C. C. DODGE.

MACHINE FOR TWISTING CRANK SHAFTS.

APPLICATION FILED FEB. 12, 1914.

1,105,188.

Patented July 28, 1914.

4 SHEETS—SHEET 1.

Fig. 1.

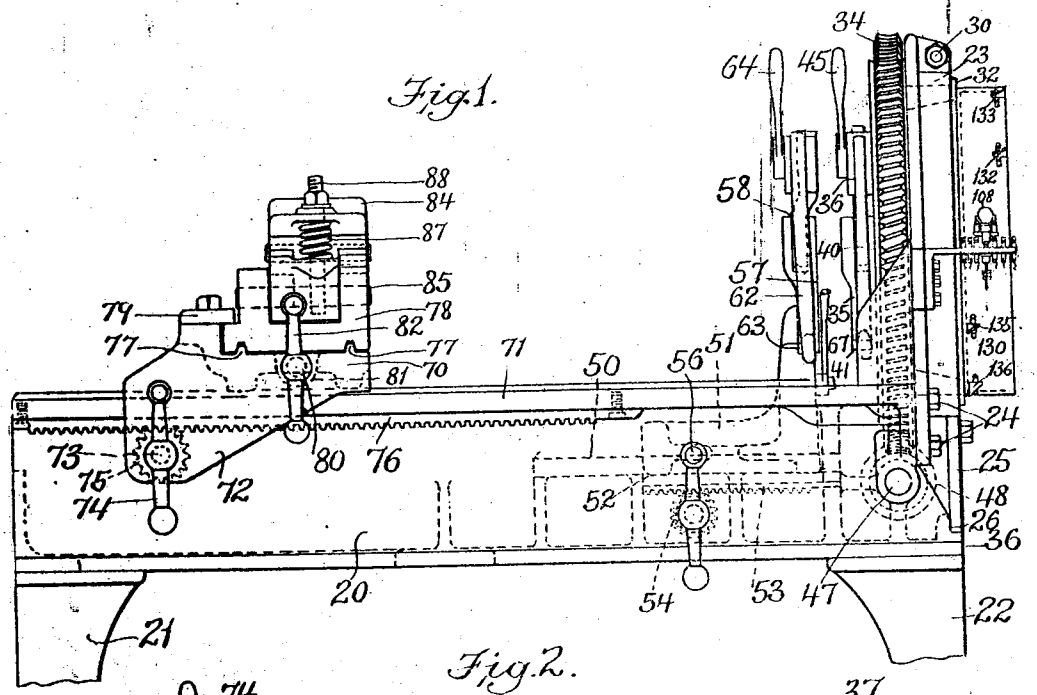
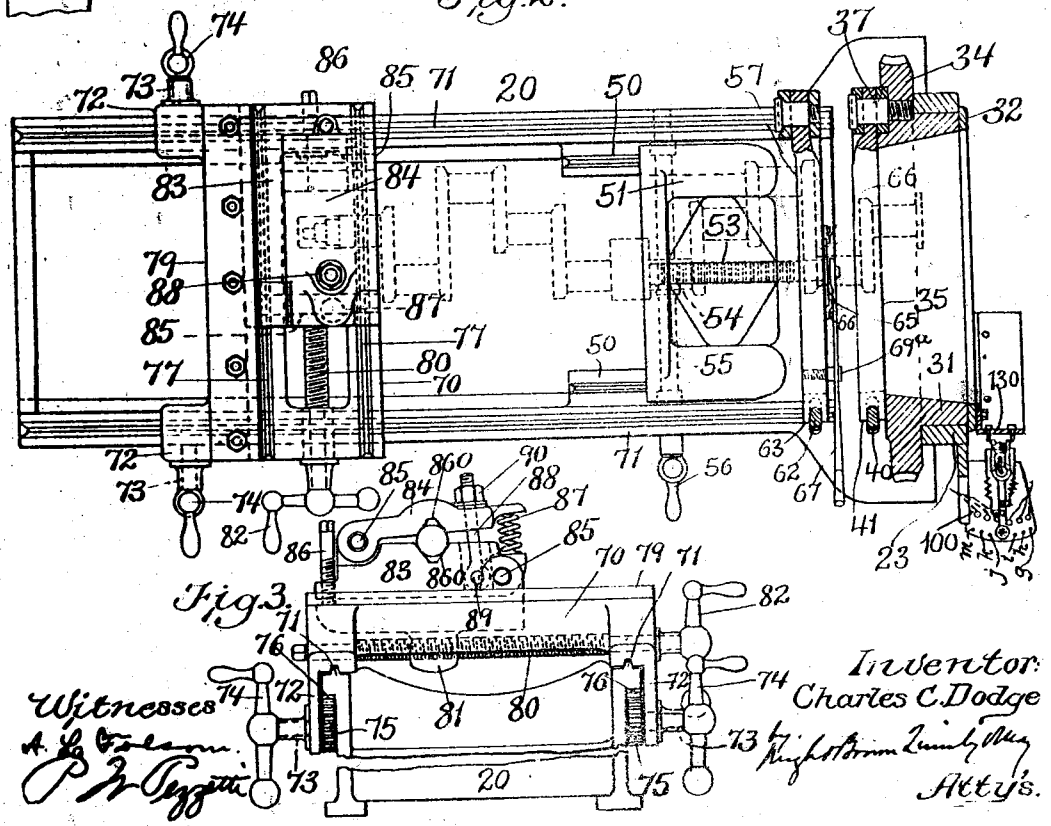


Fig. 2.



Witnesses

A. L. Coleman.

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4 SHEETS—SHEET 2.

Fig. 8.

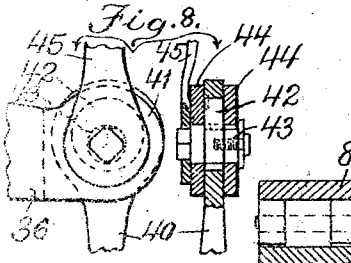


Fig. 4.

Fig. 6.

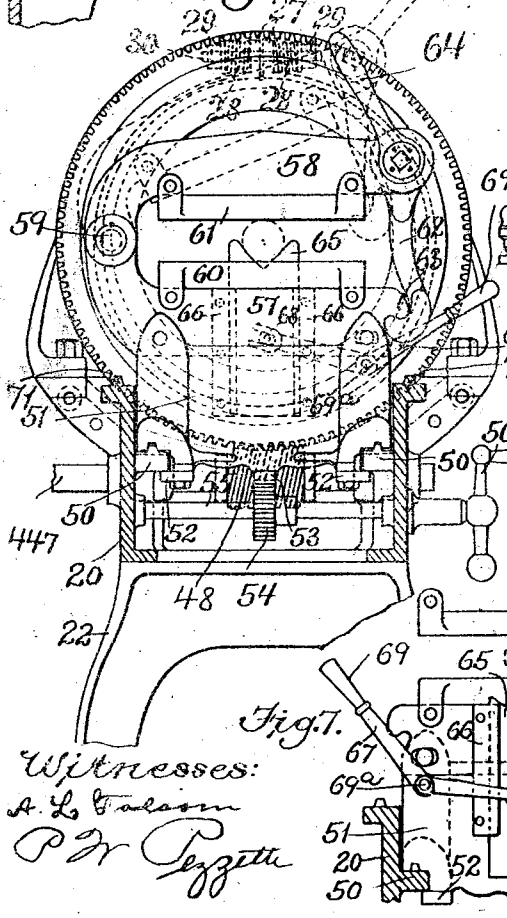


Fig. 5.

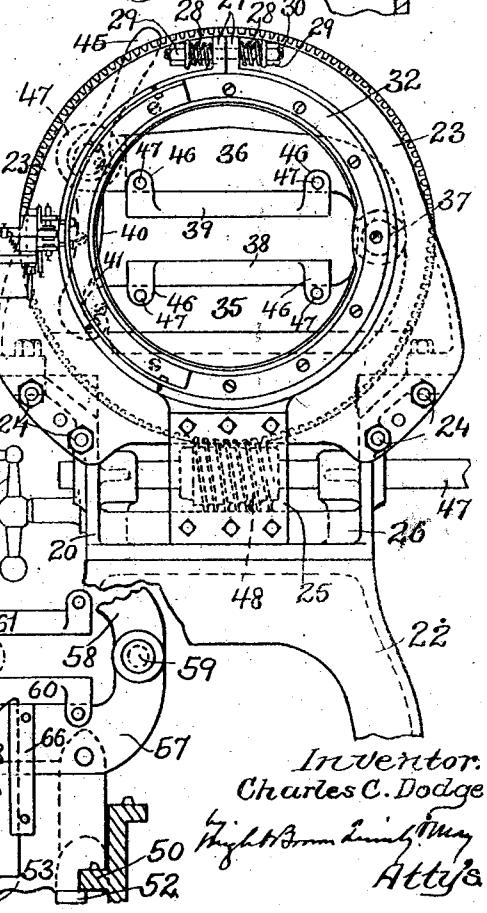
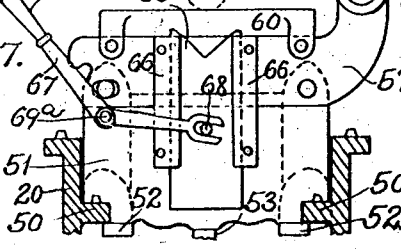


Fig. 7.



Witnesses:

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4 SHEETS—SHEET 3.

Fig. 9.

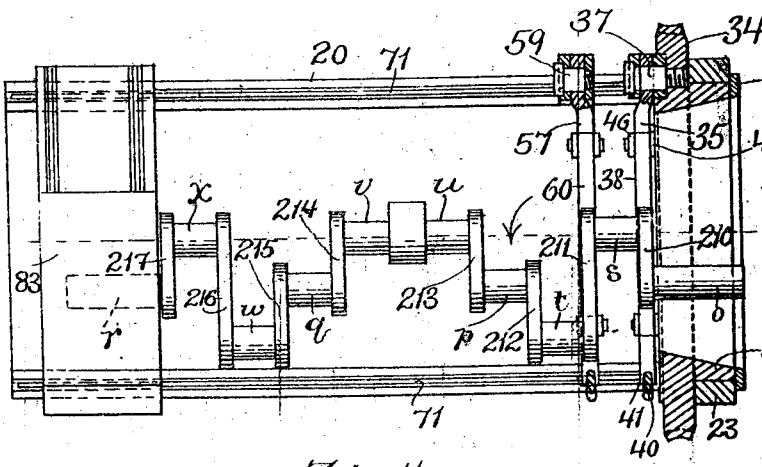


Fig. 10.

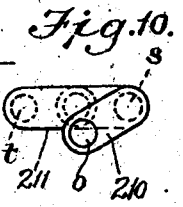


Fig. 11.

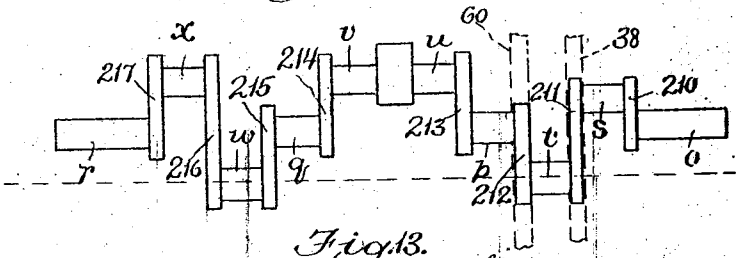


Fig. 12.

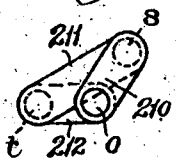


Fig. 13.

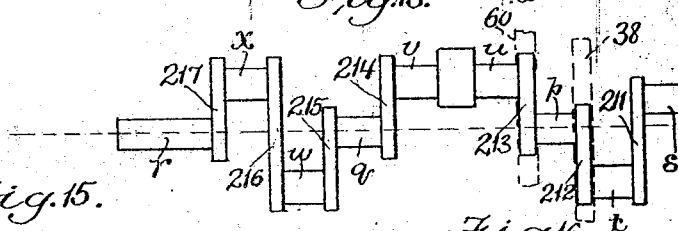


Fig. 14.

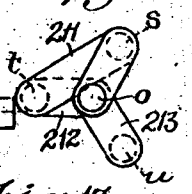


Fig. 15.

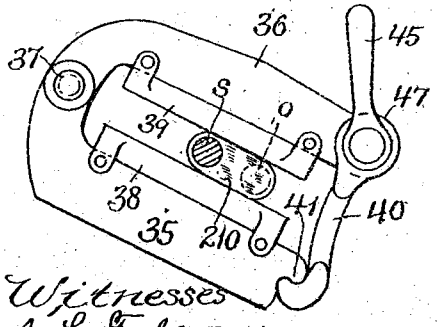


Fig. 16.

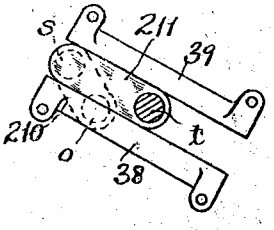
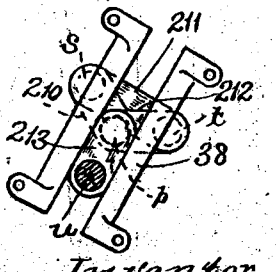


Fig. 17.



Witnesses
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4 SHEETS—SHEET 4.

Fig. 18.

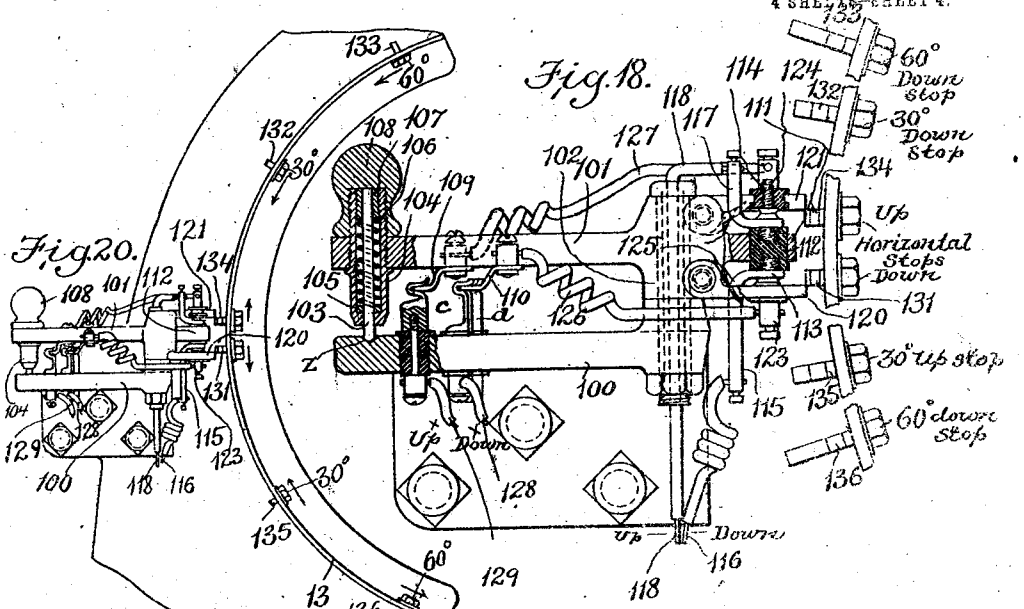


Fig. 20.

Fig. 21.

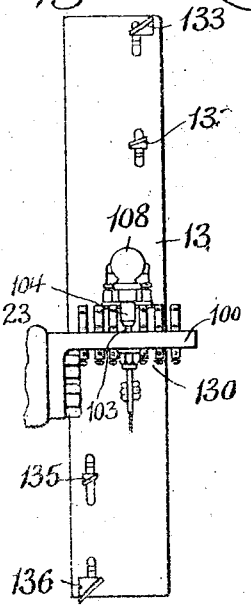
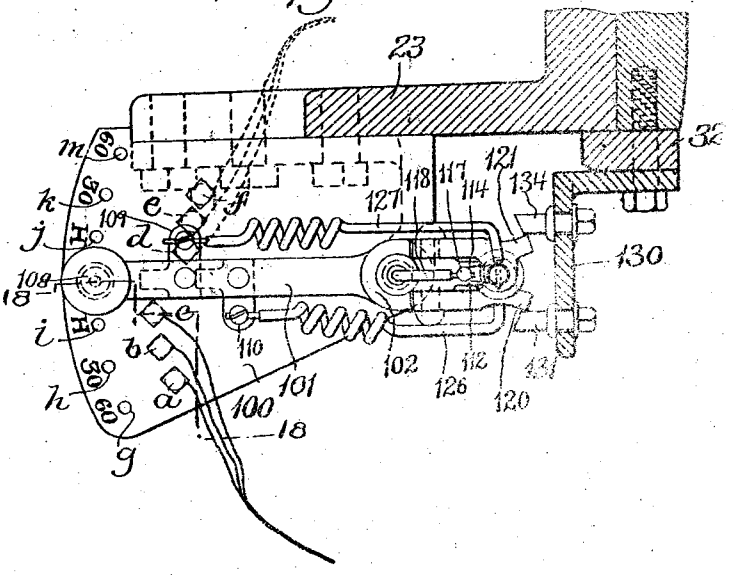


Fig. 19.



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UNITED STATES PATENT OFFICE.

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MACHINE FOR TWISTING CRANK-SHAFTS.

1,105,188. Specification of Letters Patent. Patented July 28, 1914.

Application filed February 12, 1914. Serial No. 818,424.

To all whom it may concern:

Be it known that I, CHARLES C. DODGE, a citizen of the United States, and a resident of Worcester, in the county of Worcester and State of Massachusetts, have invented certain new and useful Improvements in Machines for Twisting Crank-Shafts, of which the following is a specification.

Crank shafts for three-cylinder and six-cylinder motors are usually forged with the pins and bearings in a single plane and the forging must thereafter be twisted in order to locate the pins at the proper angles to each other.

The object of the present invention is to provide a machine by which the forging after a single heating, may be properly twisted and the pins accurately located according to the design of the shaft.

The invention is capable of a variety of embodiments, but I have illustrated upon the drawings and shall hereinafter describe the best embodiment of the invention now known to me.

Referring to the said drawings,—Figure 1 represents in side elevation a crank-shaft-twisting machine embodying the invention. Fig. 2 represents a plan view of the same, partially in section. Fig. 3 represents a view of the tail end of the machine. Fig. 4 represents a longitudinal section through the machine. Fig. 5 represents a section on the line 5—5 of Fig. 4. Fig. 6 represents a similar section on the line 6—6 of Fig. 4. Fig. 7 represents a face elevation of the holding vise, and shows the device for centering the shaft. Fig. 8 shows in side elevation and in section one of the vise locks. Figs. 9, 10, 11, 12, 13 and 14 illustrate successive steps in twisting the shaft to locate the crank pins at the proper angles, Figs. 10, 12 and 14 being end views of the shaft as shown in Figs. 9, 11 and 13. Figs. 15, 16 and 17 show the position of the clamps of the twisting vise after the latter has twisted various portions of the crank shaft. Figs. 18 to 21, inclusive, show the controlling mechanism for the motor, Fig. 18 being a side elevation partially in section on the line 18—18 of Fig. 19.

The machine, which illustrates one embodiment of the invention, comprises, generally speaking, a rotatable twisting vise, a relatively stationary vise for holding that portion of the forging which is to be twisted in alinement with the axis of the twisting vise, and a tail clamp or vise for holding the main body of the forging. These parts are all supported upon a suitable bed, mechanism being provided for moving the holding vise longitudinally of the machine toward and from the twisting vise. The tail vise is movable longitudinally of the machine and laterally thereof, it being necessary not only to advance the forging longitudinally of the machine, but also to move it laterally to position the part to be twisted in the axis of the twisting vise. These relative movements could easily be secured by moving any of the three elements to which I have referred, but, for the sake of convenience of construction and design, it is preferable that the twisting vise be mounted in fixed bearings, in which event the holding vise should likewise be held against transverse movement, but should be capable of movement toward and from the twisting vise. For the same reason, therefore, it is desirable that the tail vise should be capable of both lateral and longitudinal movement, as stated. I provide mechanism for rotating the twisting vise by power and for stopping the movement thereof at predetermined points in its rotation. For instance, it is desirable to twist some portions of the forging through an arc of 30°, and others through an arc of 60° in twisting a six-crank shaft. While the holding vise and tail vise may be moved by power transmitted from a suitable power mechanism, yet this is not essential and the machine, as shown, is provided with means by which these elements may be moved from manually-driven shafts.

The bed of the machine is indicated at 20 and is of the box type, being shown as supported at its ends by pedestals or standards 21, 22. At the head of the bed there is affixed a split bearing 23, (the split permitting expansion of the bearing). This bearing has a relatively large internal diameter, and it is shown as secured by bolts 24 to the end of the bed. As a detail of construction, it may be noted that the central lower portion of the bearing is bolted to a plate 25 which in turn is bolted to a transverse rib 26 extending across the bottom of the bed. The bearing, as stated, is split, and the adjacent lugs 27 are held together by powerful springs 28 which are located between the lugs 27 and nuts 29 on a threaded pin 30 passing through the lugs. Journaled in the bearing is what may be termed the twisting head or vise, which comprises an annular

carrier 31. At its outer end, the carrier is provided with a gib 32 which takes over the outer face of the bearing 23, and with a peripheral flange 34 which bears against the inner face of the bearing 23, so that the carrier 31 is held against axial movement. The flange is provided with worm teeth so as to constitute a worm wheel by movement of which the ring may be rotated about its axis. Preferably the axis of the bearing is in a vertical longitudinal central plane of the bed, and in a horizontal plane some distance above the bed, as shown in Fig. 4. To the inner face of the carrier are secured two clamping-jaws, of which one is movable relatively to the other. The stationary jaw is indicated at 35, and the movable jaw at 36, the latter being pivoted at one end to the stationary jaw by a screw pin or pivot 37 (see Fig. 2). The said jaws, when in operative position, are substantially in parallelism, and they are provided with removable face blocks or shoes 38, 39 for engagement with the cheeks or cranks of the forging. For the purpose of closing the jaws and locking them in closed position, a hooked latch 40 is provided. The hooked portion of the latch is adapted to take under a keeper 41 at the corresponding end of the jaw 35. Said latch is mounted upon an eccentric 42 keyed to a stud shaft 43 journaled in ears 44 formed on the end of the movable jaw 36, as shown in Fig. 8. Secured to the shaft 43 there is a handle 45, so that, after the hook 40 has been engaged with the keeper 41, the shaft 43 may be rotated by the handle 45 to exert great power in bringing the two jaws into clamping engagement with the cheeks of the forging. By imparting a half revolution to the shaft 43, so as to bring the major axis of the eccentric 42 in line with the hook 40, the jaws will be locked in their clamping or operative positions. Upon swinging the handle 45 to the left in Fig. 5, the hook will be released from the keeper and the hook may be swung manually away from the keeper so as to permit the movable jaw 36 to be swung upwardly by hand out of engagement with the work. By providing interchangeable face blocks or shoes 38 and 39 of different thicknesses, it is possible to accommodate the machine for forgings of different sizes. Each face block or shoe is provided at its ends with lugs 46 which straddle the jaw and through which lugs removable pins 47 are passed, as shown in Figs. 4 and 5. The twisting vise, which has thus been described in detail, is rotated by a transverse power shaft 447, preferably driven in opposite directions by an individual electric motor. I have not deemed it necessary to show this motor, and any one of the various forms of motors now on the market may be utilized for the purpose. The shaft 447 extends transversely of the bed and is mounted in bearings afforded by side walls of the bed at the head end thereof. There is a worm wheel 48 keyed to the said shaft and engaging the worm teeth formed on the vise for rotating the latter. I will subsequently describe the mechanism by which the rotation of the vise may be started and then stopped automatically, after it has been rotated a predetermined number of degrees.

The holding vise is, as previously stated, arranged to slide longitudinally of the bed. To this end, there are formed on the side walls of the bed internal guideways or shears 50, as shown in Fig. 6, upon which is mounted a sliding carriage 51 which sets within the bed. It will be noted as a detail of construction that the carriage is provided with gibs 52 which take under undercut portions of the guideways or shears 50. To the under side of the carriage is secured a longitudinal rack 53 with which is engaged a pinion 54 on a transverse shaft 55 journaled in the side walls of the bed below the carriage and having upon its projecting end a crank handle 56 by which it may be rotated to advance or withdraw the carriage, as may be. Mounted upon the carriage are clamping-jaws 57, 58, the end of the latter being pivoted to the end of the former by a pivot pin 59. The stationary-jaw 57 is secured to the carriage by pins, of which one may slide in a slot as the jaw expands or contracts. To the opposing faces of the clamps 57, 58 are secured interchangeable face blocks or shoes 60, similar to those secured to the jaws of the twisting vise. The means for locking the two ends of the jaws together is the same as that utilized for locking the jaws of the twisting vise and comprises the hook 62 adapted to take under a keeper 63 on the stationary jaw, said hook being journaled upon an eccentric which is rotated by a handle 64. When the jaws of the holding vise and the twisting vise are in horizontal position, the faces of the blocks 39 and 61, and 38 and 60 are substantially in alinement, or are in the same horizontal plane respectively.

It is necessary that that portion of the crank-shaft which is to be twisted should be accurately centered with respect to the axis of the twisting vise, and to this end I provide the holding vise with a centering mechanism. This comprises a notched slide 65 adapted to slide in guideways 66 formed on or secured to the front face of the carriage 51. Normally the weight of the slide causes it to drop into an inactive position. For the purpose of moving it into position to center the work, I provide a two-armed lever 67, the inner end of which is forked to engage a pin 68 projecting from the slide and the outer end of which is formed with a handle 69 which may be grasped and manipulated by the operator. The lever is piv-

oted upon a pin 69ª projecting from the face of the carriage.

The tail vise, as I have already stated, may be fed longitudinally of the bed and also transversely thereof. This vise comprises a carriage 70 which is adapted to slide longitudinally of the bed upon ways or shears 71 formed on the upper edges of the side walls of the bed. Said carriage has aprons 72 which project downwardly and overlap the outer faces of the said side walls. Journaled in the aprons are two shafts 73, 73, each of which is provided with a crank handle 74 by which it may be rotated. On each shaft there is a pinion 75 located behind the apron, and intermeshing with a rack 76 secured under the undercut portion of the way or shear 71. By revolving either of the crank handles 74, the carriage may be fed longitudinally of the bed. It will be observed, by an inspection of Fig. 1, that the apron 72 projects rearwardly from the carriage and that the shaft 73 is journaled in a vertical plane in the rear of the main body of the carriage. This is to counterbalance pressure exerted on the tail vise by the work, when the latter is supported wholly by the tail vise. The upper portion of the carriage is provided with transverse guides 77 to receive a cross slide 78, the latter being held in place by a gib 79. This cross slide is moved transversely of the bed by a screw shaft 80 journaled in the carriage 70 and engaging a nut 81 formed on or secured to the underside of the cross slide. On the projecting end of the screw bar there is a crank handle 82 by which it may be rotated. Upon the cross slide are mounted the clamping jaws 83, 84. One end of the jaw 83 is pivoted to the slide by a pin 85 so that the other end may be swung freely upward, and also adjusted by a screw 86, said adjusting screw passing through a threaded aperture in the jaw 81 and engaging the upper surface of the cross slide. The movable jaw 84 is pivoted to the jaw 83 by the pin 85; and the confronting faces of the jaws are provided with V-shaped notches 860, 860 to receive the work. The jaws are normally thrust apart by a compression spring 87 placed between the free end of the jaw 84 and the pivoted end of the jaw 85, but said jaws are forced together by any suitable clamping mechanism, such as a screw pin 88 pivoted at 89 to the lower jaw and passing through a slot in the jaw 84. A nut 90, on the threaded portion of the screw pin, above the upper jaw, may be rotated to force the movable jaw 84 toward the jaw 83 so as to clamp the work between them.

I have heretofore referred to the fact that mechanism is provided for automatically stopping the rotation of the twisting vise after the latter has been rotated through a predetermined number of degrees. Any suitable knock-off mechanism for accomplishing this may obviously be used. Inasmuch, however, as I have indicated that it may be desirable to drive the twisting vise by an electric motor, I have illustrated means for closing the circuit and for interrupting the circuit through the motor when the twisting vise has reached the desired limit of its rotation, in one direction or the other. This mechanism comprises a switch or controller, by which the circuits for supplying current to the motor are so regulated or controlled that the twisting vise will be driven in the proper direction, and electric circuit breakers movable with the switch into the path of movement of any one of a series of cam stops revolving in unison with the twisting vise, whereby the circuit will be broken when the said vise has been rotated through the desired arc. Secured to the bearing 23, there is a bracket 100 to which is pivoted a controller or switch lever 101 by means of an upright hollow screw or sleeve 102. The bracket 100 is shown in Fig. 9 as sector-shaped in plan view, and it is provided with two series of switch contacts, these several contacts being indicated at *a*, *b*, *c*, and *d*, *e*, *f*. Corresponding to the contacts, there are apertures *g*, *h*, *i*, *z*, *j*, *k* and *m* formed in the plate to receive a spring-tensioned pin 103 carried by the end of the switch-lever 101, and hold said lever in any one of a plurality of positions. Although the details may be greatly varied, I will describe the means which I have illustrated for mounting the pin.

Passed upwardly through the switch lever, there is a socket piece 104, through the lower end of which the pin 103 passes. A collar 105 is secured to the pin, against which bears a spring 106 arranged in the socket piece, its upper end abutting against a sleeve 107 screwed into the upper end of the socket piece 104. A handle 108 of wood or other insulating material is screwed upon the projecting end of the socket piece to furnish means by which the switch lever may be swung about its axis or pivot. It will be noted in Fig. 19 that the switch contacts *a*, *b*, and *c* are more remote radially from the pivot 102 for the switch arm than the contacts *d*, *e* and *f*. Secured to the under side of the switch arm, there are contact members 109, 110, the former for making electrical contact successively with the stationary contacts *a*, *b* and *c*, and the latter for making like contacts successively with the contacts *d*, *e* and *f*. When the switch arm 101 is in its neutral position with the pin in the hole *z*, as shown in Fig. 19, the motor is deprived of current for its operation and is at rest. The lever 101 has a short arm 111 projecting from the pivot pin in the opposite direction, and on the

free end of this arm and in an insulation block 112 secured therein are two stationary contacts 113, 114 which project upwardly and downwardly from the block as shown. The contact 113 has an extension 115 to which is secured a conductor 116 leading to one side of the motor, and to the contact 114 there is an extension 117 to which a conductor 118 is connected, the last-mentioned conductor passing upwardly through the hollow pivot or sleeve 102.

Pivoted to the hub or the lever 101 are two parallel circuit breakers or levers 120, 121, which carry contacts 123, 124, respectively, for engagement with the relatively stationary contacts 113, 114, the contact on each lever being held in engagemnet with its corresponding contact by a spring 125. The contact 123 is flexibly connected by a conductor 126 with the contact member 110, whereas the contact 124 is connected by a similar conductor 127 with the contact member 109. The two pairs of contacts 114 and 124, and 113 and 123, may be respectively opened or separated to break the circuit through the motor and thus cause the immediate stopping of the same.

Connected to the contacts *d*, *e* and *f* is a conductor 128, which, with the conductor 116, supplies current to the motor to cause the rotation of the armature thereof and drive the twisting vise in a clockwise direction. A like conductor 129 is connected to the three contacts *a*, *b* and *c* so that through this conductor and the conductor 118 a rotation of the armature of the motor is such as to rotate the twisting vise anti-clockwise. Now it will be seen that, by swinging the handle or switch lever 101 in one direction or the other, current may be supplied to the motor to drive the twisting vise in the corresponding direction. When the switch handle is in its neutral position, no current is supplied to the motor, since the two contacts 109, 110 are disengaged from their corresponding contacts *a*, *b*, *c*, and *d*, *e*, *f*, and the motor will remain at rest until the current is closed. But when either contact 109 or 110 is in engagement with any one of its complemental contacts, current will be supplied to the motor and the latter will continue to rotate the twisting vise. It is for this reason that I provide the switch lever with the circuit breakers 120, 121, and the contacts mounted thereon. To operate the circuit-breakers, I provide a plurality of adjustable knock-off cam stops, and into the path of which the breakers are movable, which is movable with the twisting vise. To this end, I secure to the gib 32 a segmental carrier 130 which extends through an arc of a little more than 120°. To the convex side or to the periphery of this carrier, I attach two series of staggered stops, one series for each of the circuit breakers 120, 121, as shown in Figs. 20 and 21. The stops which are employed for coaction with the breaker arm 120, when the twisting vise is moving anti-clockwise, (looking at the head end of the mechanism), are indicated at 131, 132 and 133, while those which cooperate with the circuit-breaker 121 are indicated at 134, 135 and 136. The two stops 131 and 134 operate their corresponding breaker arms so as to stop the rotation of the twisting vise when the jaws thereof are in exactly horizontal position, as shown in Fig. 5. The stops 132 and 135 break the circuits when the jaws have reached an angle of exactly 30° to the horizontal, whereas the stops 133 and 136 stop the rotation of the twisting vise when the jaws thereof are at an angle of 60° to the horizontal, all according to the direction of rotation of the twisting vise. The said stops 131 to 136 are arranged in staggered position upon the carrier 130, as stated, and as shown in Fig. 21, so that when the twisting head is moving clockwise, the stops 134, 135 and 136 will move into engagement with or pass the arm 121 according to the position in which the switch lever may be located. When the switch lever is moved from its neutral position so that the pin 103 is in the socket *j* and the contact 110 is engaged with the contact *d*, the end of the circuit-breaker 120 will be set into position to be engaged by the stop 131 so as to break the circuit through the motor and stop the vise in a horizontal position. By moving the switch lever 101 into engagement with the contacts *e* and *f*, the circuit-breaker 120 will be brought successively into paths of the stops 132 and 133. Conversely, the switch arm 101 may be brought to close the circuit through the contacts *c*, *b* or *a*, and the circuit-breaker 121 be set in the paths of either the stops 134, 135 and 136, as the case may be, so as to stop the rotation of the twisting vise with the jaws, either in a horizontal position at an angle of 30° or at an angle of 60° to the horizontal. From the foregoing, it will be readily seen, therefore, that by setting the switch lever the motor may be operated to drive the twisting head or vise in either direction, and that when the latter has rotated through the desired number of degrees, it will be brought to a state of rest automatically by breaking the circuit which supplies current to the motor. As I have stated, however, any other suitable stop mechanism (either electrical or mechanical) may be utilized in lieu of the one which I have herein described.

I will now describe how the machine may be operated in twisting a crank-shaft for a six-cylinder gasolene motor, although it will be understood that the machine is equally capable of twisting a crank-shaft for a three-cylinder motor if desired, or in twisting

other forms of work. I have already stated that it is common practice to forge these crank-shafts with the crank pins, the bearings and the various crank arms all in a common plane, as shown in Fig. 9. The crank-shaft shown in this figure is formed with the bearings o, p, q and r and with the crank pins s, t, u, v, w and x. The cheeks or crank arms are indicated respectively at 210, 211, 212, 213, 214, 215, 216 and 217. The tail vise is moved to the rear end of the machine. The cross slide is adjusted thereon to the proper position and the bearing r of the heated forging is clamped between the jaws thereon. The crank arm 211 is clamped between the jaws of the holding vise after the latter has been adjusted to proper position and the crank arm 210 is clamped between the jaws of the twisting vise, with the axis of the crank pin s centered in alinement of the axis of the twisting vise, the latter being at this time with its jaws in a horizontal position. The controller or switch arm 101 is set in position to start the rotation of the twisting vise anti-clockwise (looking at the machine from the head end thereof), and so that the rotation of the twisting vise will be stopped by the circuit-breaker after it has rotated through an arc of 30°. The rotation of the twisting vise twists the crank pin s and swings the crank arm 210 into the position shown in Fig. 10. Thereupon the clamps of the twisting vise and the holding vise are quickly released and the tail vise advanced to bring the crank arm 211 between the twisting vise and the holding vise, and through the controlling mechanism the twisting vise is reversely rotated and the jaws thereof are brought back to horizontal position. The tail vise is then advanced and adjusted laterally to place the crank arm 211 in the jaws of the twisting vise and the crank arm 212 in the jaws of the holding vise, with the crank pin t axially in alinement with the twisting vise. Thereupon the twisting vise is again rotated anti-clockwise through an arc of 30° to twist the crank pin t and set the crank arm 211 in the position shown in Fig. 12. The effect of this twist is to bring the bearing o back into alinement with the other bearings p, q and r. Thereupon, the clamps of the holding and twisting vises are again opened and the tail vise again advanced a short distance to free the crank arms from the said vises and the twisting vise is again returned to its normal position with the jaws thereof horizontal. Then the tail vise is again advanced and laterally adjusted to place the crank arm 212 between the jaws of the twisting vise and the crank arm 213 between the jaws of the holding vise, with the axis of the bearing p axially in alinement with the axis of the twisting vise. Through the controlling mechanism, as previously described, the twister head is again rotated anti-clockwise through an arm of 60° on the axis of the bearing p, and, as a result, the shaft in end elevation will have the appearance shown in Fig. 14. In like manner, the crank shaft forging is advanced step by step and the remaining bearings and crank pins q, w, and x twisted successively through arcs of 60°, 30° and 30° in a clockwise direction, this varying, however, according to the design of the shaft. During all of this operation, which I have thus described, the end bearing r remains firmly clamped in the tail vise and the forging is supported by the latter as it is being advanced through the holding and twisting vises. In order to prevent the engagement of the shoulders with the stationary jaws of the last-mentioned vises, the tail vise is pivoted so that a lever or pinch bar may be inserted under its rear end to lift it and the forging high enough for the shoulders on the forging to pass freely the stationary jaws of the holding and twisting vises.

It will be understood that all of the operations which I have described as being performed upon the forging are accomplished after a single heating of the forging, these operations being performed with great rapidity and with nicety and accuracy. Since the forging is highly heated while the various operations thereon are being performed, portions of the machine become heated intermittently, and are caused to expand and contract. For this reason the bearing for the twisting vise is split and expansible, and is secured only at its lower portion in proximity to the worm which is below it, so that the worm and worm wheel will always intermesh, notwithstanding the expansion and contraction of the annular carrier of the twisting vise.

What I claim is:—

1. In a machine for twisting crank shafts having bearings and crank pins, a hollow head, means for rotating it, jaws extending across the said head on opposite sides of the axis thereof and movable one toward the other to clamp the work between them, and means for securing said jaws to said head to leave an unobstructed space between the jaws on either side of said axis for the transverse adjustment of the work crosswise of the head to bring any crank pin or bearing in alinement with said head.

2. A machine for twisting crank shafts having bearings and crank pins, comprising a rotatable twisting vise, a holding vise, a bed on which said vises are mounted, said twisting vise consisting of a hollow head, jaws on the end thereof crossing the opening therethrough on both sides of the axis and having an unobstructed space between their faces for the transverse adjustment of the crank shaft crosswise of the head to permit any pin or bearing to be positioned in

alinement with said axis, means for attaching said jaws to said head, and means for locking said jaws upon the crank arms of the crank shaft.

3. A machine for twisting the crank pins and bearings of crank shafts, comprising a rotatable twisting vise and a holding vise, each of said vises having a pair of clamping jaws arranged on both sides of the axis of the twisting vise, each pair of jaws being separated to provide a space extending diametrically across said vises to permit the shaft to be moved longitudinally of said space to locate a crank pin or a bearing thereof in alinement with the axis of the twisting vise.

4. A machine for twisting the crank pins and bearings of crank shafts, comprising a rotatable twisting vise and a holding vise each having a pair of clamping jaws spaced to provide a transverse adjustment of said shaft to locate any pin or bearing in axial alinement with the twisting vise, a bed for supporting said vises, means for effecting the rotation in either direction of the twisting vise, and means for supporting and transversely adjusting said shaft with relation to the holding and twisting vises.

5. A machine for twisting the crank pins and bearings of crank shafts, comprising a rotatable twisting vise and a holding vise each having a pair of clamping jaws spaced to provide a transverse adjustment of said shaft to locate any pin or bearing in axial alinement with the twisting vise, a bed for supporting said vises, means for effecting the rotation in either direction of the twisting vise, transversely movable means for holding and transversely adjusting said shaft with relation to the holding and twisting vises, and mechanism for effecting a relative longitudinal movement of said holding and twisting vises and said transversely movable means, to locate the crank arms of said shaft successively in said holding and twisting vises.

6. A machine of the character referred to comprising a non-rotary vise having clamps for engaging a crank shaft, a rotatable twisting vise having clamps for engaging the crank shaft, means for rotating the twisting vise in one direction or the other, a tail vise having clamps for engaging the crank shaft, and means for moving said tail vise laterally to adjust the crank shaft relatively to the holding and twisting vises.

7. A machine for twisting crank-shafts comprising a vise for engaging one crank arm of a crank-shaft, a vise for engaging another crank arm of said shaft, means for rotating one of said vises to twist a portion of the shaft between said crank arms, clamping jaws on each of said vises having an unobstructed space between them to permit a lateral adjustment of the crank shaft for bringing any bearing or crank pin into alinement with the twisting vise, and means for locking the jaws of each vise upon the shaft.

8. A machine of the character referred to comprising a holding vise, a twisting vise, a bed upon which said vises are mounted, and means on said bed for moving the work longitudinally and laterally relatively to said vises.

9. A machine of the character referred to comprising a bed, a head journaled on said bed with its axis longitudinal of said bed, clamping jaws carried by said carrier, means for rotating said carrier, a second carrier on said bed, means for moving one of said carriers longitudinally relatively to the other, a cross slide on the second carrier, and a work clamp on said cross slide.

10. A machine of the character referred to comprising a bed, an annular carrier journaled on said bed with its axis longitudinal of said bed, clamping-jaws carried by said carrier, means for rotating said carrier, a carriage slidable longitudinally on said bed toward and from said carrier, clamping-jaws on said carrier, a tail carriage slidable longitudinally on said bed, a cross slide on the tail carriage and a work clamp on said cross slide.

11. A machine of the character referred to comprising a bed, a twisting vise journaled thereon with its axis longitudinal of the bed and having jaws for engaging a crank arm of a crank-shaft, a holding vise on said bed having means for centering that portion of the shaft to be twisted in axial alinement with the twisting vise, and also having jaws for engaging the said shaft, and means for rotating the twisting vise in either direction.

12. A machine of the character referred to comprising a bed, a twisting vise journaled thereon with its axis longitudinal of the bed and having jaws for engaging a crank arm of a crank-shaft, a holding vise on said bed having means for centering that portion of the shaft to be twisted in axial alinement with the twisting vise, and also having jaws for engaging the said shaft, means for rotating the twisting vise in either direction, and means for moving one of said vises longitudinally of said axis.

13. A machine of the character referred to comprising a bed, a twisting vise journaled thereon with its axis longitudinal of the bed and having jaws for engaging a crank arm of a crank-shaft, a holding vise on said bed having jaws for engaging the said shaft, means for rotating the twisting vise in either direction, and a tail vise on the bed movable both longitudinally and laterally to locate the work in the first-mentioned vises.

14. A machine for twisting the crank pins and bearings of a crank shaft comprising a holding vise for engaging one crank arm of

a crank-shaft, a twisting vise for engaging another crank arm of the work, each of said vises having jaws for engaging said crank arms and for receiving said crank arms with any crank pin or bearing of said shaft in axial alinement with the twisting vise, means for rotating said twisting vise in either direction through arcs of varying length, and means for automatically stopping the rotation of said twisting vise in either direction at predetermined points.

15. A machine for twisting the crank pins and bearings of a crank shaft comprising a holding vise for engaging one crank arm of a crank-shaft, a twisting vise for engaging another crank arm of the work, each of said vises having jaws for engaging said crank arms and for receiving said crank arms with any crank pin or bearing of said shaft in axial alinement with the twisting vise, means for rotating said twisting vise in either direction through arcs of varying length, and automatic means controlled by the twisting vise for stopping the rotation of said twisting vise when the work has been twisted through a predetermined arc of movement in either direction.

16. A machine of the character referred to comprising a bed, a holding vise thereon, a twisting vise thereon, means for rotating the twisting vise in either direction, a plurality of stops rotatable simultaneously with the twisting vise, and means coöperating with said stops for automatically stopping the rotation of the twisting vise in either direction, at any one of several predetermined points in its rotation.

17. A machine for twisting crank shafts, comprising a holding vise and a rotatable twisting vise, each of said vises having jaws for engaging the crank arms and for receiving said arms with any pin or bearing of said shaft in axial alinement with the twisting vise, mechanism for rotating said twisting vise, and mechanism including a plurality of stops, for automatically stopping the rotation of the twisting head at any one of several predetermined points in its rotation.

18. A machine for twisting crank shafts, comprising a holding vise and a rotatable twisting vise, each of said vises having jaws for engaging the crank arms and for receiving said arms with any pin or bearing of said shaft in axial alinement with the twisting vise, mechanism for rotating said twisting vise in either direction, and mechanism for stopping the rotation in either direction of said twisting vise at predetermined points comprising a controller for determining the direction of rotation of said twisting vise, knock-off devices, and a plurality of stops.

19. A machine of the character referred to comprising a holding vise, a rotatable twisting vise, work-engaging jaws on each of said vises, means for rotating the twisting vise, and means for centering that portion of the work to be twisted in the axis of the twisting vise.

20. A machine for twisting the crank shaft for three or six cylinder motors, comprising a rotatable twisting vise including an annular head and clamping jaws extending across said head on both sides of the axis thereof and separated to have an elongated space between them extending diametrically across the head, a holding vise having similarly spaced jaws, means for causing said jaws to clamp the crank arms of the crank shaft, means for rotating the twisting vise in different directions, means for controlling the direction of rotation of said twisting vise, and mechanism for determining the length of the arc of rotation of said twisting vise.

21. In a machine for twisting the crank pins and bearings of a crank shaft, comprising a rotatable hollow carrier, and jaws mounted on said carrier, and extending when in locked position substantially in parallelism across said carrier, said jaws providing an open slot diametrically of the carrier whereby the crank shaft may be bodily adjusted transversely of the axis of the carrier to locate any pin or bearing of said shaft in axial alinement with said carrier, in combination with means for effecting such bodily adjustment of said shaft, and a bed on which said carrier and said means are supported.

In testimony whereof I have affixed my signature, in presence of two witnesses.

CHARLES C. DODGE.

Witnesses:
JOHN BROCKLEBANK,
J. O. LINDGREN.