooling operations on each work piece in its traverse over said part of said orbital path, means for thereafter ejecting said work piece from its holder, electrical circuits for connecting said two driving means to electrical power, an electrical control means associated with said manually movable means for maintaining the electrical circuit to said independent driving means open while said first-named driving means is uncoupled from said turning means and electrical means for releasing said holding means upon failure of ejection of a work piece from its holder.

28. A machine of the character described comprising, a turret member, work holders rotatably supported in said turret member, means for turning said turret member to move said work holders along an orbital path, an electric motor for driving said turning means, manually operable means for coupling said motor to said turning means, holding means for maintaining the said coupling, means for locating work pieces in said holder, means for rotating each of said work holders as it travels over a portion of said orbital path, an independent electric motor for operating said rotating means, means for effecting tooling operations on each work piece in its traverse over said portion of said orbital path, means of thereafter ejecting each tooled work piece from its holder, electrical circuits connecting each of said motors to a source of electric power, an electrical switch in the circuit of said independent motor adapted to be operated by said manually movable means for completing the latter electrical circuit only when said first-named motor is coupled to said turning means, an electrical switch also in the latter circuit for breaking the latter upon improper location of a work piece in a work holder and electrical means connected in the electric circuit of said second-named motor for releasing said holding means upon failure of ejection of a tooled work piece from its holder by said ejecting means.

29. A machine of the character described comprising, a turret member, movable work holders rotatably supported in said turret member, means for turning said turret member to carry said work holders along an orbital path, electrically operated driving means for operating said turning means, manually operable means for coupling said driving means to said turning means, holding means for maintaining said coupling, means for rotating each of said work holders as it travels over a portion of said orbital path, an inde-

pendent electrically operated driving means for operating said rotating means, means for effecting tooling operations on each work piece in its traverse over said portion of said orbital path, means for thereafter ejecting each tooled work piece from its holder, electrical circuits connecting said two driving means to a common source of electric power, means for inserting and locating work pieces in said work holders, an electrical control means in the electrical circuit of said independent driving means and operated by said manually movable means for effecting completion of the latter electrical circuit only when said first-named driving means is coupled to said turning means, an electrical control means also in the latter electrical circuit and associated with said locating means for breaking the latter electrical circuit upon improper location of a work piece in a work holder and electrical control means also in the latter electrical circuit for releasing said holding means upon failure of ejection of a tooled work piece from its holder.

30. A machine of the character described comprising, a turret member, work holders rotatably supported in said turret member, means for turning said turret member to move said work holders along an orbital path, an electric motor for driving said turning means, manually operable means for coupling said motor to said turning means, holding means for maintaining the said coupling, means for locating work pieces in said work holders, means for rotating each work holder as it travels over a portion of said orbital path, an independent electric motor for operating said rotating means, means for effecting tooling operations on each work piece in its traverse over said portion of said orbital path, means for ejecting each work piece from its work holder upon completion of said tooling operations thereon, electrical circuits connecting each of said motors to a source of electric power, an electric switch in the circuit of said independent motor adapted to be closed only when said first-named motor is coupled to said turning means, an electric switch also in the last-named circuit for breaking the latter upon improper location of a work piece in a work holder, and electrical means for releasing said holding means upon failure of a work piece to be ejected from its work holder.

31. A machine of the character described comprising, a turret member, work holders rotatably supported in said turret member, means for turning said turret member to move said work holder along an orbital path, an electric motor for driving said turning means, manually operable means for coupling said motor to said turning means, holding means for maintaining said coupling, means for locating work pieces in said work holder, means for rotating each work holder and its contained work piece as it travels over a portion of said orbital path, an independent electric motor for operating said rotating means, means for effecting tooling operations on each rotating work piece in its travel over said portion of said orbital path, means for ejecting each work piece from its holder upon completion of said tooling operations thereon, electrical circuits connecting each of said motors to a source of electrical power, an electric switch in the circuit of said independent motor adapted to be closed only when said first-named motor is coupled to said turning

means, an electric switch also in said last-named circuit for opening the latter upon improper location of a work piece by said locating means, solenoid means for releasing said holding means, an electric circuit for connecting said solenoid means to a source of power, a switch for closing said last-named circuit and actuating the releasing solenoid means upon improper location of a work piece in its work holder by said locating means, and another switch in said circuit for closing said last-named circuit independently and actuating said releasing solenoid means upon failure of a work piece to be ejected from its work holder.

32. A machine of the character described comprising, a turret member, work holders rotatably supported in said turret member, means for turning said turret member to move said work holders along an orbital path, an electric motor for driving said turning means, manually operable means for coupling said motor to said turning means, holding means for maintaining said coupling, means for locating work pieces in said work holder, means for rotating each work holder and its contained work piece as they travel over a portion of said orbital path, an independent electric motor for operating said rotating means, means for effecting tooling operations on each rotating work piece in its travel over said portion of said orbital path, means for ejecting each finished work piece from its holder upon completion of said tooling operations thereon, electrical circuits connecting each of said motors to a source of power, electrical means for opening the electric circuit of said second motor upon improper location of a work piece in its work holder and also upon failure of a finished work piece to be ejected from its work holder, electrical means for releasing said holding means upon improper location of any work piece, and electrical means connected in the electric circuit of said second motor for preventing further operation of said coupling means as long as any improperly located work piece remains in its work holder and also until any finished work piece which said ejecting means has failed to eject is removed from its holder.

KARL F. WUNSCH.  
JOHN E. FERGUSON.

#### REFERENCES CITED

The following references are of record in the file of this patent:

#### UNITED STATES PATENTS

Number	Name	Date
766,403	Vincke	Aug. 2, 1904
1,289,390	Calleson	Dec. 31, 1918
2,117,713	Friden	May 17, 1938
2,140,019	Lewis	Dec. 13, 1938
1,895,562	Yager	Jan. 31, 1933
2,063,339	Probach	Dec. 8, 1936
2,109,600	Vanderbeek	Mar. 1, 1938
1,996,368	Drissner	Apr. 2, 1935
2,016,570	Adams	Oct. 8, 1935
2,126,462	Groene et al.	Aug. 9, 1938
2,089,421	Pierle	Aug. 10, 1937
1,857,516	Oakley	May 10, 1932
1,540,809	Sears	June 9, 1925
2,080,157	Yager et al.	May 11, 1937
2,359,939	Reynolds	Oct. 10, 1944