

[54] KEY DUPLICATING AND VENDING MACHINE

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[51] Int. Cl. B23c 1/16

[58] Field of Search 90/13.05

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3,442,174 5/1969 Weiner et al. 90/13.05 A

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Primary Examiner—Francis S. Husar

[57] ABSTRACT

An unattended semi-automatic, coin operated dupli-

cate key vending machine for use by members of the general public, the machine having a supply of key blade blanks with different cross sectional shapes in storage. The correct blank may be quickly selected by a customer by placing his key into one of a plurality of slots or selector openings, each of the slots adapted to receive a key blade of different shapes which cross section corresponds to the shape of one of the blanks in storage. Positioning the key in the correct slot thus selects a blank of appropriate cross section and automatically positions such blank for milling a duplicate profile. By placing the key to be duplicated in a second slot or key receiving opening, the profile of the key blade blank is cut with great precision to provide a faithful representation of the original key that will smoothly and without jamming operate the tumbler of the original lock. Simultaneous with the discharge of the duplicate key blade, the machine provides a durable plastic, snap, fit, irremovable head which may be easily secured to one end of the blade so as to complete the key with a conventional key head.

29 Claims, 28 Drawing Figures

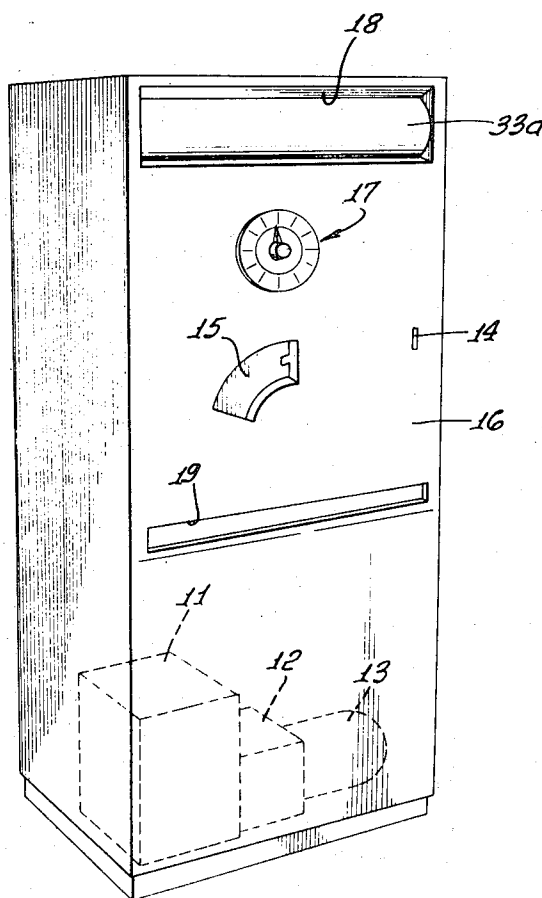


FIG. 1.

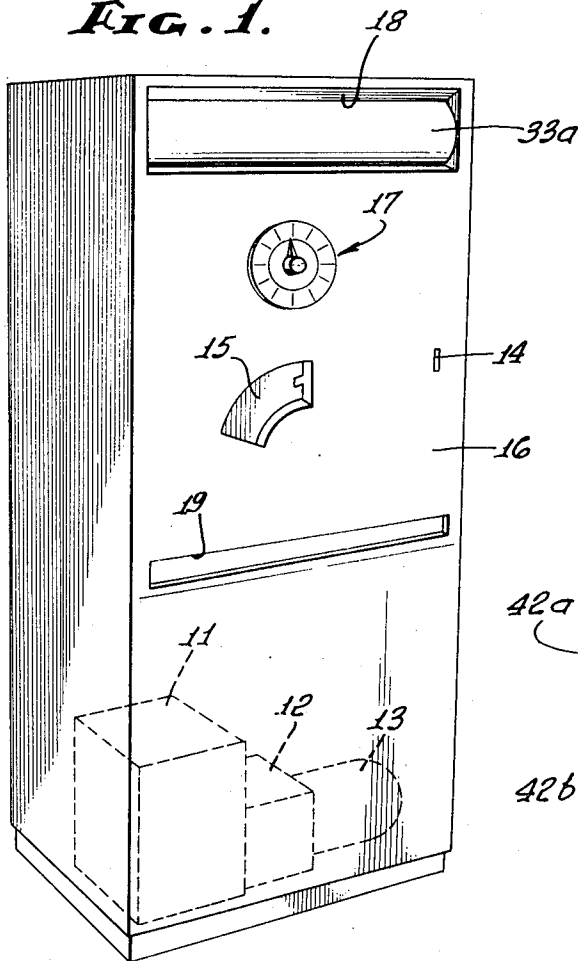


FIG. 6.

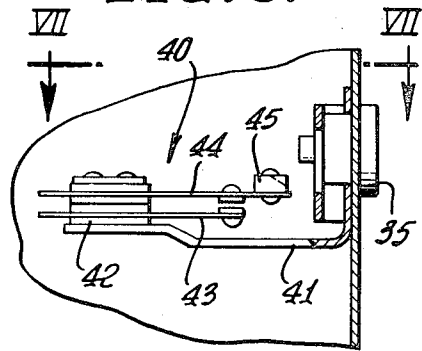


FIG. 7.

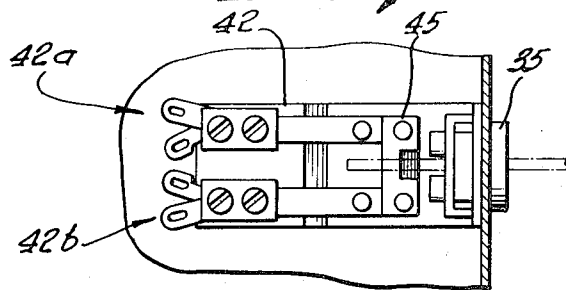


FIG. 8.

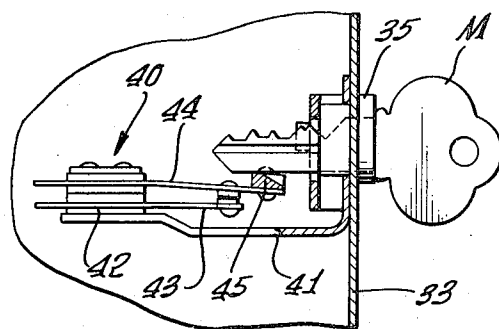


FIG. 5.

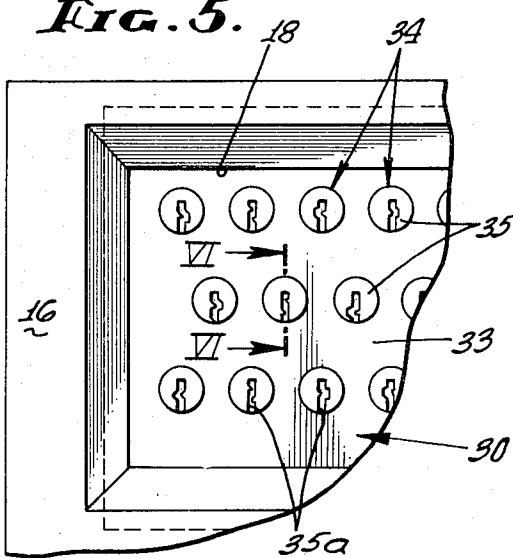
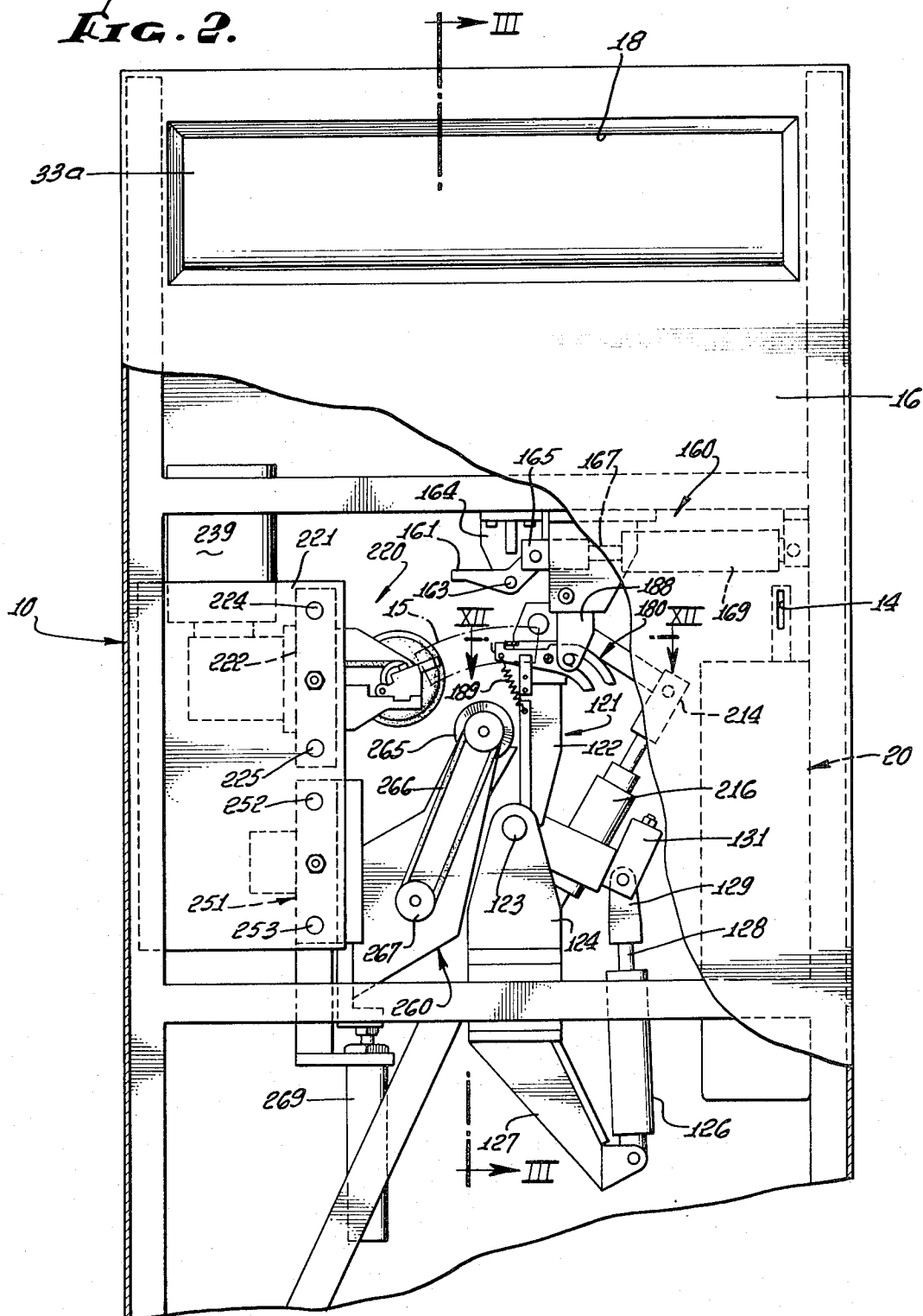
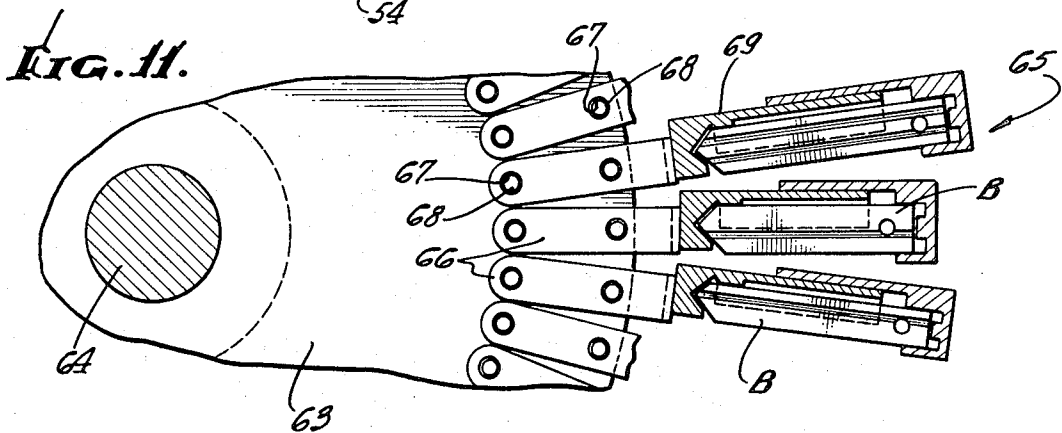
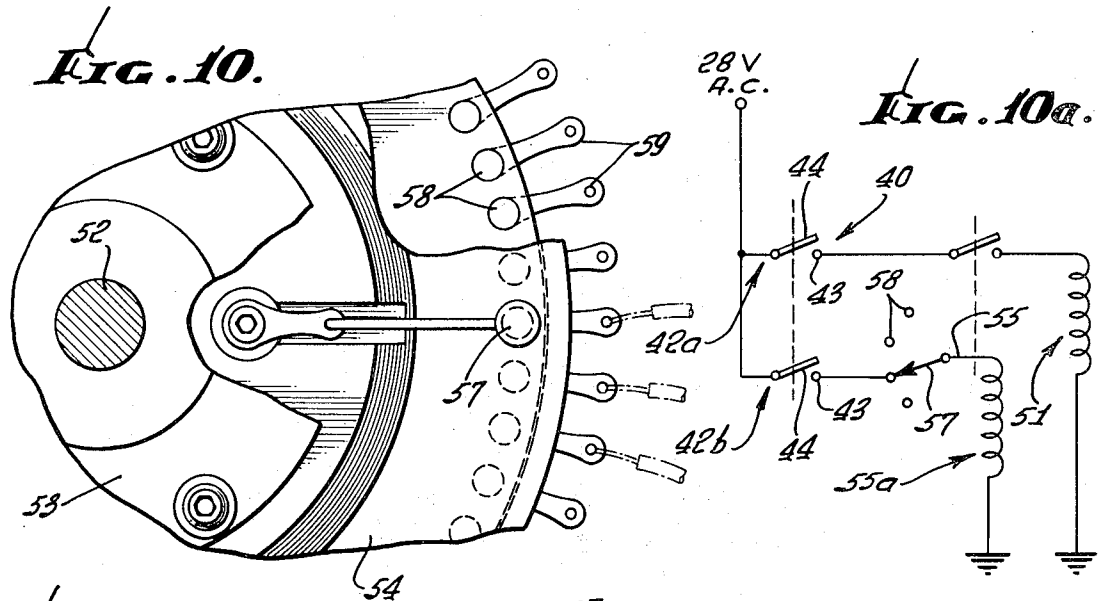
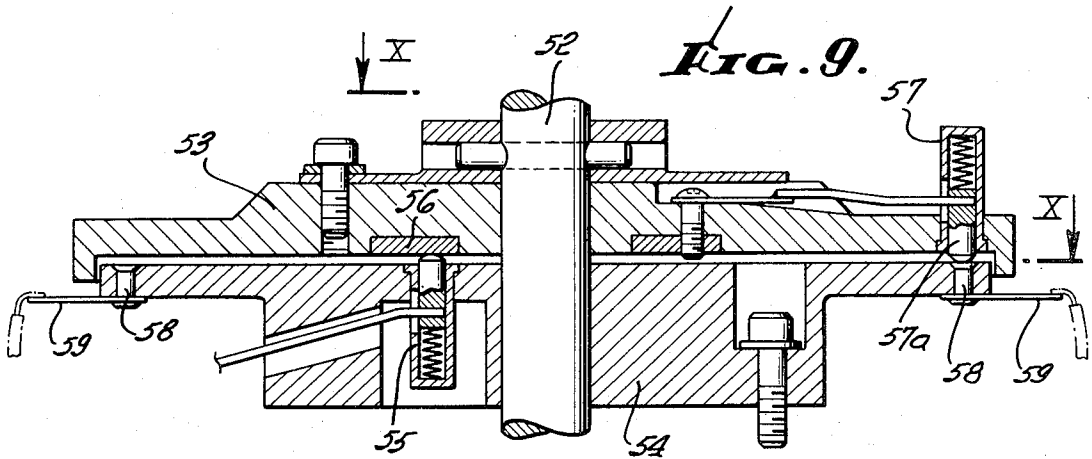
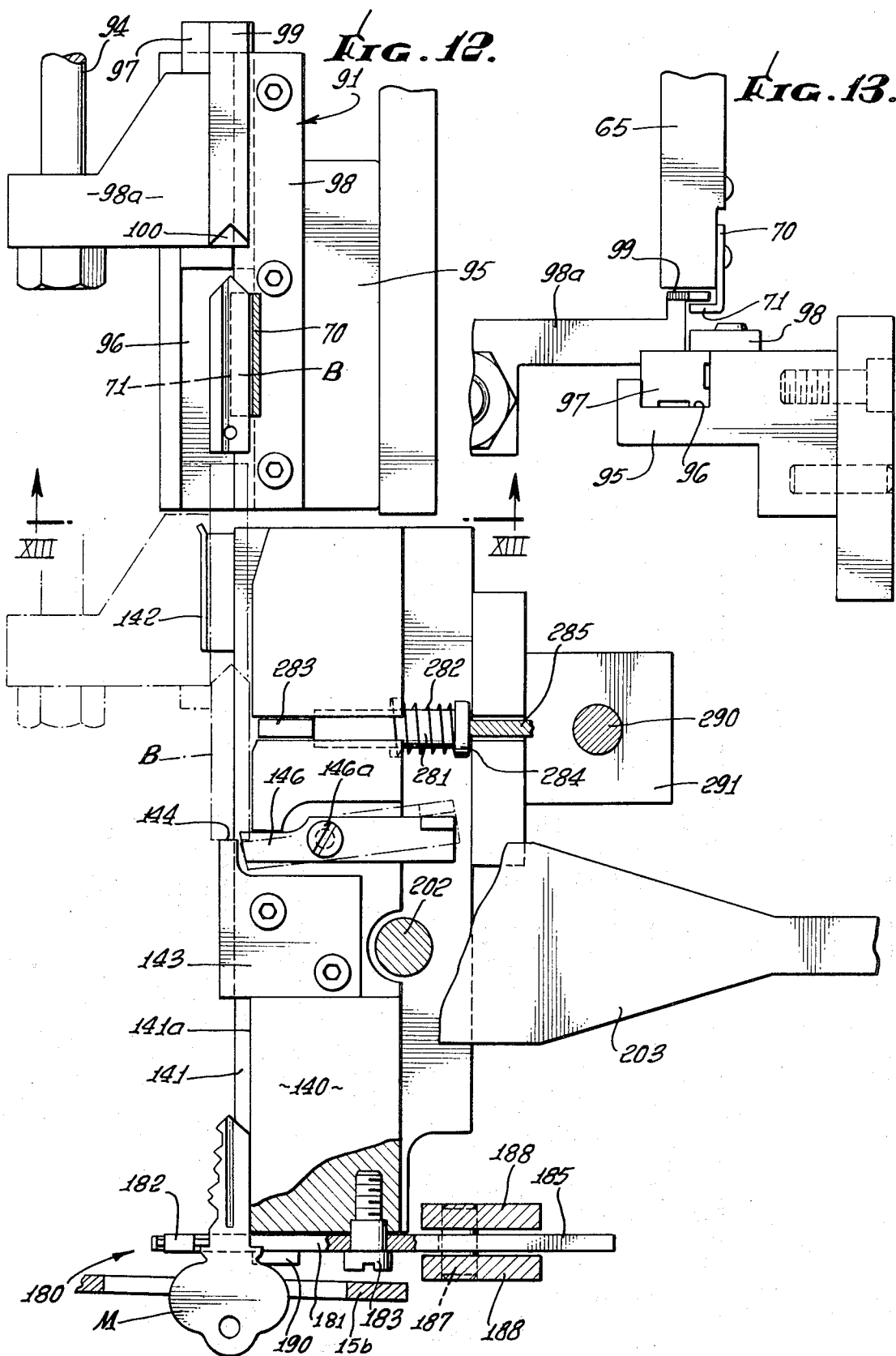
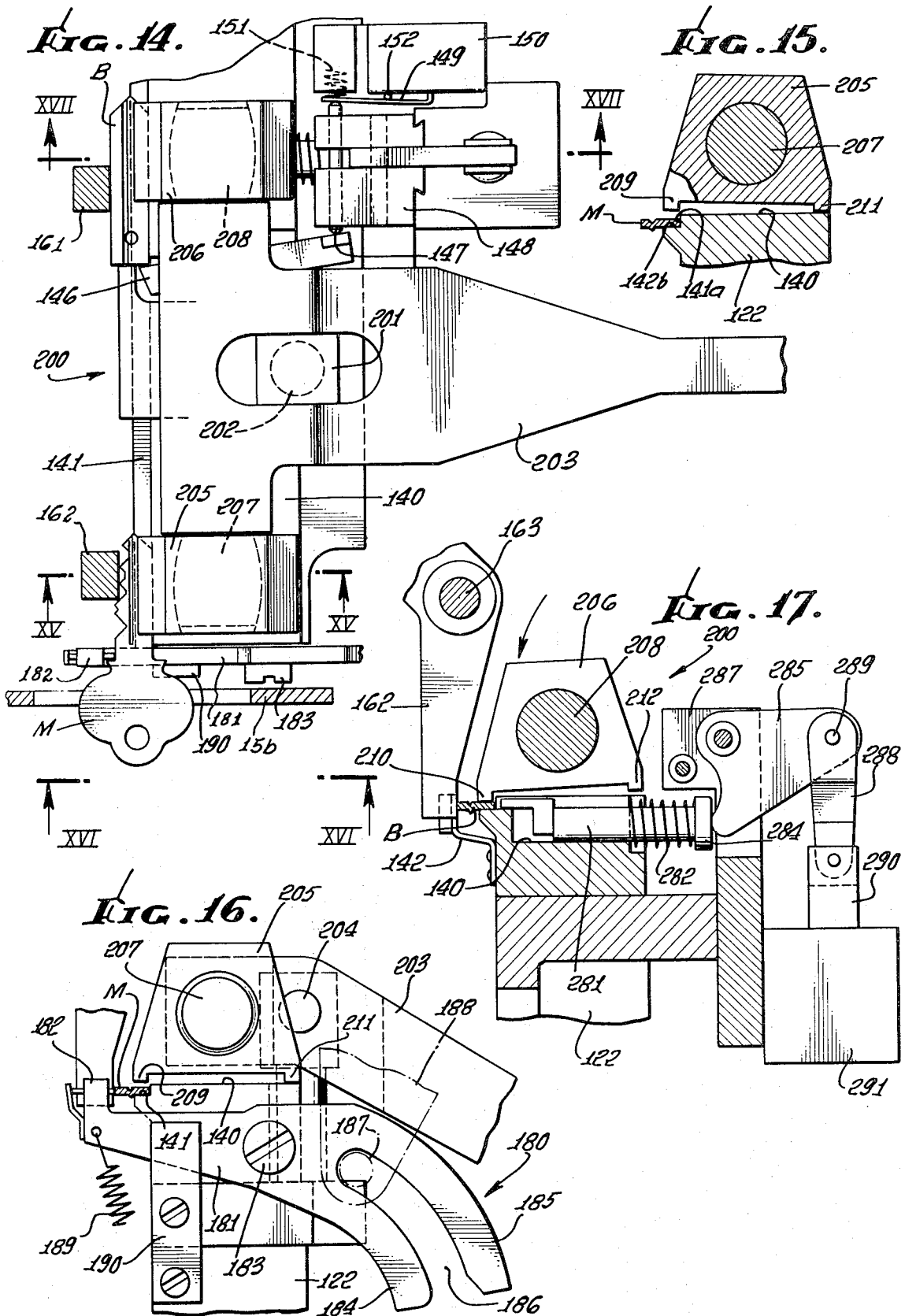


FIG. 2.









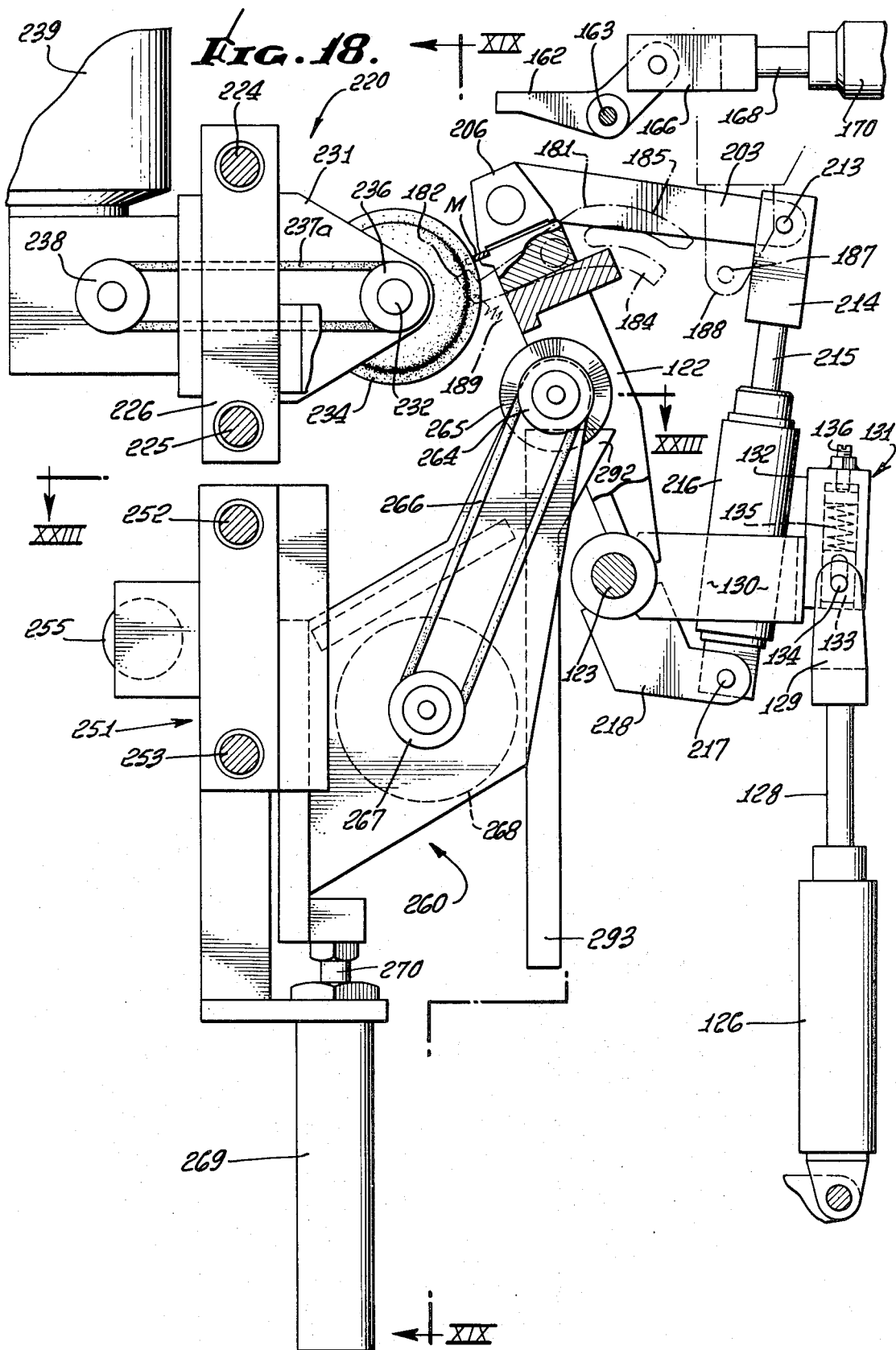
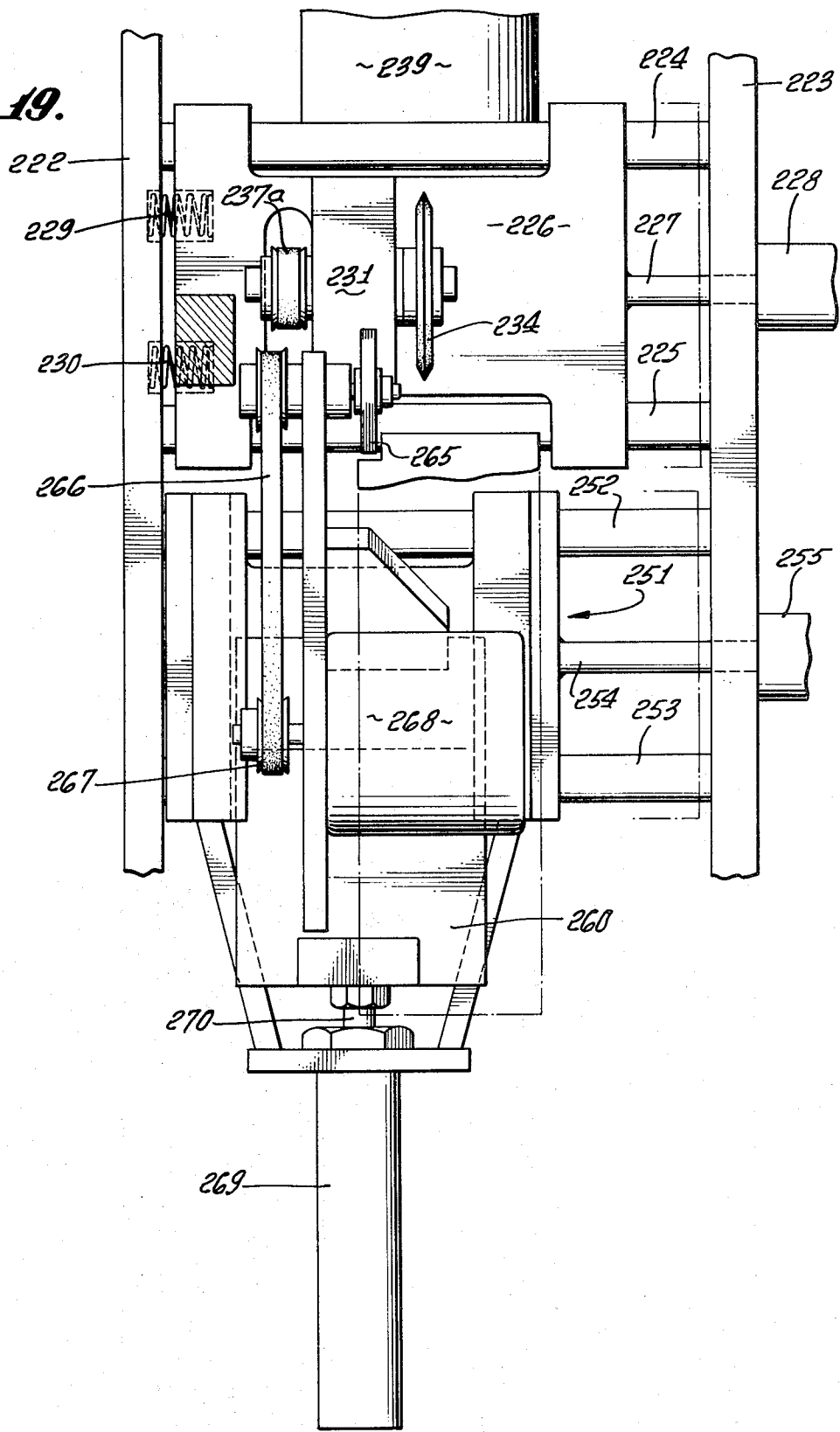
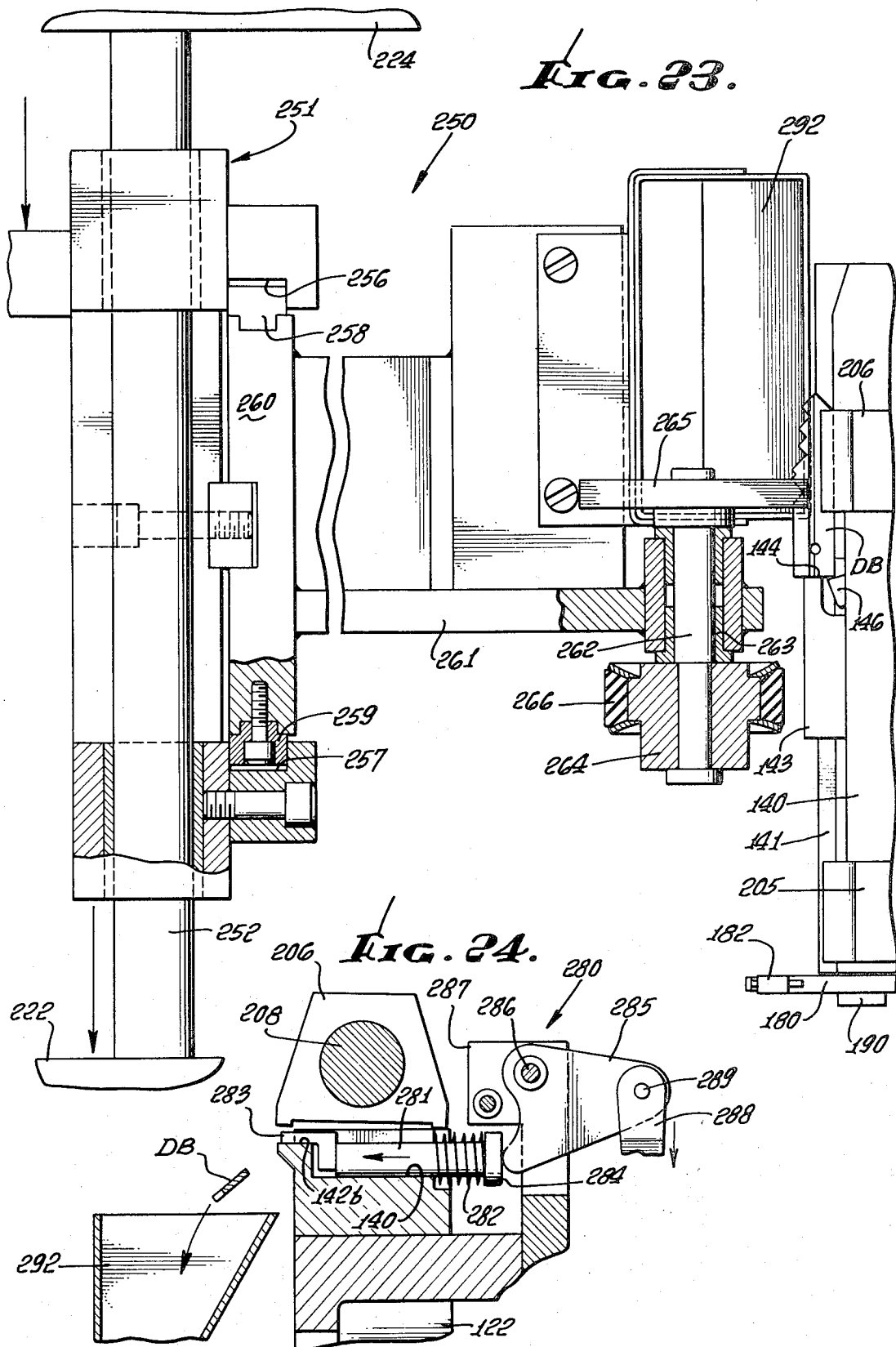
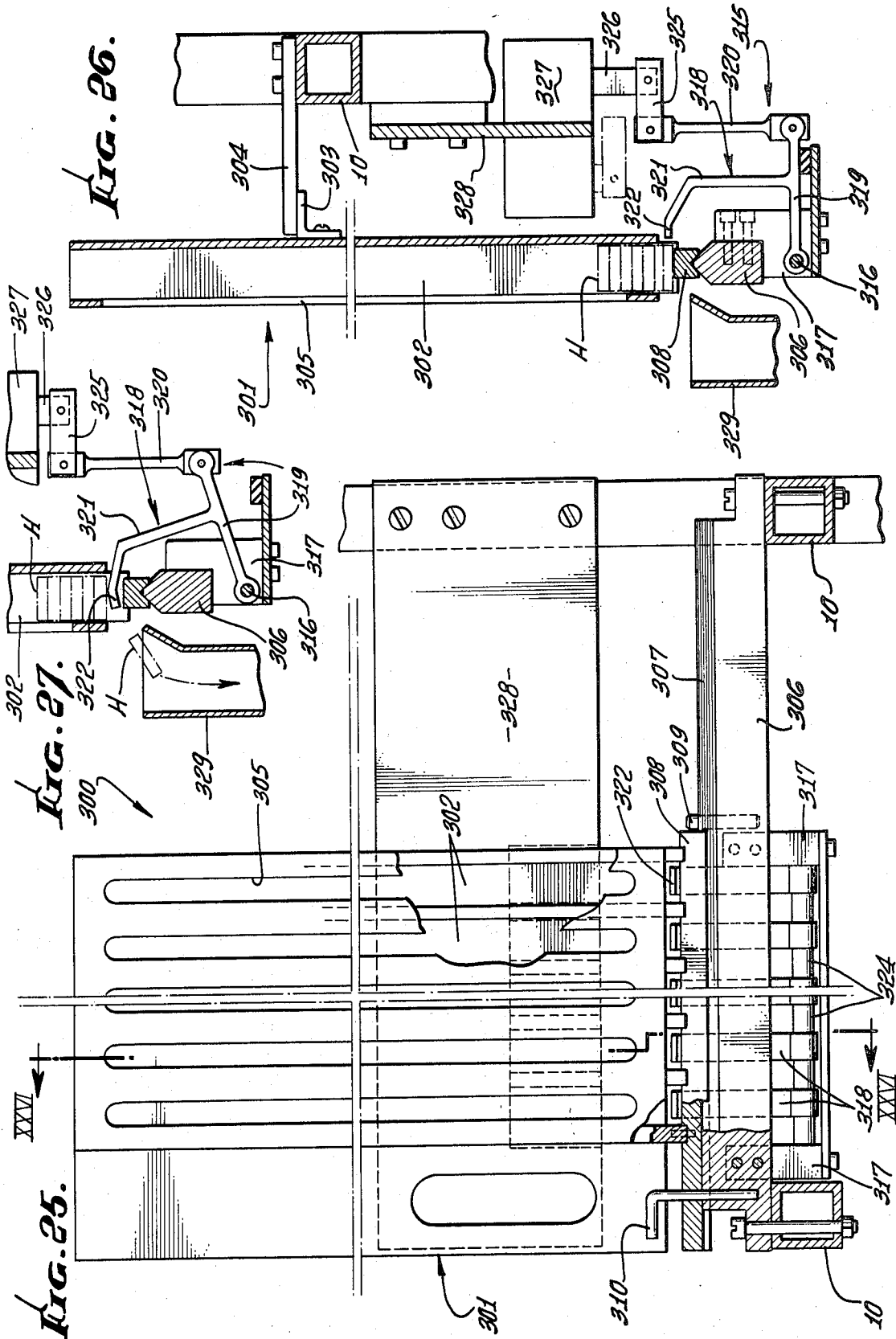


FIG. 19.







KEY DUPLICATING AND VENDING MACHINE

BACKGROUND OF THE INVENTION AND PRIOR ART

It has long been recognized that manual duplication of keys by an operator is a very inefficient process. Where key duplication is the sole product and service of a business entity, there is quite obviously a great loss in labor since the operator will rarely be continuously engaged in the duplication of keys for customers. Moreover, manual key duplication must be performed by a trained operator since there is at least some skill involved in operating the key duplicating machines available to produce a perfect copy or duplicate. The manual process of key duplication also requires that the operator select a key blank having the correct cross section before milling the key profile.

It will be understood that the configuration and size of the cross section of the blade of a key permits or prevents the insertion of the key into the conventional cylinder lock and that the profile or bitted portion of the blade cooperates with the tumblers to permit the cylinder to be rotated when the tumblers are correctly positioned. There are therefore two considerations with respect to shape or configuration of a key that determines its appropriateness for a lock and these requirements are satisfied in two separate steps. All known key duplicating machines provide a cutter or milling wheel which permits the profile of the key to be duplicated from the profile of the original or master key. The proper cross section is obtained, not by cutting, but rather by selecting a key blank having the correct cross section. While there may be millions of variations of a single lock manufacturer's keys, a single manufacturer may have only one or three or five cross sections which, in combination with the various profiles, provides a source of selection that is extremely large without requiring the repetitive use of a single cross section/profile combination. For example, one of the largest automobile manufacturers in this country which provides an ignition key-operated switch for each automobile sold, preferably without repetitive use of a particular cross section/profile combination, has used only five cross sections for all of the automobiles manufactured by this concern over a substantial period of time. Thus, to duplicate a key for this manufacturer, an operator must select a key blank with the correct cross section out of five possible cross sections once the manufacturer's name, indicia, or other designation on the original key has been matched with a corresponding identification on prepared key blanks. Key duplication, therefore, involves the steps of selection of a key blank with a proper cross section and subsequently milling the proper profile on such blank.

It will be recognized that, even if the general public could operate a manual profile milling machine, such machine would still be inadequate as a vending machine since the operation of the mill cutter would be dangerous and it would still require a suitable supply of key blanks and some method of dispensing such blanks upon the receipt of coins. While key blank dispensing devices are known, such as those shown in U.S. Pat. Nos. 3,265,245 and 2,148,667, the disadvantage and inadequacy of these devices from a broad point of view lies in the simple failure to provide a device which completes the entire key duplicating process and thus such

machines are not duplicate key vending machines in the actual sense.

A number of known attempts have been made to produce a duplicate key vending machine which functions satisfactorily but there are no known commercial devices in use. Examples of prior art duplicate key vending machines may be found in U.S. Pat. Nos. 3,358,561, 3,138,999, 3,430,535, 3,116,665 and 3,413,892. It is believed that the principal difficulty in the successful operability of these prior art devices resides in the difficulty in providing a supply or store or key blanks having a multiplicity of differently configured key blank heads. This fact results in complexities in the apparatus for storing, transferring, positioning, aligning, and other steps which must be performed in the selection and milling of a duplicate key.

It is also known in the prior art that keys may be formed which are not integral such as by the provision of a metallic blade which is permanently joined to a separately formed metal or plastic head so as to provide a key having the conventional parts. I have previously invented a two-part key comprising a metallic blade and a snap-on plastic head which may be permanently affixed to the blade very simply and expeditiously and such two-part key is the subject matter of my copending application Ser. No. 138,675. A two-part key is exemplarily illustrated in connection with the disclosure of the present invention.

It will be apparent from the following description that the two-part key in itself does not satisfactorily solve the problem and disadvantages in prior art key duplicating vending machines. For example, another disadvantage of the prior art devices resides in the mechanism for movement of the key and blank during the profile milling operation. Prior art devices of both the manual and automatic types, as well as the present invention, utilize the well known mechanism wherein the milling wheel and a tracer or follower stylus are mounted in fixed relation to one another so as to move as a unit relative to the original key and a blank secured in a holder. In other words, the follower traces the profile of the master key so as to simultaneously move the milling wheel relative to the blank thereby creating a blank profile that is a perfect copy of the profile of the master key. The milling operation involves both a longitudinal and transverse movement of the releasably held master and blank keys relative to the follower and cutting wheel. In all of the prior art devices known, either the follower and cutter wheel are moved longitudinally and transversely relative to the fixedly mounted master and blank keys, or alternatively, the follower and cutting wheel are fixed and the holder for the master and blank keys is moved both longitudinally and transversely. The prior art mechanism to perform these movements are complex, expensive, and commercially unsuccessful. Other disadvantages of the prior art automatic duplicate vending machines involve problems in the use of only mechanical or electromechanical assemblies, alignment of the blank and key, transfer of the blank from one position to subsequent positions, exposure of key openings on the exterior of the machine which are subject to tampering, and the like.

SUMMARY OF THE INVENTION

In light of the disadvantages of prior art devices, it is one object of the present invention to provide an unattended duplicate key vending machine that provides a

duplicate key blade and separate head which may be easily manually joined by the customer. Another object of the present invention is to provide a semi-automatic duplicate key vending machine in which selection of a blank is performed by the insertion of the master key into an exposed key slot having a mating cross section, withdrawal of the key and subsequent insertion into a second independent key slot so as to form the profile of the blank. Yet another object of the present invention is to provide a duplicate key vending machine in which the transfer and milling of the blank utilizes hydraulically operated assemblies. One more object of the present invention is to provide an unattended duplicate key vending machine for use by the general public which includes at least one key slot for reception of a key to be duplicated that is unexposed so as to be tamperproof until coins of appropriate value are deposited in the machine. The key duplicate machine of the present invention also has the advantage of a milling assembly in which the milling wheel and profile tracer are moved longitudinally in relation to the blank and master keys while the holder for the blank and master keys moves transversely thereby cutting a precise profile copy of the master key which will perform satisfactorily in the original lock. The key duplicating machine of the present invention is compact in size, relatively simple in operation and manufacture and thus reasonable in cost as would be required in a vending machine service operation. Other features of the key duplicating machine of the present invention include the provision of an article storing means, such as key heads, bearing different colors, indicia or designs that may be selected by the customer for subsequent attachment to the duplicate key blade when dispensed from the machine.

Generally stated, the present invention comprises a semi-automatic unattended duplicate key vending machine for use by the general public which includes a housing, coin receiving means for operation of the machine in response to insertion of coins of appropriate value, at least one key opening or slot in the exterior of the machine housing into which a key may be inserted by a customer for selection of a key blank of appropriate cross section for duplication, tamperproof means movably positioned with respect to the housing to prevent access to the key opening, and means responsive to insertion of coinage in the coin receiving means for positioning the tamperproof means to permit access to the key opening. The key vending machine may also include key blade blank supply means, means for selecting and positioning the blank supply means so that a key blank having the same cross section as the cross section of the key opening into which the customer inserted his key is transferred, key profile milling means including a milling cutter and tracer mounted for longitudinal movement in relation to a holder for the key blanks and master which move transversely relative to the cutter and tracer, means for positioning and aligning the blank and master prior to milling, a supply of key heads which may be snap fit onto duplicated key blades produced by the machine, means for selecting a key head of desired color, indicia, or configuration, and means for discharging the key blade and head from the machine to the customer. The invention may also include a duplicate key vending machine as described above in which the major subassemblies are electrically or hydraulically operated.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of an exemplary embodiment of an unattended semi-automatic duplicate key vending machine constructed in accordance with the present invention;

FIG. 2 is a front elevation view of the machine shown in FIG. 1;

FIG. 3 is a sectional view taken along the plane III-III of FIG. 2;

FIG. 4 is a detail view of a portion of the machine shown in the sectional view of FIG. 3;

FIG. 5 is a partial front elevation view of the vending machine blank selector taken along the plane V—V of FIG. 3;

FIG. 6 is a sectional view of a portion of the blank selector showing one of the blank selector switches in non-operative position;

FIG. 7 is a sectional view taken along the plane VII—VII of FIG. 6;

FIG. 8 is a view identical to FIG. 6 except showing a key in position and the switch in its operative position;

FIG. 9 is a sectional view of a portion of the key blank selection means;

FIG. 10 is a sectional view taken along the plane X—X of FIG. 9;

FIG. 10A is a diagrammatic illustration of the key slot switch circuit;

FIG. 11 is a plan view, partially in section, of a portion of the key blank supply means;

FIG. 12 is a plan view of the key blank transfer means;

FIG. 13 is a sectional view taken along the plane XIII—XIII of FIG. 12;

FIG. 14 shows a portion of an exemplary clamping holder of key blank milling means of the machine in relation to the key blank transfer means and in the operative position;

FIG. 15 is a sectional view taken along the plane XV—XV of FIG. 14;

FIG. 16 is a sectional view taken along the plane XVI—XVI of FIG. 14;

FIG. 17 is a sectional view taken along the plane XVII—XVII of FIG. 14;

FIG. 18 is a front elevation view of a portion of the machine showing portions of the key blank milling means, the key blank transfer means, the holder for clamping selected key blanks, the milling cutter, and the deburring means;

FIG. 19 is a sectional view taken along the plane XIX—XIX of FIG. 18;

FIG. 20 is an enlarged view of a portion of the key blank milling means clamping holder and the cutting wheel shown in the operative position;

FIG. 21 is a sectional view taken along the plane XXI—XXI;

FIG. 22 is a partial front elevation view, partly in section, of the deburring means shown in its operative position;

FIG. 23 is a sectional view taken along the plane XXIII—XXIII of FIG. 18;

FIG. 24 is a view of the ejector means shown in the operative position;

FIG. 25 is an elevation view of article storage means for key heads as used in the exemplary embodiment of the present invention;

FIG. 26 is a sectional view taken along the plane XXVI--XXVI of FIG. 25; and

FIG. 27 is a partial enlarged view of the operating mechanism shown in FIG. 26.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention includes a plurality of cooperating assemblies which function to provide a key duplicating vending machine whereby a customer may quickly and with minimal expense obtain a duplicate of any selected key in his possession. Such duplicating vending machine may be entirely unattended and may be located at various convenient locations such as gasoline service stations, shopping plazas, parking lots, and the like. As required for vending machines in general, the machine must be capable of maintaining a large supply of the item to be dispensed, be durable in construction and reliable in operation so as to minimize maintenance and repair costs, and must be relatively tamperproof to prevent the inevitable attempts at unauthorized operation of the device.

While it is apparent that the particular exterior configuration of the key vending machine of the present invention is not important to its overall utility, there is shown in FIG. 1 an exemplary duplicate key vending machine which has an exterior skin of metal or plastic panels to present a pleasing aesthetic appearance. Generally, and by particular reference to FIGS. 1 through 3, the key vending machine includes a frame indicated generally at 10, coin receiving means of conventional construction indicated at 20, key blank selection means indicated at 30 (see FIG. 3) and including means 50 for positioning key blank supply means indicated at 60, key blank transfer means indicated at 90, and key blank milling or forming means indicated generally at 120 including alignment means 160, means 180 for limiting the insertion of the master key, clamping means 200, cutting and tracing means 220, deburring means 250, blank ejection means 280, and article storage means 300. Prior to describing each of these assemblies in detail, a brief explanation of the general operation of the entire apparatus should facilitate an appreciation for the function performed by the various assemblies comprising the device.

Referring then to FIGS. 1 through 3, the key vending machine includes a blank selector panel which is normally unexposed to prevent tampering therewith but which becomes exposed when coins of proper value are deposited into the coin receiving means. Movement of the panel exposes a plurality of key blank selector openings each of which has a slot cross section that corresponds to the cross section of one of the many keys that are commercially available, for example, the ignition key of a particular automobile manufacturer. The cross section of the customer's key can only be inserted in the proper key slot which automatically actuates the key blank supply means 60 so that a key having an identical cross section and proper length is positioned for transfer. If there is no blank selector opening slot that will receive the customer's key, a refund button may be provided which can be pressed by the customer for return of the money deposited. If a proper slot is found, an indicator light or other device may be provided to notify the customer that the key may be moved to a lower opening. The customer then removes the master key from the blank selector opening and moves

the key to the lower opening where the master key is clamped into position for cutting the profile of the selected blank. The selected blank is transferred from the supply means to another portion of the key blank milling means where it is also clamped to the same holder as the master key. If there is no blank in the supply means the indicator light will not operate and the start button (which must be pressed to commence the remaining operations) is locked out. The coin return may then be actuated. After the key is transferred to the second slot, a suitable printed instruction on the housing informs the customer to select a key head. If the selected head is exhausted, another indicator light may be provided to inform the customer that the machine supply is "empty" and the money deposited may be returned; the start button is also locked out. If a blank is present and the selected head is in supply, the start button may be pressed and the clamping mechanism moves the master and blank keys, after proper alignment, toward a milling cutter and follower which traces the profile of the master key and effects simultaneous and identical cutting of the profile on the blank key blade. A deburring wheel is then moved into position to debur the duplicated blank which is then ejected into suitable means for transferring the key blade to a position accessible to the customer. Subsequently, the key head is ejected from a key head supply means and is also transferred to a location accessible to the customer. The customer may then insert the key blade into the key head with an easy snap fit to complete the duplicated key.

Referring now more specifically to the apparatus as shown in FIG. 1, the machine includes a source of power including a motor 11, a hydraulic pump 12 and a hydraulic fluid accumulator or reservoir 13 which supplies the fluid under pressure to the piston-cylinders to actuate such assemblies as will be herein further described. There is also shown in FIG. 1, the coin slot 14, and an independent, separate key receiving means 15 having a slot 15a in the housing 16. The separate receiving means includes a panel 15b which is pivotable with respect to the housing together with the pivotable clamping means as hereinafter explained. The housing 16 also carries on its face a key head selector mechanism indicated generally at 17, an opening 18 for a portion of the key blank selector means, and an opening 19 through which the duplicated blank and key head are accessible to the customer.

In conventional manner, the coin slot 14 is in communication with a coin receiving means 20 of conventional construction forming no part of the present invention and which is commercially available from manufacturers such as The Vendo Company. The coin receiving means is actuated when coins of a preselected proper value are deposited into the apparatus through the slot 14 and permits operation of the vending machine.

The key blank selection means 30 is immediately responsive to the insertion of coins of proper preselected value and includes tamperproof means, indicated generally at 31 (see FIG. 3), including a movable member 32 positioned adjacent the opening 18 in the housing 16. The movable member 32 has a surface portion 33 on which a plurality of key openings indicated generally at 34 (see FIG. 5) are located, and an uninterrupted or blank surface portion 33a which is normally exposed through the housing opening 18 when the ma-

chine is not in use. The movable member 32, in the exemplary embodiment, comprises a rotatably mounted body supported by the frame 10 by at least one shaft 36 as seen in FIG. 3. The movable member 32 is shown in FIG. 4 in the non-operative position wherein the uninterrupted surface 33a is exposed through the housing opening 18 and it will be seen that surface portion 33a may have an arcuate face so that extremely small gaps 37 appear between the face and the edges of the housing opening 18. In this manner, not only is the plurality of key openings 34 on face 33 unexposed through the opening 18, but it also prevents tampering with the machine by precluding the jamming or lodging of foreign materials between the edge of the opening of the housing and the face of the rotatable member 32 to effectively prevent tampering with the apparatus.

When coins of a proper selected value are deposited into the coin receiving means, there is provided hydraulic cylinder and piston means indicated at 38 which rotates the rotatable member 32 into the position shown in FIG. 3 wherein the surface portion 33 containing the key openings are exposed through housing opening 18.

Each of the key openings indicated generally at 34 include a key slot body 35 having a slot cross section 35a corresponding to that of one of commercially available keys. Each of the key slot bodies 35 on the surface portion 33 have a different cross section and one or groups of such slots may be identified with the name of a lock manufacturer or the name of a large lock user, such as an automobile company. The customer, observing the name of the manufacturer of the key which he desires to be duplicated, attempts to try the key in one of the slots of such manufacturer, if multiple, until the key is properly inserted as shown in FIG. 8.

Immediately behind each key slot body 35 there is provided an electrical switch, one of which is indicated generally at 40 which may include a base portion 41 secured to the movable member wall 33, for example, by clamping between two portions of the key slot body 35 or in a similar manner. The base 41 supports a switch body 42 of insulating material which carries two pairs of switches 42a and 42b for connection to a motor, power, relay and means for positioning key blank supply means 60 in a manner and for a purpose to be hereinafter explained. The switch body also supports a lower contact element 43 and an upper movable contact element 44 having a key engaging block 45 at its free end disposed adjacent to the rear end of the key slot body 35 and immediately below the slot 35a. As seen in FIG. 6, the switch 40 is normally open when no key is present in the key slot 35a. When a key of appropriate cross section is inserted into slot 35a, as shown in FIG. 8, the lower blade portion of the key contacts key engaging block 45 so as to depress contact 44 downwardly to make contact with contact 43 and thus close the switch 40.

The leads of the switch 40 are connected to means 50 for positioning the key blank supply means 60 shown best in FIGS. 9 and 10. Means 50 includes a motor 51 (see FIG. 3) for rotating a shaft 52 on which is mounted a disc 53 which rotates with respect to a fixed cylindrical member 54 supported by housing 10. Disposed in member 54 is a spring loaded brush 55 connected to a relay 55a bearing against an annular conductor bar 56 mounted on the lower surface of disc 53 and which is electrically connected to a movable spring loaded

brush 57 disposed in the outer marginal portion of disc 53. Brush 57 includes a contact element 57a and fixed cylindrical member 54 includes a plurality of contact elements 58 (see FIG. 10) having leads 59 mounted circumferentially spaced apart in a circle immediately below the path of contact element 57. Each of the leads 59 is attached to one of the switches 40.

Referring now to FIG. 10A and operation of the device, insertion of the key M closes the contacts 43, 44 so as to supply electric power to the motor 51 and relay 55a to operate the motor and rotate disc 53 and shaft 52. As disc 53 rotates, brush contact element 57a will, in the course of one revolution, engage one of the fixed contact elements 58 that is connected through its lead 59 to its respective switch 40 to complete the ground circuit and thereby turn off motor 51. The position at which disc 53 stops will thus correspond to the key slot in which the customer's key has been inserted and positions the key blank supply means.

The key blank supply means 60 is positioned beneath the last-described blank selector means as seen best in FIG. 3 and includes a turret indicated at 61 comprising a pair of circular plates 62, 63 attached to a shaft 64 journaled in frame 10 and rotatable with shaft 52 of the blank selector means. The plates 62, 63 support a plurality of cartridges 65 (two of which are shown in FIG. 3) in which a plurality of identical key blade blanks B are positioned in vertically stacked relation. Each of the cartridges 65 are supported by brackets 66 having a pair of radially spaced apart openings 67 which may be inserted onto a pair of radially spaced apart pins 68 in the marginal edge portion of the plates 62, 63, as seen best in FIG. 11, for supporting the cartridges 65 in close circumferentially spaced relation around the entire periphery of the turret. The weight of the cartridges 65 maintains the cartridges in position and the cartridge may be removed by a serviceman to reload the cartridge with key blanks by simply lifting the cartridge such that the brackets 66 disengage the pins 68 allowing the cartridge to be removed.

It will be seen from FIG. 11 that each of the cartridges are of generally rectangular cross section and include walls 69 which define a longitudinally extending channel having a length, width and configuration which corresponds to a particular type of key blade blank B. As seen in FIG. 13, the lower end of each cartridge is open and there is attached to the rear wall 69 of the cartridge an L-shaped bracket 70 having a lower wall portion 71 on which the key blade blanks B rest. The short or radial ends of the cartridge lower construction are thus open so that the lowermost key blank in each cartridge may be moved out of the cartridge in a radial direction as may be seen in FIG. 12 in a manner to be hereinafter described. From FIG. 11, it will be seen that the longer axis of each cartridge is substantially radially aligned with respect to the turret thus permitting the cartridges to be in close circumferentially spaced relation. This configuration considerably reduces the overall size of the machine particularly when compared to prior art machines wherein the blanks include integral key heads that precludes the close spacing between adjacent stacks of blanks thereby requiring a larger diameter turret to accommodate an equal number of stacks.

It will now be seen that each of the cartridge positions containing a particular type of key blank B are in registry with one of the electrical contact elements 58.

When the apparatus is actuated through making the contacts on switch 40, corresponding to a particular key blank cross section, the turret will rotate until the brush 57 makes contact with the lead from that particular switch. The turret will then assume a position such that the cartridge 65 containing the key blank which corresponds to the cross section of the key slot into which the key has been inserted is positioned for transfer such as shown in FIG. 12.

Key blank transfer means 90 is mounted below the turret 61, as seen best in FIG. 3, supported by the frame 10. The transfer means includes a slide assembly indicated generally at 91 mounted for reciprocal movement through the piston-cylinder means 92 which is supported at one end through a pivot mounting 93 and having the rod 94 extending from the other end thereof and secured to the slide assembly 91 as may also be seen in FIG. 12. Slide assembly 91 includes a fixed member 95 attached to the frame 10 and having a longitudinally extending track or channel 96 in which is disposed a slide 97 connected through an arm 98a to the piston rod 94 of means 92. The slide 97 is retained in the track 96 through the bar 98 secured to member 95 so as to overlie the track 96. Above track 96, and secured to arm 98a is the key blank transfer block 99 which has a V-shaped notch forward end 100 for mating engagement with the rearward V-shaped end of the key blade blank B and for guiding its linear movement during transfer. It will be seen from FIG. 13 that the transfer block 99 is disposed in the horizontal plane slightly above the lower leg 71 of the L-shaped member 70 of the blank cartridge 65 so that the linear movement of the slide assembly causes the block 99 to contact the lowermost key blank B in the proper blade position cartridge 65 and thus move the key blank out of the cartridge and to the key blank milling means 120.

Key blank milling means 120 includes support means for the selected key blade blank B and the key M inserted by the customer in the slot 15a of key receiving means 15. Such support means, in the exemplary embodiment, is indicated generally at 121 (see FIGS. 2, 3, 14-18 and 20). The support means includes a support 122 pivotally mounted on a shaft 123 carried by pivot blocks 124 mounted on frame 10. The support 121 is moved from a transfer position (as shown in FIG. 2) to the cutting position (as seen in FIG. 18) by piston-cylinder means including the cylinder 126 pivotally supported at its lower end to a support bracket 127 and a piston rod 128 having an end bracket 129. Affixed to support 121 is a fixed arm 130 (see FIG. 18) having at its outer end connecting means 131 for attachment to bracket 129 of the piston rod 128. The connecting means includes a housing 132 having a chamber in which there is disposed a movable block 133 therein connected to the bracket 129 through a pivot pin 134 and a spring 135 normally biasing the block 133 downwardly. The biasing force of spring 135 may be adjusted through a screw 136.

The upper end of support 121 comprises a generally flat platform 140 having a key and blank blade supporting portion or notch 141 having a vertical wall 141a and a bottom wall as seen in FIG. 12. One end of the notch 141 is adjacent the front of the machine behind key receiving opening panel 15b so that upon insertion of the master key M into the slot 15a, the blade rests on the notch 141. Since the notch on support 121 piv-

ots to the milling position as previously explained, the panel 15b will also pivot. At the end of the platform 140 adjacent the cartridge, the notch 141 is provided with a flat alignment spring 142 which laterally guides the key blank B into the position shown in phantom lines in FIG. 12 as it is moved by the slide transfer assembly 91. The key blank B is positioned longitudinally through the provision of a stop element 143 secured to platform 140 and having a stop shoulder 144. The platform also carries means for sensing the proper position of the key blank B through the transfer assembly which includes a sensing arm 146 mounted on a pivot pin 146a and with its forward edge slightly forward of the stop shoulder 144 so as to be engaged by the forward end of the key blank B when the key blank is properly positioned thus rotating the sensing arm 146 to the position shown in phantom lines in FIG. 12.

As seen in FIG. 14, the opposite end of the sensing arm 146 bears against a pin 147 supported in a block 148 on platform 140 the other end of which engages contact element 149 of a microswitch 150. The contact element 149 is biased so that the switch is normally open through a spring 151. When the key blank B is positioned, the pin 147 is moved to the position shown in FIG. 14 where the contact element 149 contacts a second contact element 152 to close the switch 150.

The key blank milling means 120 also includes means 160 for aligning the key and blank along a common longitudinal axis by forcing the rear edge of the key and blank against the vertical wall 141a of the notch 141 on the support. Such aligning means may include a key blank alignment finger 161 and a master key alignment finger 162 mounted on a shaft 163 carried by a pivot block 164 connected to the frame 10. Each of the alignment fingers 161, 162 are connected at one end to brackets 165, 166 carried by the free end of piston rods 167, 168, respectively, mounted in cylinders 169, 170 pivotally mounted to frame 10. Each of the alignment fingers are independently actuated since the width of the master key and blank will not be equal prior to milling the profile on the blank. As seen in FIG. 2, when the support 121 is in its substantially vertical or transfer position in which the key blank is transferred to the support means 121, the alignment fingers 161, 162 are positioned substantially above the holder support 121. The fingers are pivoted from the retracted position as shown in FIG. 2 to the operative position as shown in FIGS. 14 through 17 where the fingers engage the master key M and blank B respectively forcing the edge of the key against the vertical wall 141a of the notch 141 so as to precisely align the longitudinal axes of the key and blank.

The key blank milling means 120 also includes means 180 for limiting the distance to which the master key may be inserted into the machine key receiving slot 15a and thus positions the master key with respect to the notch 141 of the support 122. Referring to FIGS. 12, 14 and 16, the exemplary embodiment of the means 180 includes an arm 181 having a master key shoulder stop element 182. Arm 181 is pivoted about a shoulder machine screw 183 so as to pivot in a vertical plane relative to the support 122. The end of arm 181 opposite from the stop element is bifurcated into a pair of arcuate arms 184, 185 defining an arcuate slot 186 for receiving a pin 187 carried by a pair of ears 188 attached to the frame 10 (see FIG. 2). A spring 189 is attached to the opposite end of the arm 182 and at its lower end

to the support 122 so as to bias the arm 181 in a counter-clockwise direction as viewed in FIG. 2. When the support 122 is in the vertical or transfer position as shown for example in FIG. 16, the shoulder stop 182 is positioned in the same general horizontal plane as the notch 141 which receives the master key blade when inserted into the slot 15a. In this position, the shoulder of the key M on the profile portion of the key will strike the stop element 182 when the key is completely inserted and thus in proper position for duplicating.

It will however be apparent that if the profile portion of the master key extends closely adjacent the shoulder of the key, the shoulder stop element 182 would interfere with movement of the sensor and prevent the duplication of the entire profile of the key. To prevent such interference, when the support 122 is pivoted into the blank cutting position, as shown in FIG. 18, the pin 187 moves out of the slot 186 between the bifurcated arms 184, 185 allowing the spring 189 to pivot the arm 181 about the screw 183 so as to move the stop element 182 from out of the general plane of the master key M as seen best in FIG. 20. Pivotal movement of the arm 181 through the urging of the spring 189 is limited by the bracket 190. When support 121 returns to the transfer position the slot 186 engages pin 187 and guides the arm 181, against the bias of spring 189, to the position shown in FIG. 16.

The key milling means 120 also includes, in the exemplary embodiment, clamping means 200 comprising a pivot block 201 (see FIG. 14) secured to the platform 140 of support 121 by a post 202 and pivotally supporting a clamping arm 203 through a pivot shaft 204. At each side of one end of clamping arm 203 there is provided a pair of clamps 205, 206 mounted on self-aligning stub shafts 207, 208, respectively. Clamp 205 includes a projection 209 for bearing against the upper surface of the master key so as to clamp the master key to the bottom wall 142b of the notch 141. Similarly, clamp 206 includes a projection 210 for clamping the blank B. Each of the clamps 205, 206 also has a fulcrum projection 211, 212, respectively, which rests on platform 140 of support 122.

The opposite end of clamp arm 203 is attached through a pivot pin 213 to a bracket 214 carried on the end of a piston rod 215 in clamping cylinder 216 pivotally supported on a pin 217 to a portion 218 of the support 122. Hydraulic actuation of the cylinder 216 will therefore extend rod 215 so as to rotate clamp arm 203 about pivot pin 204 causing the clamps 205, 206 to rotate relative to stub shafts 207, 208 so that the clamp tabs 209, 210 will bear upon the master and blank clamping them to the notch bottom wall 141b of the support 122. The entire clamping assembly is rotatable with the support 122 so as to maintain the blank and master in clamped position during pivoting of the support 122.

The key blank cutting means 120 also includes, in the exemplary embodiment, cutting and tracing means 220 including subframe 221 attached to main frame 10 and comprising two vertically disposed members 222, 223 (see FIG. 19) between which are mounted a pair of vertically spaced guide bars 224, 225. A fixture 226 is mounted for longitudinal movement along slides 224, 225 and is connected to a piston rod 227 reciprocally moved by hydraulic cylinder 228. A pair of springs 229, 230 are carried at one longitudinal end of the fixture

226 to provide a damped travel of the fixture in the terminal portion of its movement.

Fixture 226 is provided with a horizontally extending standard 231 (see FIG. 18) in which is journaled a shaft 232 (see FIG. 21) in a bearing 233 and carrying at one end a cutting wheel 234 secured on the shaft by a nut 235 and carrying a driven pulley 236, at the opposite end, also secured by a nut 237 to the shaft 232. Driven pulley 236 is connected by a belt 237a (see FIG. 18) to a drive pulley 238 carried by the fixture 236. Means for rotation of the cutter wheel 234 is provided, which in the exemplary embodiment comprises a motor 239 suitably geared to drive pulley 238. Also extending horizontally from the fixture 226 is the sensor support arm 245 which carries, as seen best in FIGS. 20 and 21, a sensor, tracer, or stylus 246 supported by a mounting block 237 through a cap screw 248. The mounting block 247 is secured to arm 245 through a cap screw 249 and there are provided adjusting screws 249a, 249b carried by a portion 249c of arm 245 for adjusting the position of the stylus 246 relative to the cutting wheel 234 which is also fixedly mounted to the fixture 226.

The duplicate key vending machine may also include deburring means 250 for removing the rough edges of the milled key blank so that the duplicated key may be easily inserted into the lock mechanism. In the exemplary embodiment, such deburring means includes a longitudinally slidable fixture 251 mounted on horizontal slides 252, 253 and positioned generally below the key milling fixture 226. The slides 252, 253 are supported by the subframe member 222, 223. The deburring fixture 251 is connected to a piston rod 254 reciprocally operated by a hydraulic cylinder 255 and suitable control mechanism. The fixture 251 includes a pair of vertical tracks 256, 257 (see FIG. 23) in which are disposed a pair of slides 258, 259 connected to a carriage 260 including a vertically disposed support member 261 on the outer end of which there is carried a shaft 262 mounted in a bearing 263 and having a driven pulley 264 on one end and a deburring wheel 265 on the opposite end. The deburring wheel 265 may comprise a conventional cylindrical steel brush. Pulley 264 is driven by a belt 266 (see FIG. 19) connected to a drive pulley 267 mounted on the output shaft of an electric motor 268 carried by the carriage 260. The carriage 260 is moved upwardly so as to position the deburring wheel in its operative position adjacent the duplicated blank DB through a lifting cylinder 269 and piston rod 270 attached to the lower end of the carriage 260 and to frame 10.

The duplicate key vending machine also includes ejection means 280 for ejecting the duplicated blank key blade DB from the clamping means 200 and for transferring the duplicate DB to the opening 19 in the front face of the housing 16 of the machine where the blade is accessible to the customer. The ejection means may be best seen in FIGS. 14, 17, 22 and 24. The ejection means, in the exemplary embodiment, comprises an ejection pin 281 normally biased into the inoperative position by a spring 282 and which is slidably mounted in the upper end of the support 121 longitudinally adjacent the key blank B when in the milling position as shown in FIG. 14. The pin 281 includes a projection 283 for contact with the blank B at one end and a head 284 in engagement with a cam element 285 pivotally mounted through a pivot pin 286 to a block 287

supported at the upper end of support 121. The cam element 285 is also connected to a vertically disposed lever 288 connected to the cam element through a pin 289 and connected at its opposite end to the armature 290 of a solenoid 291 fixedly mounted on the support 121.

The ejector pin 281, during the sequence of operations previously described, is normally in the position shown in FIG. 17 wherein the projection 283 is not in contact with the inner edge of the key blank B and upon completion of duplication of the customer's key, the clamping means is actuated so as to release the key blank whereupon solenoid 291 is actuated so as to move pin 281 striking blank B and causing it to fall into a chute 292 carried by the deburring means frame 260. The chute terminates in an end 293 (see FIG. 18) which is positioned above a tray (not shown) that is connected to the opening 19 in the apparatus.

The present invention also includes article storage means 300 for an unattended vending machine and is exemplarily illustrated in connection with the key vending machine of the present invention as means for storing a plurality of key heads. The article storage means 300 is adapted to store a plurality of generally rectangular molded plastic key heads which are dispensed from the vending machine with each duplicated key blade and which may be secured to the key blade with a snap fit to complete the duplicated key.

Means 300 includes a rectangular frame indicated generally at 301 having a plurality of elongated channels 302 disposed in the vertical position and adapted to receive articles in vertically stacked relation. The frame 301, in the exemplary embodiment, is attached to an L-shaped bracket 303 for a member 304 to the housing 10. The article storage means 300 as shown has provision for a plurality of generally rectangular key heads H as seen in FIGS. 26 and 27. Each of the elongated channels 302 has a slot 305 in the front face thereof so as to visually indicate the number of key heads which remain in each elongated channel so as to facilitate supply servicing of the apparatus. Immediately below rectangular frame 301 there is provided a track 306 supported at opposite ends by the frame 10 and having a peaked upper slide surface 307. Secured to the lower end of frame 301 is a slide block 308 of generally rectangular longitudinally extending configuration and having an inverted V-shaped notch on its lower surface for mating sliding engagement with the slide surface 307 of track 306.

As seen in FIG. 25, at one end of the rectangular frame 301 there is provided a stop pin 309 and at the opposite end the slide block 308 and track 306 are provided with openings, in registry when the frame is positioned against the hold pin so that an L-shaped lock pin 310 may fix the rectangular frame 301 relative to the track 306. When it is desired to refill or resupply the elongated channels 302, the pin 310 may be easily removed and the entire rectangular frame may be slid along the track 306 to provide easy and convenient accessibility to the upper ends of each of the elongated channels where the articles are deposited to resupply the apparatus.

The article storage means also includes means 315 for ejecting an article from its respective elongated channel 302 into a suitably disposed means for carrying the ejected article to its intended destination. In the exemplary embodiment of the present inventions, such

means 315 includes a pivot shaft 316 mounted between a pair of pillow blocks 317 and immediately below the rectangular frame 301. At spaced apart locations along the pivot shaft 316 and disposed immediately below each of the respective elongated article channels 302, there is provided ejection members 318 which includes a first horizontal arm portion 319 one end of which is pivotally supported on the shaft 316 and the opposite end of which is attached to an actuating arm 320. Intermediate the ends of the arm portion 319, the member 318 includes a vertical arm portion 321 and a bent arm portion terminating in a finger 322. As seen in FIG. 26, the finger 322 when arm portion 319 is in the horizontal position resting on stop element 323 is positioned below the edge of the rectangular frame 301 and to one side thereof adjacent one of the articles H in one of the elongated channels. Each of the arms 318 are similarly disposed beneath one of the elongated channels and are spaced from one another by spacers 324 as seen in FIG. 25. The actuating arm 320 is connected at its upper end to a second actuating arm 325 which in turn is pivotally connected to the rod 326 of a solenoid 327 mounted on a bracket 328 connected to the housing frame 10. As may be seen in FIG. 27, when a customer has selected a particular article to be ejected from the apparatus and has pressed a corresponding button or similar selection device the solenoid 327 is actuated so as to move the actuating member 320 upwardly causing the arm 318 to pivot about shaft 316 moving finger 322 to the left (as seen in FIG. 27) forcing one of the articles H out of its respective elongated channel. Such article may be delivered to an opening, such as the opening 19 in the housing 16 of the apparatus of the present invention through a suitable article conveying chute 329.

Having now fully described all of the structure of the present invention and to the extent that its operation has not been fully described, one sequence of operation will hereinafter be described. As previously noted, the vending machine is normally installed in some location at which it is completely unattended and thus must be safe against any possible tampering or attempt to obtain a duplicate key without proper payment. Accordingly, when in the non-operating condition, the apparatus appears substantially as shown in FIG. 1 wherein the key selection means blank surface portion 33a is exposed to the opening 18 in the skin of the machine 16. All of the key openings 34 are thus unexposed and the key slots 35a cannot be clogged or filled with foreign objects which would prevent the later insertion of a key of proper cross section. Immediately below the unexposed blank surface portion 33a of the key blank selection means there is provided a key head style and/or color selector device 17 which may be manually rotated so as to choose a particular style and color of key head. The selector mechanism 17 is operated, in accordance with printed instructions, and may be moved so as to choose a key head as desired by the customer. If the key head selected is not in supply, an indicator light is activated to inform the customer that such head is not available and permitting the customer to refund his money. Obviously, various types of selection means are commercially available and useable in the device of the present invention.

When coins of appropriate preselected value have been inserted by the customer through the coin slot 14 the coin receiving means permits the sequence of oper-

ation in the key duplicating process to commence. Such operation of course includes the activation of the motor 11 so as to turn on pump 12 to provide the source of hydraulic pressure required for actuation of the various assemblies and subassemblies of the apparatus. Concurrently, hydraulic pressure is supplied to the cylinder and piston means 38 which rotates the rotatable member 32 into the position shown in FIG. 3 where the surface portion 33 is exposed to the opening 18 providing access to the plurality of key slots 35a.

Generally concurrently with the movement of the key blank selector rotatable member 32 electrical power is supplied to the motor 51 of the means 50 for positioning the key blank supply means 60 through one of the plurality of switches 40 connected to each of the key openings 35a. Since each of the key openings 35a are identified in a general manner by the name of the manufacturer of a lock or other product utilizing a lock, the customer may quickly identify a key blank slot corresponding to the key which he wishes to duplicate or at least a group of key blank openings which have the same manufacturer's name as on the key to be copied. The customer, through suitable instruction provided on the exterior of the apparatus, will then proceed to place his key into that key blank opening which he believes corresponds to his particular key. If the customer is incorrect, the key blank selection means will not be rendered operative since the cross section of the customer's key will not correspond to the key slot chosen and thus the key cannot be inserted into such opening. This would indicate to the customer that another key opening must be tried and he will continue to try such openings until the cross section of the blade portion of the customer's key is such that it will be accommodated by the cross section of the correct slot 35a. Thus, the first process in selecting an appropriate key blank is carried out by the matching of a customer's key with one of a plurality of key blank openings, each of which have different cross sections and only one of which, if any, will correspond to the cross section of the customer's key. If no key opening corresponds, the customer may obtain a refund of his coins through a conventional coin-return mechanism.

When the key M has been inserted into the proper key blank slot 35a, the blade of the key will engage the member 45 on the key contact 44 so as to make contact for the switch 40 which effects operation of the motor 51 causing the disc 53 to rotate together with the shaft 52 which in turn rotates the cylindrical turret 61 carrying the key blank blade cartridges 65. The other pair of leads of the switch 40 are connected through the disc 53 such that when the brush member 57 thereon engages a contact element 58 to which the other lead of the pair is connected, the motor 51 will be immediately shut off and thus the turret 61 will be positioned. The position assumed by the turret 61 corresponds to the positioning of a cartridge 65 adjacent key blank transfer means and such cartridge has been preselected to carry a key blank blade having a cross section which corresponds to that cross section of the key slot positioned adjacent the switch which stops the motor when the correct cartridge is in the transfer position.

When the blank cartridge is positioned, a valve for actuating the cylinder 92 is activated which, through piston rod 94, moves the slide assembly 91 so that key blank transfer block 99 will move a key blank blade B out of the cartridge 65 and onto key blade supporting

portion 141 of the key blank milling means 120, as seen in FIG. 12, in phantom lines. The key blank blade B is guided through the flat alignment spring 142 and is moved by the slide assembly 91 until the blade contacts stop shoulder 144, at which time it trips sensing arm 146 which in turn trips microswitch 150 thus indicating that the blank blade B is in proper position for subsequent milling. Microswitch 150 is also connected to an indicator light on the front panel which notified the customer to move the key to the second key receiving opening 15. If the blank supply is exhausted, the light will not be activated and the coins may be returned.

At this point in the sequence of operation, suitable means may be provided in conventional manner for actuating the piston cylinder means 38 to move the rotatable member 32 back into the original position. The second key forming operation is commenced when the customer takes the master key and inserts it into the second key receiving opening 15 which has no cross section and thus may accommodate any of the keys which are receivable in one of the key blank selector openings 34.

Responsive to a start button pressed by the customer, the means 160 for longitudinally aligning the key and blank is actuated through a suitable valve which supplies hydraulic pressure to cylinder 170 moving piston rod 168 and pivoting alignment fingers 161 and 162 which simultaneously aligns the blank B and the blade of the master key M. When the fingers 161, 162 are moved to their limit position, a suitably positioned microswitch is tripped so as to actuate a valve providing hydraulic pressure to the clamping cylinder 216 moving the piston 215 so as to move clamping arm 203 rotating the pair of clamps 205, 206 so that the projections 209, 210 bear upon the upper surface of the blank and master key blades, respectively, thereby fixedly but releasably clamping the blades in position for milling. The alignment fingers are then moved to the retracted position.

When the blank and master blades are clamped into position, the hydraulic valve is actuated through suitable means to supply hydraulic fluid to cylinder 126 moving piston rod 128 so as to pivot support 122 toward the milling cutter and sensor in the position shown in FIG. 18. It should be noted that when support 122 is pivoted, the master key limit means 180 is actuated such that the arm 181 is pivoted under the influence of spring 189 so that the stop element 182 is rotated out of the plane of the master key thereby exposing the entire bitted or profile portion of the master key such that the entire profile up to the shoulder may be traced by sensor 246. It will also be appreciated that movement of piston rod 128 which rotates support 122 will compress the spring 135 in housing 132 attached to arm 130 so as to bias this spring thereby urging the profile of the master key into continuous biased engagement with the sensor 246 and also biasing the forward edge of the blade blank B into contact with the cutting wheel 234.

When support 122 is rotated such that the blank and master key blades are in contact with the milling wheel and sensor the motor 239 is actuated to begin rotation of the milling wheel 234 and a valve is actuated so as to pressurize cylinder 228 moving fixture 226 of the cutting and tracing assembly longitudinally with respect to the longitudinally fixed blank and master whereby the profile on the master key is traced with the

sensor 246 and the milling cutter 234 will cut the identical profile in the blank blade B. The springs 229 in fixture 226 provide a yielding stop limit for the travel of the fixture allowing the sensor to reach the shoulder of the master key to assure that the profile is traced along its entire longitudinal extent.

When the fixture 226 reaches its stop limit position, a valve is actuated so as to provide hydraulic pressure to cylinder 269 which raises carriage 260 relative to the longitudinally slidable frame 251 of the deburring means 250. The deburring wheel 265 is then rotated and engages the profile of the duplicated blank DB, as shown in FIG. 22, and when the carriage 260 reaches its upper stop limit a valve is actuated so as to supply pressure to cylinder 255 moving piston rod 254 so as to longitudinally slide the frame 251 moving the deburring wheel longitudinally with respect to the blank while the motor 268 is in operation thereby deburring the duplicated blank.

While the carriage 260 remains in its raised position, hydraulic pressure is supplied to the cylinder 216 so as to retract the piston rod 215 thereby moving the clamping blocks 205, 206 to release the blank. When the clamping blocks 205, 206 are actuated, the ejection means 289 is actuated through the provision of the solenoid 291 thereby moving ejector pin 281 pushing the duplicated blank off the notch 141 so that it falls into the ejector chute 292 which conveys the key to the opening 19 at the front end of the vending machine.

During the same portion of the operation of the key milling means, the solenoid 327 of the article storage means 300 is activated so that the finger 322 will push one of the key heads H out of the elongated channel 302 which corresponds to the color and/or shape of key head selected by the customer through the selection means 17 whereby the key head H will be deposited into the chute 329 and also conveyed to the opening 19 in the vending machine face.

The customer may then take the key blade that has been duplicated and the head which has been dispensed and force the head over the key blade end to provide a snap fit, yielding a completed key. The key milling means support 122, during the latter portion of the milling operation, will be pivoted back to its vertical position and all other assemblies will be returned to their initial position and the customer may then extract the master key which was inserted in the opening 15 and the entire operation is complete. The machine, as is common, can be operated again only through the insertion of additional coins which repeats the cycle just described.

From the preceding description of the structure and operation of an exemplary embodiment of the duplicate key vending machine of the present invention, it will be seen that the machine provides a duplicated key which is cut with great precision to provide an accurate representation of the original or master key. It will also be seen that the entire operation of the device is carried on through hydraulic actuating mechanisms which are easily controlled through appropriate electrically actuated hydraulic valves. It will also now be appreciated that internal transfer and handling of the blank to be duplicated has been greatly facilitated by the fact that only the blade portion of the duplicate is handled and the cumbersome head is separately dispensed but the final result is a completed key of conventional shape and configuration. Many other advantages, as previ-

ously set forth, for example, the provision of an unattended key duplicating vending machine which is tamperproof will have now become apparent from the preceding description. Of course, it will also be obvious to those having skill in the art that various modifications and changes to the apparatus of the present invention may be made without departing from the scope of the invention.

I claim:

1. An unattended semi-automatic key duplicating and vending machine for use by the general public to duplicate a selected key including a housing, key blank supply means and means for milling a duplicate key from a key blank that is a duplicate of the selected key, said machine comprising:

key blank selector means including at least one key blank selector opening in said housing in which the customer's selected key may be inserted and means actuated by the insertion of said key in said selector opening for operating said key blank supply means to position a key blank of corresponding cross-section to said inserted key at a key blank transfer position within said machine;

means for transferring said blank within said machine from said key blank transfer position to said means for milling for subsequent milling;

an independent, separate key receiving means in which the customer's selected key may be subsequently inserted; and

means for supporting and clamping said key when, inserted in said separate key receiving means, together with the blank, when transferred by said means for transferring, for milling of the blank by said milling means to produce a duplicate key.

2. The key vending machine of claim 1 in which the separate key receiving means and said support and clamping means are movable relative to the housing, together with the key inserted during said subsequent milling.

3. The key vending machine of claim 1 comprising: tamper-proof means including means for movably mounting said key blank selector means relative to said housing to provide for movement of said key blank selector opening to a position within said housing which is not accessible from the outside of said housing to prevent access to said key blank selector opening, said means for movably mounting said key blank selector means being operable upon the insertion of coins of preselected value in a coin-receiving means associated with said machine to automatically place said key blank selector opening in a position in which it is accessible from outside of said housing.

4. The key vending machine of claim 1 comprising: ejecting means for ejecting said blank after said milling from said means for milling to a key delivery location of said machine, said blank comprising a key blade portion only; and

supply means for key heads which are engageable with said key blanks and means for delivering a selected head to said delivery location whereby upon delivery of said duplicated key blank and said key head the customer may interengage the head and the blank to provide a complete duplicate key.

5. The key vending machine of claim 1 wherein said key blank supply mounting means includes a generally cylindrical turret supporting a plurality of releasably

mounted cartridges in close circumferentially spaced relation.

6. The key vending machine of claim 5 wherein each of said cartridges are vertically elongated for storing a plurality of key blanks in stacked relation and each cartridge has a generally rectangular cross-section with its longer axis aligned radially with respect to said turret.

7. A key duplicating and vending machine, including a frame, a supply of key blanks and key blank milling means, for use by the general public to permit the duplication of a selected customer key comprising:

key blank selection means for selecting a key blank to be milled from said supply of key blanks, and positioning it at a key blank transfer position within said machine;

means for transferring said blank from said supply means at said transfer position to said key blank milling means; and

support means associated with said key blank milling means for supporting said blank transferred by said means for transferring and on which is mounted means for clamping said key blank and said key when inserted thereon by the customer in fixed relation;

a milling cutter including means for operation thereof; and

a key profile tracing means fixedly mounted with respect to the milling cutter on a fixture, said fixture being longitudinally movable relative to the key and blank support and said key and blank support being transversely movable with respect to the milling cutter and tracer fixture.

8. The duplicate key vending machine of claim 7 wherein said key and blank support means is pivotally mounted on said frame for movement with respect to said milling cutter and tracer fixture.

9. The duplicate key vending machine of claim 8 wherein said support during the cutting operation is pivoted to a position wherein the profile of the key and blank engage the tracer and milling cutter.

10. The duplicate key vending machine of claim 9 wherein said pivotally mounted support means and the key and blank clamped thereon are yieldably urged into continuous engagement with said milling cutter and tracer to permit precise copying of the key profile on the blank.

11. The duplicate key vending machine of claim 7 additionally including means for longitudinally aligning said key and blank on said support means after transfer of said blank from said supply means to said support means.

12. The duplicate key vending machine of claim 11 wherein said aligning means comprises a pair of pivotally mounted fingers selectively movable into engagement with the profile edge of the key and blank prior to clamping and out of engagement with said faces prior to transverse movement of said support means.

13. The duplicate key vending machine of claim 12 wherein said fingers are hydraulically urged into engagement with the profile edge of the key and blank.

14. The duplicate key vending machine of claim 7 additionally including means for receiving a key and being movable with said key and blank holder, the blade of said key when received in said means being positioned with respect to said support means for clamping.

15. The duplicate key vending machine of claim 14 additionally including means for limiting longitudinal movement of the key blade relative to the support means by selective engagement with the key shoulder.

16. The duplicate key vending machine of claim 15 wherein said means for limiting longitudinal movement of key blade includes an arm pivotally mounted on said support means and including a stop element, the stop element being positioned in the plane of the key when inserted and out of the plane when the support means is transversely moved.

17. The duplicate key vending machine of claim 7 wherein said fixture is longitudinally moved by a hydraulically operated cylinder and piston means.

18. An unattended duplicate key vending machine including a housing, and key blank milling means for duplicating a key to be inserted in said machine by a customer, comprising:

compact supply means for a plurality of key blade blanks of different cross-section;

means for selecting a key blade blank corresponding to a customer's key;

means for transferring said blade blank from said supply means to said key blank milling means;

storage means for a plurality of key heads adapted to snap fit on a duplicated key blade; and

means for ejecting said key blade blank after milling and for ejecting a selected key head to said customer whereby said customer may manually assemble said head and blade blank into a completed key.

19. The duplicate key vending machine of claim 18 wherein said compact key blade blank supply means comprises a rotatably mounted turret and a plurality of key blade blank cartridges releasably mounted around the periphery of said turret, each magazine holding a plurality of key blade blanks of identical cross section in stacked vertical relation.

20. The duplicate key vending machine of claim 19 wherein each of said key blank blade cartridges are elongated and have a generally rectangular cross section, the lower end of each cartridge having openings in opposed walls through which a key blade blank may pass and wherein said means transferring the blade blank from the supply means to the key blank milling means includes a transfer block mounted for movement into one of said openings so as to force the lowermost key blade blank out of the opposite opening thereby transferring the blade blank from the supply means to the key blank milling means.

21. The duplicate key blank vending machine of claim 20 wherein said key block has a forward edge for engagement with the key blade blank that includes a V-shaped notch for mating engagement with the V-shaped end of the key blank for guiding the blank during movement.

22. The duplicate key vending machine of claim 21 comprising:

a support associated with said key blank milling means and clamping means mounted on said support for releasably securing a customer's key and a transferred key blade blank clamped to the support during milling of the key blade blank profile.

23. The duplicate key vending machine of claim 22 wherein said means for transferring said key blade blank includes means for laterally guiding the blank

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during movement from the supply means to the support.

24. The duplicate key vending machine of claim 18 wherein said storage means comprises a generally rectangular frame including a plurality of adjacent elongated channels for receiving and holding a plurality of key heads in vertical stacked relation, each channel holding key heads different than heads in other channels, and additionally including means for selection of a key head from one of said channels by a customer.

25. A key duplicating and vending machine having a supply of key blanks and key blank milling means for duplicating a key to be inserted in said machine by a customer, comprising:

key blank selection means, including at least one key receiving slot, for selecting an appropriate key blank from said supply of key blanks in response to a customer inserting his key in said first key receiving slot;

key blank transfer means for automatically transferring said key blank within said machine from said supply of key blanks to said key blank milling means;

a second key receiving opening in said machine to receive said customer's key after withdrawal of said key from said key receiving slot;

key blank and key receiving and support means associated with said key blank milling means for receiving and supporting said key blank transferred from said supply and said key inserted through said opening; and

means for clamping said key blank and key on said support when received thereon, preparatory to milling of said blank.

26. The key duplicating and vending machine of claim 25 comprising:

means for aligning said key and blank along a longitudinal axis on said support means prior to clamping thereon by said clamping means.

27. The key duplicating and vending machine of claim 25 comprising:

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means for limiting the distance said key may be inserted through said opening relative to said key receiving and support means to facilitate prepositioning of said key prior to clamping thereof by said respective clamping means.

28. In a key duplicating and vending machine having a key profile tracing means for tracing a key profile and associated milling means for milling a duplicate profile in a key blank, the improvement comprising the provision of:

first means for mounting said profile tracing means and milling means in fixed relative positions and for concurrent longitudinal movement relative to the longitudinal axis of a key and key blank to be operated upon;

second means for supporting and clamping a key blank and a key in fixed relative positions with their longitudinal axes generally parallel to the direction of longitudinal movement of said means for mounting said tracing and milling means and for concurrent movement transversely of the longitudinal direction of movement of said tracing and milling means; and

means for operating said first means for mounting in said longitudinal direction and said second means transversely thereof to concurrently move said key blank and key transversely of said tracer and milling means as said tracer and milling means are moved longitudinally thereof to thereby mill a profile in said key blank which is a duplicate of that of said key.

29. In the key duplicating and vending machine of claim 28, the additional provision of:

means for automatically transferring a selected key blank from a supply thereof to said second means in response to a customer's inserting his key to be duplicated in a first key blank selector slot; and a separate key receiving opening through which said key may be inserted to place said key to be duplicated on said second means.

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