N. K. TURNBULL.

MACHINE FOR REMAKING WIRE DRAWING DIES.

APPLICATION FILED MAR. 4, 1911.

1,028,305.

Patented June 4, 1912.

5 SHEETS—SHEET 1.

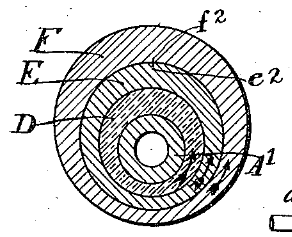


Fig. 6.

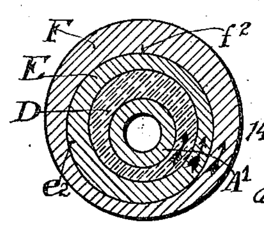


Fig. 7.

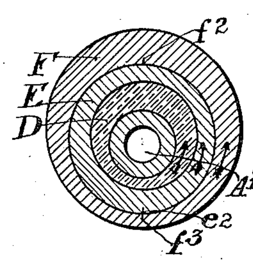
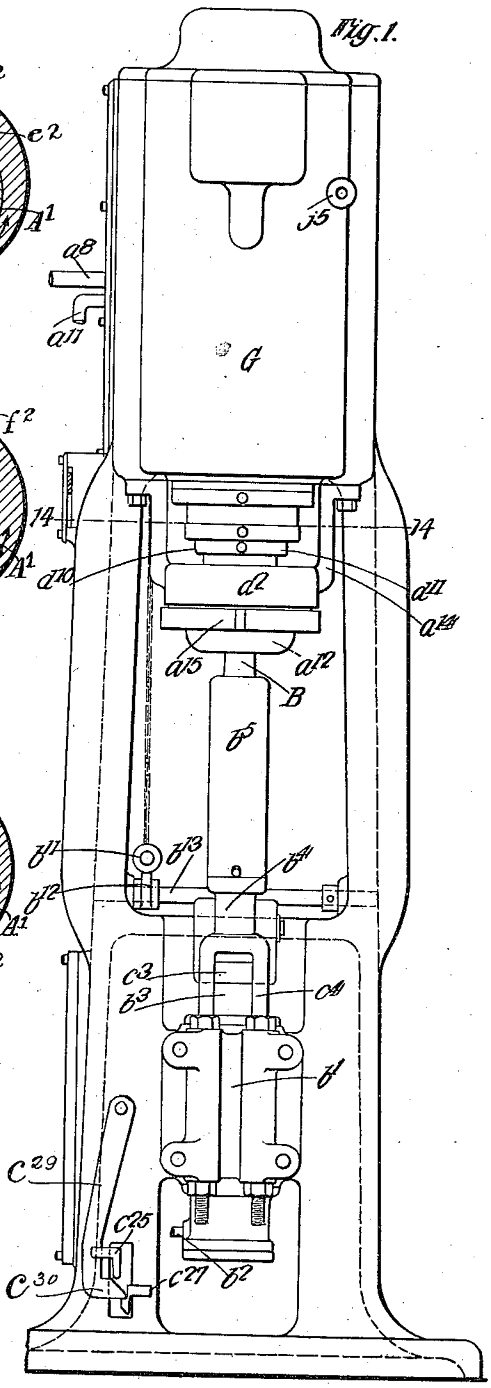


Fig. 8.



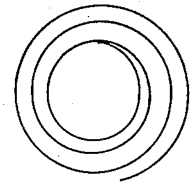


Fig. 9.

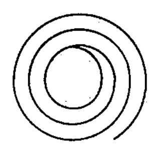


Fig. 10.

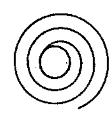


Fig. 11.

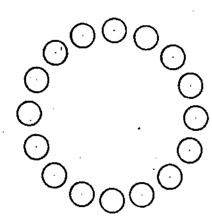


Fig. 12.

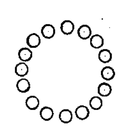


Fig. 13.

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Fig. 2.

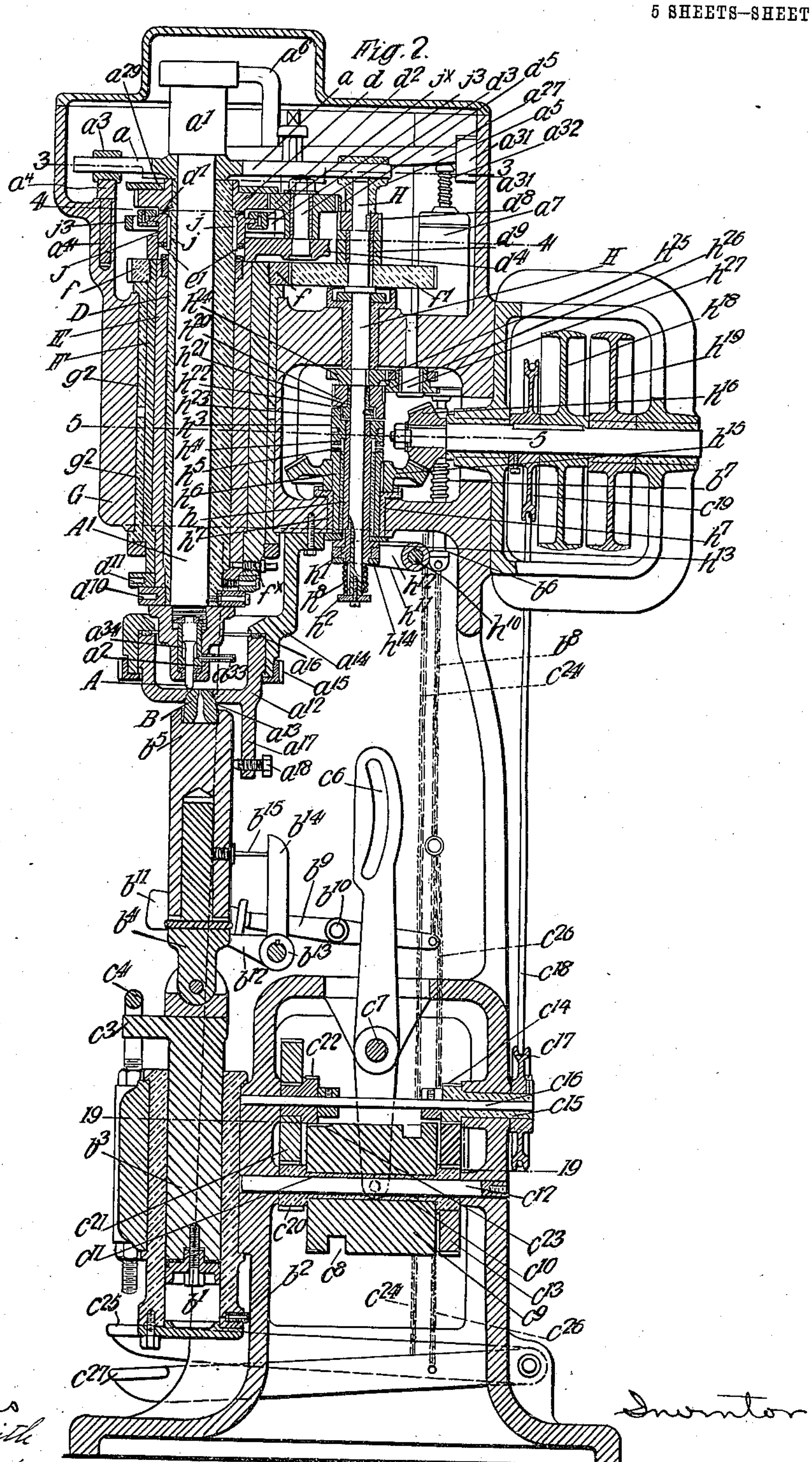

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Fig. 3.

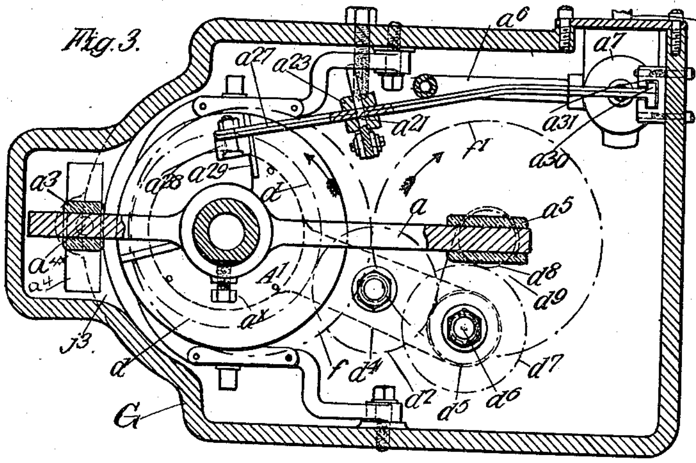


Fig. 4.

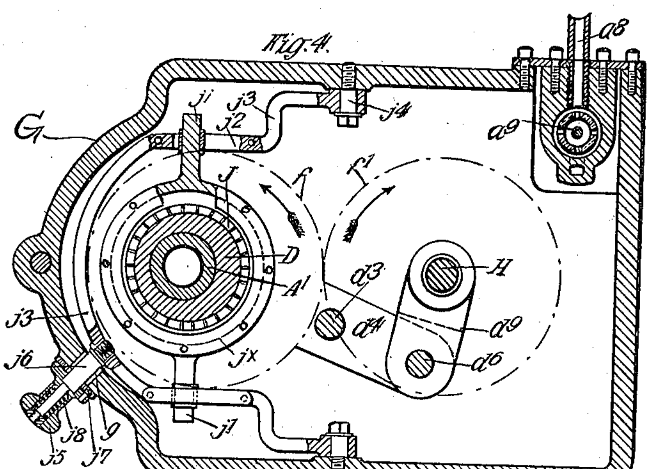
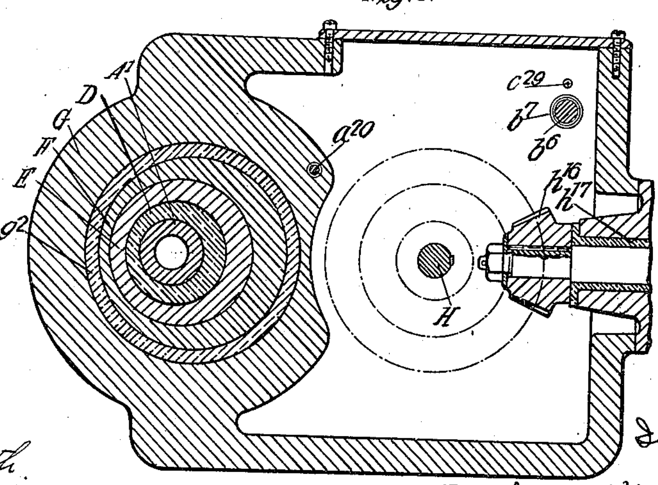


Fig. 5.



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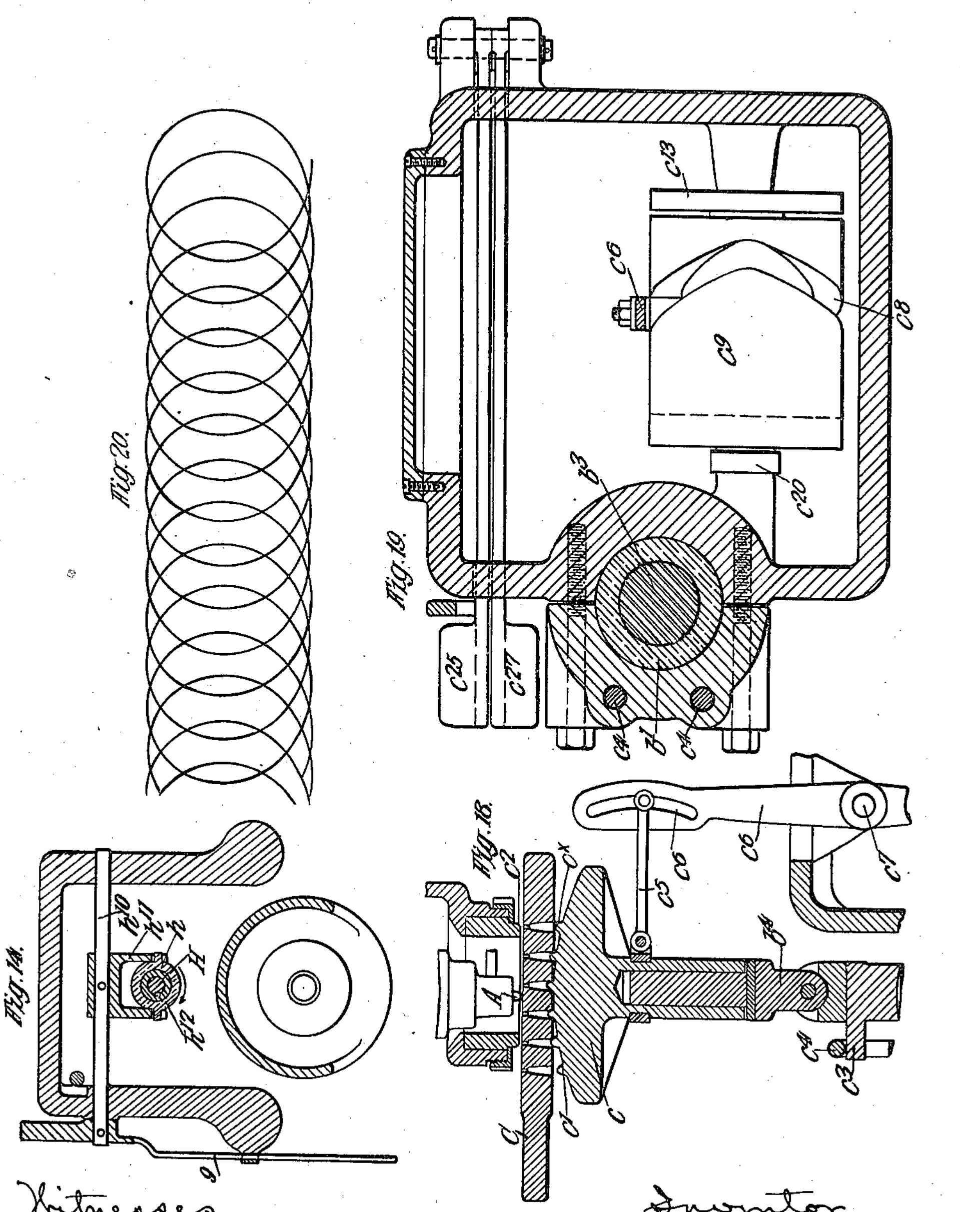

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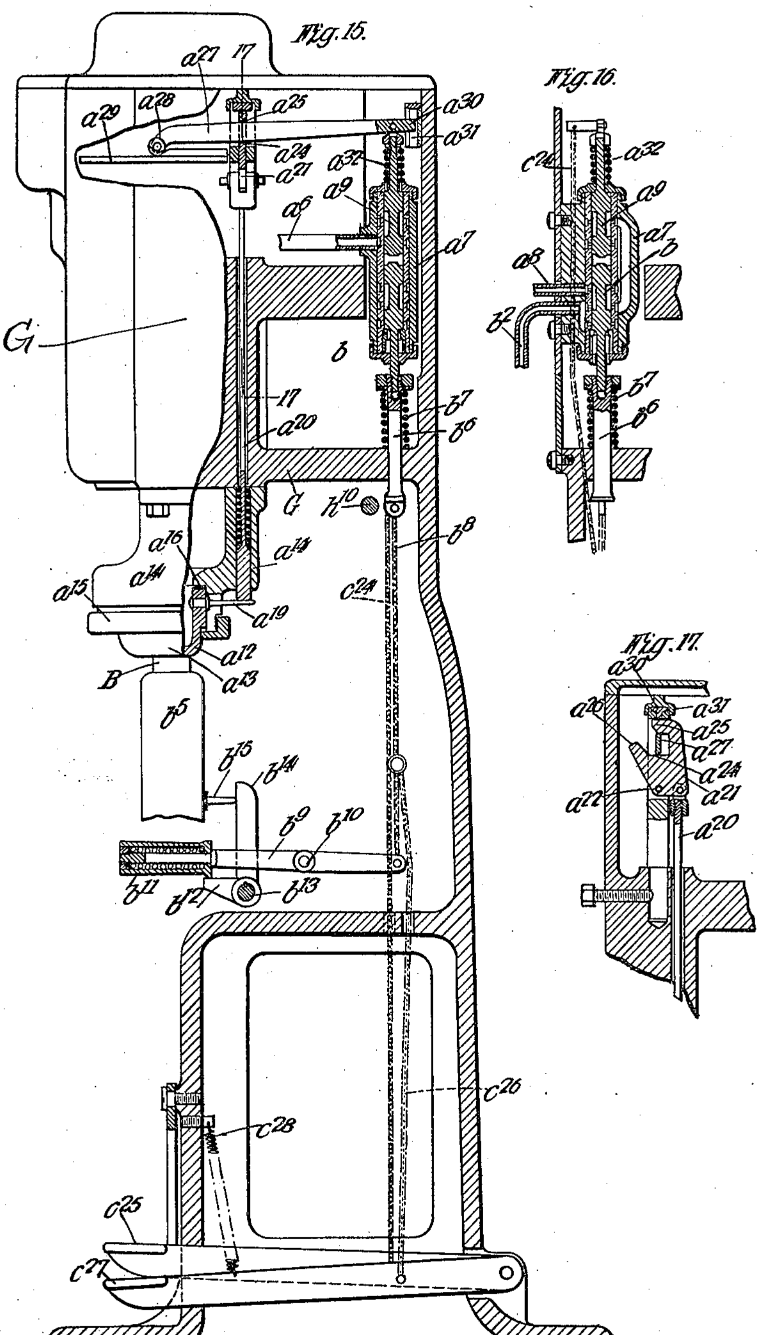
5 SHEETS—SHEET 5.



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UNITED STATES PATENT OFFICE.

NICHOLAS KING TURNBULL, OF MANCHESTER, ENGLAND.

MACHINE FOR REMAKING WIRE-DRAWING DIES.

1,028,305. Specification of Letters Patent. **Patented June 4, 1912.**

Application filed March 4, 1911. Serial No. 612,387.

To all whom it may concern:

Be it known that I, Nicholas King Turnbull, a subject of the King of Great Britain, residing at Wire Works, Trafford Park, Manchester, in the county of Lancaster, England, have invented certain new and useful Improvements in Machines for Remaking Wire-Drawing Dies, of which the following is a specification.

This invention relates to a machine that is more particularly applicable for hammering large plates or dies, also plates or dies having a number of rows of eyes. The last mentioned plates in addition to being hammered around the various eyes, require to be hammered in lines between the rows of eyes in order to relieve the strain that is set up in the plate by hammering the same around its eyes. This strain if not relieved, is liable to result in the plate becoming cracked and consequently spoiled.

According to this invention the machine is so constructed and arranged that in effecting the hammering process the hammer is moved in a curved path around the eye or eyes of the plate or die and in some cases in addition to describing the said path around the eyes of the plate or die, the said curved path is described between such eyes by automatically or otherwise causing the plate to be traversed to and fro in relation to the path described by the hammer with the result that the blows will be delivered in overlapping circles or curves which will practically cover the whole surface of the plate. A convenient form of mechanism for causing the hammer to describe a spiral path in relation to the die or plate consists in eccentrically mounting a pneumatic or other appropriate hammer in a tube or bearing that is eccentrically and rotatably mounted in another tube or bearing, each tube or bearing being capable of rotation about its own axis at a different relative speed, with the result that the hammer is caused to described an approximately spiral path which may extend around the eye of the die or plate. If desired the mechanism may be adjusted to cause the hammer to describe a circular path and by traversing the said plate in relation to the path described by the hammer, the blows are delivered in a series of approximately circular or similar paths which overlap each other in accordance with the relative speed of the hammer moving mechanism and the speed at which the plate is traversed. The hammer is advantageously made with a cylindrical holding portion arranged to fit the bore of the inner tube or bearing, the outer circumference of which is formed eccentric to the bore. This inner bearing is advantageously arranged to fit the bore of the outer tube or bearing which is also formed with an outer circumference situated eccentrically in relation to its bore, any suitable gearing being employed for imparting the required rotary movements to the tubes or bearings and also to the cylindrical portion of the hammer if the latter were mounted eccentrically thereto. The motive fluid to the hammer may be controlled in any convenient manner; or I may provide appropriate mechanism whereby the motive fluid is controlled by the act of bringing the die or die plate into the hammering position. For example I may provide a floating lever, (*i. e.* one that has a displaceable fulcrum) which operates in conjunction with suitable mechanism for varying the position of the valves that control the motive fluid.

Means may be provided for supporting the tool of the hammering machine in its raised position when at rest; these means consisting of a metallic spring or an air cushion.

The portion of the machine that supports the die or the die plate may be raised to the working position by any suitable mechanical or pneumatic means such for example as a cam or crank or an air controlled piston.

In order that the said invention may be clearly understood and readily carried into effect, I will describe the same more fully with reference to the accompanying drawings in which:—

Figure 1 is a front elevation of a die and plate hammering machine constructed in accordance with this invention. Fig. 2 is a vertical side section of the machine. Fig. 3 is a transverse section taken approximately on line 3, 3, of Fig. 2. Figs. 4 and 5 are similar views taken approximately on lines 4, 4 and 5, 5 of Fig. 2. Figs. 6, 7 and 8 are cross sections taken through the inner, intermediate and outer tubes, showing three adjustments of the intermediate tube. Figs. 9, 10 and 11 are diagrammatic views of spiral paths described by the hammer in accordance with the said adjustments. Figs. 12 and 13 are diagrammatic views of circular paths described by the hammer, the small circles indicating the hammer indentations. Fig. 14 is a transverse section taken on lines 14, 14 of Fig. 1. Fig. 15 is a vertical side section of a sufficient part of the machine to illustrate the hammer operating and controlling gear. Fig. 16 is a detached section of the hammer controlling valve taken at right angles to that shown in Fig. 15. Fig. 17 is a vertical section of part of Fig. 15 taken approximately on line 17, 17 of that figure. Fig. 18 is a detached view of part of Fig. 2 showing in section an attachment to the machine for enabling the latter to hammer around and between the eyes of a die plate having a number of rows of eyes. Fig. 19 is a transverse section taken approximately on line 19, 19 of Fig. 2, and Fig. 20 is a diagrammatic view of a path described by the hammer between the rows of eyes of the die plate.

A represents the pneumatic hammer. A′ the cylindrical holding portion thereof, B the die, C the die plate, D the inner tube or bearing, E the intermediate tube or bearing, F the outer tube or bearing, and G the machine frame. The aforesaid cylindrical holding portion A′ of the hammer as already mentioned is arranged to fit the bore of the inner tube or bearing D. This holding portion is supported within the tube D by a lever a that is clamped by a screw $a^{\times}$ Fig. 3, to the holding portion A′ between the upper end of the inner tube D and an enlarged portion a' of the hammer casing, endwise movement of the holding portion being prevented by the aforesaid enlarged portion a' and a cap a^2 that encircles the hammer A and is screwed onto the lower end of the holding portion A′. The lever a is arranged to permit of the hammer describing an eccentric or a circular path. For this purpose one end of the lever is slidably mounted in a bearing a^3 sliding on a box a^4 pivoted at $a^{4\times}$ to the frame G, the opposite end of such lever being slidably mounted in a bearing a^5 that is rotatably mounted upon the upper end of a shaft H from which the inner, intermediate and outer tubes D, E and F are driven. Rotatably mounted upon the inner tube D is a toothed wheel d formed on its under face with teeth d' for engagement with corresponding teeth formed on one end of a clutch member J that is slidably mounted upon keys j carried by the inner tube D. The wheel d is driven from the shaft H through the intervention of a toothed wheel d^2 that is rotatably mounted upon a pin d^3 secured to an arm d^4 that is pivotally mounted about the axis of the tube D. Gearing with the wheel d^2 is another toothed wheel d^5 Fig. 3 that is also rotatably mounted upon a pin d^6 fixed to the aforesaid arm d^4. The wheel d^5 is secured to a toothed wheel d^7 which gears with a toothed wheel d^8 that is keyed upon the shaft H, the wheels d^7, d^8 being retained in gear by a link d^9 Fig. 4, connecting the arm d^4 with the shaft H. This arrangement retains the various wheels in gear while the wheel d is moving toward or away from the shaft H. Fixed on the lower end of the inner tube D is a collar d^{10} having a number of radial holes d^{11} for the reception of a pin or key by means of which the position of the inner tube can be rotatably adjusted in relation to the clutch J.

The intermediate tube E is connected to the outer tube F by a screw $f^{\times}$ adapted to enter one or other of a number of radial holes e formed in the tube E for the purpose of enabling the latter to be secured in one or other of a number of predetermined positions in relation to the outer tube F. Projecting from the upper end of the intermediate tube E are teeth e' adapted to be engaged or disengaged with corresponding teeth formed on the adjacent end of the clutch member J. The latter is mounted in a ring $j^{\times}$ having oppositely projecting pins j' Fig. 4 which engage with slots j^2 formed in a bent lever j^3 that is pivoted at j^4 to the machine frame. This lever is actuated to operate the clutch by a handle j^5 mounted upon a stud j^6 which is fixed to the lever j^3 and projects through a slot g in the machine frame. The clutch member J is capable of being locked with the teeth d' or with the teeth e' or of occupying a neutral position between such teeth. This is conveniently effected by providing the handle j^5, with a pin j^7 which is caused to engage with suitably spaced holes in the frame G through the action of a spring j^8 situated within the aforesaid handle. The outer tube F Fig. 2 is rotatably mounted in a bushing g^2 carried by the frame G and is provided at its upper end with a toothed wheel f which gears directly with a toothed wheel f' keyed upon the shaft H and having the same number of teeth as the wheel f.

The gearing for rotating the tubes D and F is so arranged that such members rotate at relatively different speeds. For example the tube D may make ten revolutions per minute and the tube F sixty revolutions per minute, the intermediate tube E being employed in the combination shown solely for adjusting the size of the path described by the hammer. When the clutch J is in engagement with the teeth d' the tubes D and F respectively rotate at the above mentioned speeds and the hammer describes a spiral path which varies in size in accordance with the position of the tube E in relation to the tubes D and F. This is clearly illustrated in Figs. 6 to 8. In Fig. 6 the tube E is connected with the tube F in such a manner that the thickest portion e^2 of the tube F coincides with the thickest portion e^2 of the tube E. This adjustment of the tube E causes the hammer to describe the maximum size of spiral as shown in Fig. 9. In Fig. 7, the tube E has been adjusted so that its thickest portion e^2 occupies an angular position in relation to the thickest portion f^2 of the tube F. This adjustment of the tube E produces a spiral of medium size as shown in Fig. 10. In Fig. 8, the tube E has been adjusted so that its thickest portion e^2 coincides with the thinnest portion f^3 of the tube F with the result that a spiral of minimum size is produced as shown in Fig. 11. When the tube D is locked to the tubes E and F by causing the clutch member J to engage with the teeth e', the hammer describes a circular path as shown in Figs. 12 or 13, the size of this path being regulated by adjusting the position of the tube E in the manner above described. If desired another eccentric tube could be inserted between the holding portion A′ of the hammer and the inner tube D so as to provide for varying the pitch of the spiral, which could be effected by rotatably adjusting the position of the said additional tube in relation to its surrounding tubes.

The shaft H is driven and controlled in the following manner. A sleeve h Fig. 2 is slidably mounted upon such shaft and carries at its lower end a key h' which engages with a keyway h^2 formed in the shaft. Rigidly fixed to the upper end of the sleeve h is a clutch member h^3 having teeth h^4 on its lower face adapted to be put into engagement with teeth h^5 projecting from the upper end of a sleeve h^6 that is rotatably mounted upon the sleeve h and is supported in a bearing h^7 carried by the frame G. The teeth h^4 are normally retained out of engagement with the teeth h^5 on the sleeve h by a spring h^8 which exerts pressure against the lower end of the sleeve h and retains the latter in its upper position. This sleeve is actuated to bring the teeth h^4 into engagement with the teeth h^5 by a starting lever h^9 Fig. 14 fixed upon a shaft h^{10} that is pivoted in the frame G and carries a fork h^{11} in which is pivoted a ring h^{12}. The latter encircles a portion of the sleeve h between a flange h^{13} projecting therefrom and a collar h^{14} that is secured to the lower end of the sleeve. The shaft H in the example shown is rotated at sixty revolutions per minute by a bevel wheel h^{15} keyed upon the sleeve h^6 and gearing with a bevel wheel h^{16} fixed on a main driving shaft h^{17} on which are mounted a fast and loose pulley h^{18} and h^{19} respectively. When the machine is set in motion the clutch member h^3 is caused to engage with the driving sleeve h^6 while the shaft H makes six revolutions, during which time the cycle of operations performed by the machine has been completed, and in order to disengage the clutch member and driving sleeve at the completion of such movement, a toothed wheel h^{20} is rotatably mounted upon a bushing h^{21} fixed upon the shaft H. This toothed wheel is formed with a recess h^{22} which is normally engaged by a tooth h^{23} projecting from the clutch member h^3. In the example shown the toothed wheel h^{20} is rotated at seventy revolutions per minute. This is conveniently effected by a toothed wheel h^{24} that is rigidly fixed upon the shaft H and gears with a toothed wheel h^{25}. The latter is fixed to a toothed wheel h^{26} which gears with the toothed wheel h^{20} and is rotatably mounted upon a pin h^{27} carried by the machine frame G. As soon as the starting lever h^9 is actuated to put the machine in motion, the toothed wheel h^{20} rotates in advance of the shaft H and retains the clutch member h^3 in engagement with the sleeve h^6 as long as the upper surface of the projection h^{23} bears against the lower surface h^{28} of the wheel h^{20}. When the shaft H has made six revolutions the recess h^{22} comes directly over the projection h^{23} which is then forced into the recess by the spring h^8 with the result that the clutch member h^3 is automatically disengaged from the driving sleeve h^6 and the machine stopped.

The hammer A is supplied with air through a pipe a^6 leading from a valve casing a^7 Fig. 15 to which air is supplied from a suitable compressor through a pipe a^8 Fig. 16. Situated in the casing a^7 are two valves a^9 and b of which the valve a^9 controls the supply of air to the hammer through the pipe a^6 and the valve b the supply of air to a cylinder b' through a pipe b^2, Fig. 2. This cylinder contains a plunger b^3 to which is pivoted a support b^4 for the reception of a die anvil b^5 which is recessed at its upper end to hold the die B. Encircling the hammer A is a controlling shoe a^{12} formed with an aperture a^{13} adapted to act as a guide or support for the upper end of the die. The controlling shoe a^{12} is slidably mounted in a casing a^{14} that is bolted to the frame G, a retaining ring a^{15} securing the controlling shoe in place and permitting its removal from the casing when required. Interposed between the controlling shoe and the casing is a cushioning ring a^{16} which absorbs the rebound of the anvil produced by the effects of the hammering operation upon the compressed air in the anvil cylinder b'. The lower end of the controlling shoe a^{12} is advantageously formed with a projection a^{17} for an adjusting screw a^{18} which limits the movement of the anvil b^5 in one direction.

Projecting from the controlling shoe a^{12} is a finger a^{19} Fig. 15, which supports the lower end of a spring controlled rod a^{20} that is slidably mounted in the frame G.

Hinged to the upper end of this rod is a lever a^{21} Fig. 17, pivoted at a^{22} in a guide a^{23} Fig. 3, carried by the frame G. This lever is formed with a pair of surfaces a^{24} and a^{25} adapted to constitute a fulcrum for a floating lever a^{27} hereinafter referred to as the hammer valve lever, and also with a lifting surface a^{26} for a purpose hereinafter described. The hammer valve lever a^{27} is provided at one end with a roller a^{28} which rests upon a cam a^{29} that is secured to the toothed wheel d Figs. 2 and 3. The other end of the lever terminates in a T head a^{30} which is slidably mounted in a guide a^{31} carried by the frame G. This end of the lever is supported by the stem of the hammer operating valve a^{9} and such valve is normally retained in its closed condition by a spring a^{32}. The stem of the anvil valve b is connected to a rod b^{6} which tends to retain such valve in its closed position through the intervention of a spring b^{7}. This rod is connected by a chain b^{8} to a hand control lever b^{9} that is pivoted upon a shaft b^{10}. This lever is provided with a spring controlled handle b^{11} adapted to be engaged either by hand or automatically with an arm b^{12} that is keyed upon a rotatably mounted shaft b^{13}. Another arm b^{14} is slidably keyed upon such shaft and when in use is placed in alinement with a pin b^{15} projecting from the anvil b^{5}.

When the machine is in its inoperative condition the anvil b^{5} may be caused to occupy a suitably inclined position for enabling a die to be readily inserted into the recessed portion of the anvil. The controlling shoe a^{12} occupies its lower position with the result that the spring controlled rod a^{20} retains the surfaces a^{24} and a^{25} on the lever a^{21} out of engagement with the hammer valve lever a^{27}, and the spring a^{32} retains the hammer valve a^{9} in its closed condition. The anvil valve b is also retained in its closed condition by reason of the fact that the pin b^{15} on the anvil b^{5} occupies a position away from the arm b^{14} thereby allowing the spring b^{7} to lift the rod b^{6} and anvil valve b. When a die has been placed upon the anvil, the latter is turned to the vertical position shown in Fig. 2. During the completion of this movement the pin b^{15} comes into contact with the arm b^{14} and operates the lever b^{9} to lower the anvil valve b through the chain b^{8} and rod b^{6} to the open position shown in Figs. 15 and 16, whereupon air passes to the cylinder b' and lifts the anvil b^{5} thereby causing the die B to be gripped tightly between the anvil and the controlling shoe a^{12} after it has raised the latter to its top position. This movement of the controlling shoe a^{12} lifts the rod a^{20}, through the finger a^{19}, and causes the operating surfaces a^{24} a^{25} of the lever a^{21} to embrace the hammer valve lever a^{27} and to act as a fulcrum therefor. As soon as the anvil valve b is opened a supply of air passes from the chamber a^{7} through a pipe a^{33} Fig. 2 to an annular chamber a^{34} extending around the hammer A and retains the latter in its uppermost position until the machine is set in operation. This is effected by depressing the starting lever handle h^{9} so as to bring the teeth h^{4} on the clutch member h^{3} into engagement with the teeth h^{5} on the sleeve h^{6} with the result that the shaft H is driven and imparts a rotary movement to the sleeves D, E and F through the gearing already described thereby causing the hammer to describe a spiral path presuming that the clutch member J is locked to the wheel d, the size of such spiral path being previously determined by adjusting the position of the sleeve E in relation to the inner and outer sleeves D and F in the manner already described. It will be seen with reference to Fig. 3, that after the machine has completed one cycle of operations the lifting portion of the cam a^{29} comes into close proximity to the roller a^{28} on the hammer valve lever a^{27} with the result that the hammering operation is commenced as soon as the machine is again set in action, and is continued until the hammer has described any of the paths indicated in Figs. 8, 9 and 10. Each of these paths is completed when the tubes E and F have made three and a half revolutions, the remaining two and a half revolutions causing the hammer to describe a spiral path in the opposite direction during which time the hammering operation is preferably discontinued by so arranging the cam a^{29} that its recessed or lower surface comes underneath the roller a^{28} on the hammer valve lever a^{27} and allows the hammer valve to close. After the tubes E and F have made six revolutions the cycle of operations is completed, the hammer has returned to the position at which it commences the hammering operation and the aforesaid projection h^{23} on the clutch member h^{3} has entered the recess h^{22} in the toothed wheel h^{20} thereby disconnecting the aforesaid clutch member with the sleeve h^{6} and so stopping the machine.

In order to render the machine applicable to hammering between the rows of eyes of a die plate such as C, Fig. 18 after the same has been hammered around its eyes, an oscillatory anvil c is substituted for the anvil upon which the plate was supported during the last mentioned hammering operation and the arm b^{14} is moved along the shaft b^{13} so as to clear the anvil c during its oscillations. The upper surface of the anvil c constitutes an arc of a circle that is described from the pivot of the anvil holder b^{4} and projecting from such surface are a number of studs c'

adapted to engage with the die openings on the underside of the die plate. The latter is supported between the aforesaid anvil and a guide c^2 which is substituted for the controlling shoe which was employed during the hammering of the spiral paths around the eyes of the die plate, the said controlling shoe acting in a similar manner to the aforesaid controlling shoe a^{12}. When the controlling shoe is removed, the rod a^{14}, Fig. 15, is no longer supported by the pin a^{19} and the spring that encircles such rod returns the latter to its lowest position thereby bringing the lifting surface a^{26} on the lever a^{21} directly under the hammer valve lever a^{27} with the result that its roller a^{28} is lifted out of engagement with the cam a^{29} which can therefore revolve without imparting any motion to such lever. To limit the upward movement of the plunger b^3 in order to prevent the die plate being gripped between the anvil and the guide c^2 when air is admitted to the cylinder b', the plunger b^3 is formed with a projection c^3 adapted to engage with an adjustable stop c^4. The anvil c is connected by a link c^5 to a slotted lever c^6 which is pivoted at c^7 to the machine frame and engages at its lower end with a cam groove c^8 formed in a drum c^9. This drum is rotatably mounted upon two sleeves c^{10} c^{11} which interlock with each other at their inner ends and are rotatably mounted upon a fixed shaft c^{12}. Rigidly secured to the sleeve c^{10} is a toothed wheel c^{13} which gears with a toothed wheel c^{14} formed on a sleeve c^{15} which is rotatably mounted upon a shaft c^{16}. Rigidly fixed upon the sleeve c^{15} is a belt pulley c^{17} connected by a belt c^{18} to a belt pulley c^{19} that is rigidly secured upon the main driving shaft h^{17}. The sleeve c^{11} terminates at its outer end in a toothed wheel c^{20} which gears with a toothed wheel c^{21} that is keyed or otherwise fixed upon a toothed wheel c^{22} which is rotatably mounted upon the shaft c^{16} and gears with teeth c^{23} formed on one end of the drum c^9. In the arrangement shown the gearing is so proportioned that the drum makes six revolutions per minute but obviously it can be driven at any other appropriate speed. As the die plate C is hammered while in a hot condition and is inconveniently large and heavy to manipulate with one hand, the hammer and anvil valves a^9 and b are provided with a treadle control. For this purpose the hammer valve lever a^{27} is connected by a chain c^{24} with a foot lever c^{25} and the rod b^6 which is fixed to the stem of the anvil valve b is connected by a chain c^{26} with a foot lever c^{27}. Both of these levers are normally retained in their upper positions by springs such as c^{28}.

c^{29} represents a gravity controlled catch arranged to retain the anvil valve foot lever c^{27} in a position for holding the anvil valve open until the hammer valve foot lever c^{25} is depressed. When this takes place the said lever bears against an inclined portion c^{30} of the catch and withdraws the latter from the anvil valve foot lever which is then returned to its normal or top position by the spring c^{28}.

In effecting the hammering operation between the rows of eyes in the die plate the hammer is preferably caused to describe a circular path by moving the above mentioned handle j^5 to lock the teeth on the clutch member J with the teeth e' on the sleeve E so as to cause the sleeves D, E and F, to revolve together. The anvil valve foot lever c^{27} is then depressed to admit air to the cylinder b' which raises the anvil until the projection c^3 on the plunger b^3 engages with the stop c^4. The die plate C is then placed upon the anvil in such a manner that the end aperture in the first row of eyes engages with the first projection c'. The machine is now set in motion by depressing the starting lever handle h^9, and the hammer valve foot lever is depressed whereupon the hammer commences to deliver a series of blows in a circular path and as the anvil and die plate are slowly traversed past the hammer the said blows are delivered upon the die plate in a series of curved lines corresponding approximately to those indicated in Fig. 20. After the die plate has been traversed past the hammer in one direction, it is shifted to bring the end aperture of the succeeding row of eyes into engagement with the last projection $c^{\times}$ on the anvil C, so that on the return movement of the latter the blows are delivered between the first and second rows of eyes. This shifting of the die plate is performed at the end of each traverse until the plate has been traversed to and fro across the hammer six times whereupon the hammering operation is completed and the machine automatically comes to a standstill by reason of the aforesaid projection h^{23} entering the recess h^{22} in the toothed wheel h^{20}, the hammer being put out of operation by the attendant allowing the hammer valve foot lever to return to its normal or top position.

What I claim and desire to secure by Letters Patent of the United States is:—

1. In a hammering machine, a hammer, a holding portion therefor, eccentric tubes surrounding the holding portion and controlling the position of the hammer, a support for the holding portion, a slidably mounted bearing in which one end of the support is slidably mounted, and a rotatably mounted bearing in which the other end of the support is slidably mounted.

2. In a die hammering machine, a hammer, a die support, means for automatically moving the hammer in a curved path in relation to the die support, and means for

moving the die support across the path of the hammer.

3. In a die hammering machine, a hammer, eccentric carrying means therefor, a die support, a support for the hammer, and rotatably mounted bearings in which the ends of the hammer support are slidably mounted.

4. In a die hammering machine, a hammer, a plurality of eccentric tubes surrounding the hammer and controlling its position, and means for imparting a rotary motion to the tubes.

5. In a die hammering machine, a hammer, a plurality of eccentric tubes surrounding the hammer and controlling its position, and means for causing the tubes to rotate at different relative speeds.

6. In a die hammering machine, a hammer, a plurality of eccentric tubes surrounding the hammer and controlling its position, and means for causing the tubes to rotate at the same speed.

7. In a die hammering machine an eccentric rotatable hammer carrier, a fluid pressure hammer carried thereby, a die support, a hammer support, bearings in which the hammer support is slidably mounted, means for rotating the hammer carrier, means for raising the die support, and means for moving the die support across the path of the hammer.

8. In a die hammering machine, a fluid pressure hammer, a rotatable eccentric carrier therefor, a die support, a fluid pressure cylinder in which the die support is mounted, means for rotating the hammer carrier, and means for moving the die support across the path of the hammer.

9. In a die hammering machine, a fluid pressure hammer, a die support, a fluid pressure cylinder carrying the die support, means whereby the supply of pressure fluid to the die support is controlled by the act of bringing the die support approximately into line with the hammer and means for moving the latter in a curved path in relation to the die support.

10. In a die hammering machine, a fluid pressure hammer, a die support, a fluid pressure cylinder carrying the die support, means for preventing the hammer from being operated until a die is inserted between the die support and the hammer, and means for moving the hammer in a curved path in relation to the die support.

11. In a die hammering machine, a fluid pressure hammer, a die support, a fluid pressure cylinder carrying the die support, a controlling shoe capable of movement toward and away from the die support and means connected with the latter and the controlling shoe for causing the die to be secured in position between such parts by the pressure fluid which holds the die support in its working position.

12. In a die hammering machine, a fluid pressure hammer, a die support, means for moving the hammer in a curved path in relation to the die support, and means for automatically stopping the machine when the hammer has completed its predetermined movement.

13. In a die hammering machine, a fluid pressure hammer, a die support, means for automatically moving the hammer around and toward the axis of the die support, a valve for controlling the supply of fluid pressure to the hammer and means for automatically opening and closing the valve.

14. In a die hammering machine, an eccentric hammer carrier, a hammer holder carried thereby, means for rotating the hammer holder carrier, a cap carried by the holder, a hammer slidable in the cap, and fluid pressure means for controlling the operations of the hammer.

15. In a die hammering machine, a hammer carrier comprising inner, outer, and intermediate eccentric tubes, a hammer carried thereby, and means for rotating the inner and outer tubes at different speeds to cause the hammer to travel in a spiral path.

16. In a die hammering machine, a hammer, a hammer carrier comprising inner and outer eccentric tubes and an intermediate eccentric tube for relatively adjusting the outer and inner tubes, and means for rotating the inner and outer tubes at different speeds to cause the hammer to travel in a spiral path.

In testimony whereof I affix my signature in presence of two witnesses.

NICHOLAS KING TURNBULL.

Witnesses:

NORMAN H. SHEARD,

JAS. STEWART BROADFOOT.