April 19, 1949. M. STOLOVE ET AL 2,467,575

KEY DUPLICATING MACHINE

Filed Nov. 12, 1947 3 Sheets-Sheet 1

Fig. 1

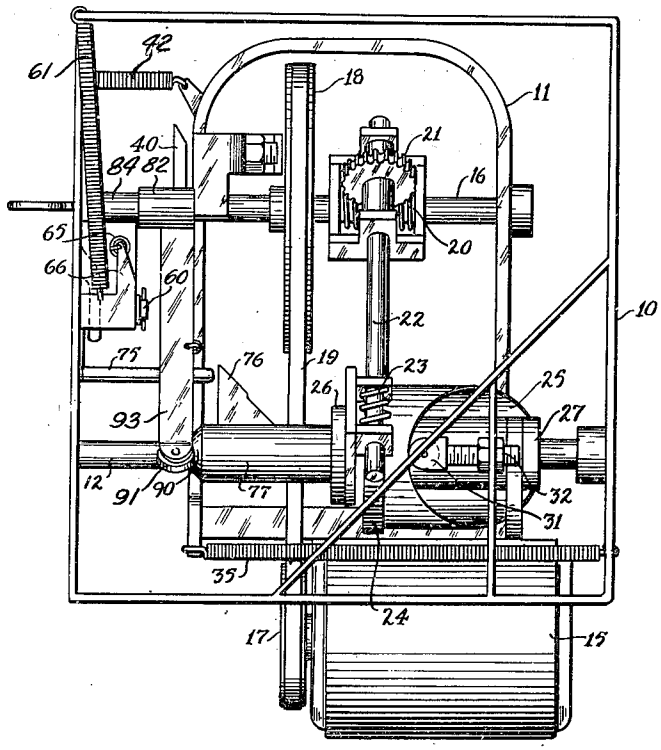
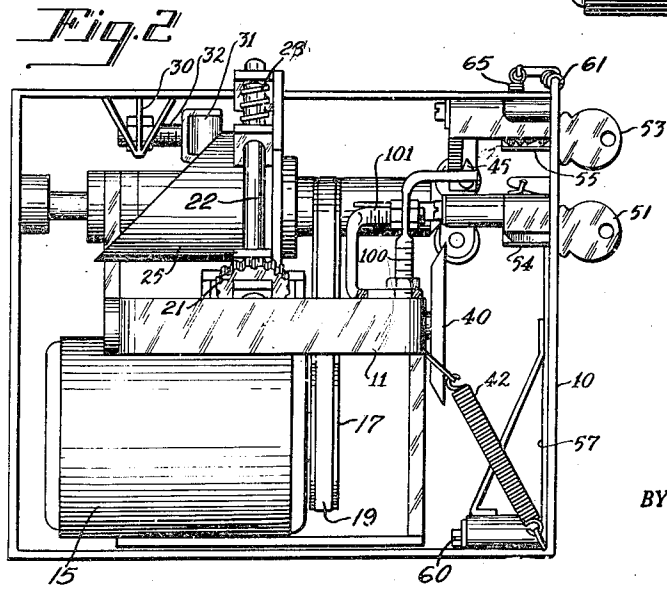


Fig. 2



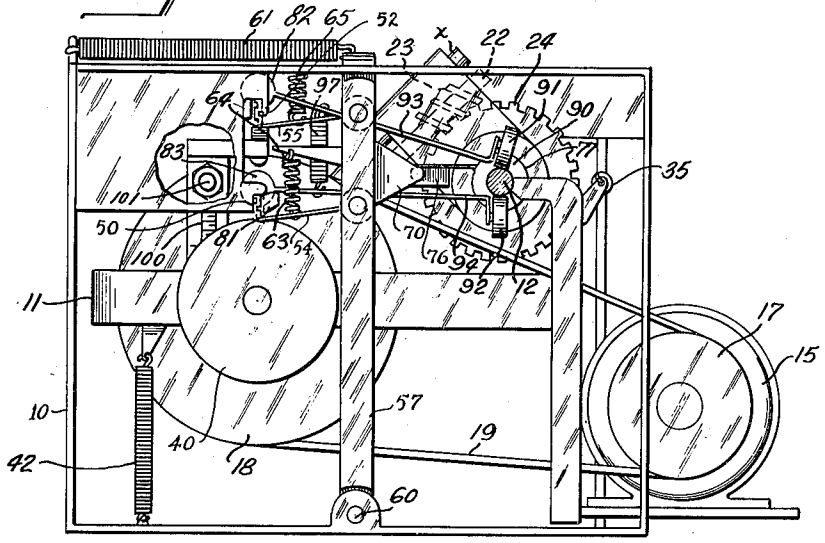
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KEY DUPLICATING MACHINE

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Fig. 3



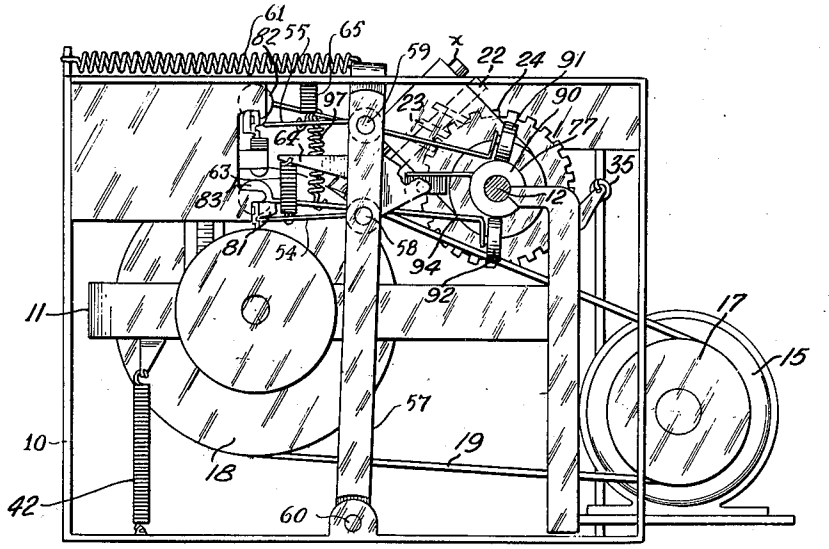


Fig. 4

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KEY DUPLICATING MACHINE

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Fig. 5

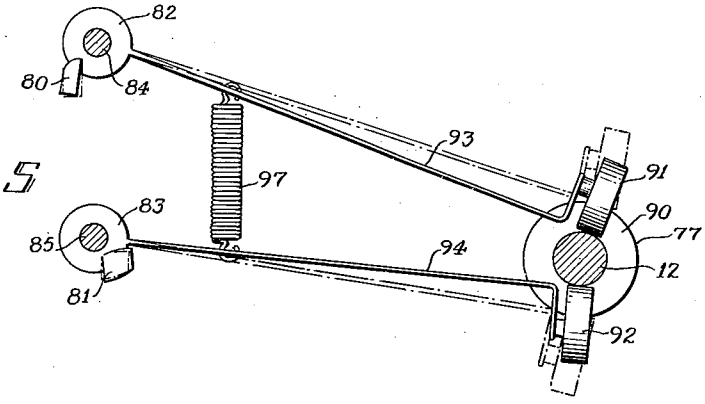


Fig. 7

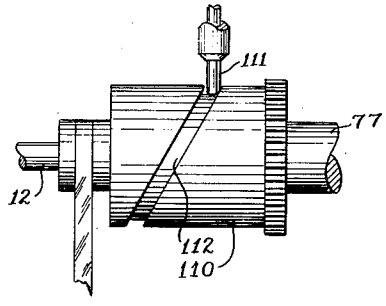
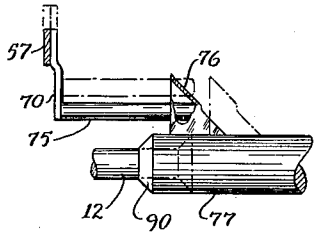


Fig. 6



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KEY DUPLICATING MACHINE

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Application November 12, 1947, Serial No. 785,264

6 Claims. (Cl. 90—13.05)

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This invention relates to a key duplicating machine and more particularly, to a machine which cuts key blanks in accordance with a master or pattern key.

The general principle that underlies all key duplicating machines is well known. There is a clamp for the key blank, a second clamp for the pattern key, a follower which engages the pattern key, and a grinding or cutting tool which engages the key blank in cooperation and in synchronization with the follower. The present invention also includes these elements. It very substantially differs from all known machines of this general character, however, in the means and method which it employs in actuating these elements.

Some of these machines which have heretofore been devised are manually operable; others of these machines are partly manually operable and partly automatically operable. But, none of these machines, to applicant's knowledge, is fully and completely automatic in its operation.

It is accordingly the principal object of this invention to provide a machine of the general character described which is automatically operable in every respect. In the machine herein claimed, the operator need only do two things to set the machine into operation: insert the pattern key and the key blank into the machine and turn on the electric current. The machine will automatically cut the key blank to the pattern of the pattern key and nothing will be left for the operator to do but to withdraw the pattern key and the finished key blank from the machine at the conclusion of the cutting operation. There is no known machine capable of accomplishing this result by so automatic a performance.

Another object of this invention is the provision of a key duplicating machine which may be operated by members of the general public who have had no previous training or instruction in the operation of key duplicating machines.

Still another object of this invention is the provision of a key duplicating machine for professional use. Among the advantages which are inherent in this machine, insofar as the professional key maker and locksmith is concerned, are the following: this machine requires no attention on the part of the operator and it automatically duplicates keys with complete accuracy. The complete absence of manual control over the operation of the machine wholly eliminates the "human error."

Still another object of this invention is the provision of a key duplicating machine which

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performs the key duplicating operation in less time than do conventional key duplicating machines.

A still further object of this invention is the provision of a key duplicating machine based upon a highly simplified design and comprising fewer parts than do conventional key duplicating machines.

Another object of this invention is the provision of a key duplicating machine which is adapted to be actuated and controlled by any conventional coin operated mechanism.

A preferred embodiment of this invention is shown in the accompanying drawing in which

Fig. 1 is a plan view thereof;

Fig. 2 is a side view thereof;

Fig. 3 is a front view thereof showing the key blank and the pattern key inserted into their respective keyways, prior to the cutting operation;

Fig. 4 is a view similar to that of Fig. 3 showing the machine in operation;

Fig. 5 is a detailed view showing the cam operated key clamps;

Fig. 6 is a fragmentary detailed view showing the cam mechanism which actuates the key holding means; and

Fig. 7 is a fragmentary detailed view of another form of cam mechanism which controls the movement of the entire frame which carries the pattern key following and key blank cutting mechanism.

Reference to the first four figures of the drawing will disclose the fact that the machine herein claimed is mounted in a frame 10. It will be understood that this frame is normally encased within a housing or cabinet to protect the working mechanism. For purposes of clarity, however, the housing has not been shown in the drawing. Frame 10 is the stationary frame and it will be noted that a second frame 11 is pivotally mounted in frame 10 on rod 12. Movable frame 11 supports all of the working mechanism on the machine and it is not only pivotally movable on rod 12 but it is also linearly movable on said rod, axially thereof.

Mounted on movable frame 11, on one side of rod 12, is an electric motor 15. Mounted on movable frame 11, on the other side of rod 12, is a shaft 16. A pulley 17 on the shaft of the electric motor and a larger pulley 18 on shaft 16, and an endless belt 19 interconnecting said pulleys enable the electric motor to drive shaft 16. A worm 20 is affixed to the drive shaft 16 and it will be noted that this worm engages a gear wheel 21 mounted on a second shaft 22. A second worm 23 is affixed

to the second shaft 22 and it will be noted that this second worm is in driving engagement with a gear wheel 24. Gear wheel 24 is mounted on a cam 25 which is itself mounted on rod 12. A pair of collars 26 and 27 respectively prevents axial movement of cam 25 on rod 12.

It will be understood from the foregoing that when the electric motor is set in operation by passing a current through it, it will cause the first worm 20 to rotate the shaft 22 and the second worm 23 on said shaft will thereby cause the gear wheel 24 to rotate. Since the gear wheel 24 is affixed to the cam 25, said cam will be caused to engage in corresponding rotary movement.

A bracket 30 is affixed to the stationary frame 10 and mounted on said bracket is a cam follower 31. It will be noted that there is an adjustable screw member 32 by which the cam follower is mounted on the bracket. It is by virtue of this adjustable screw member that the cam follower may be set in any pre-determined or selected position relative to the cam 25 which it is shown in Figs. 1 and 2 to engage. Once the cam follower is set in a pre-determined or selected position, it is fixed in that position. It has previously been indicated that the cam 25 is mounted on the rod 12 for both rotary and axial movement on said rod. It will be understood, therefore, that when the electric motor causes cam 25 to rotate in engagement with the cam follower 31, said cam will be caused to move axially on said rod with respect to said cam follower in the direction away from said cam follower. A tension spring 35 is shown in Fig. 1 to engage the movable frame 11 at one end and the stationary frame 10 at its opposite end. This spring accordingly resists movement of the movable frame 11 on rod 12, axially thereof, in the direction away from the cam follower 31. The cam 25 is free to rotate relatively to the movable frame 11, but the collars 26 and 27 prevent axial movement of said cam 25 relative to said movable frame 11. Hence, axial movement of the cam 25 and the frame 11 must necessarily be an integral movement of the one with the other. When, therefore, engagement of the cam 25 with the cam follower 31 causes an outward movement of said cam from said cam follower, a corresponding movement of the movable frame 11 will simultaneously be caused. And, by the same token, the spring action which resists the outward movement of the movable frame 11, will ipso facto resist the outward movement of the cam. When the rotary movement of the cam 25 tends to release it from engagement with the cam follower 31, the spring action acting upon the frame 11 and through said frame upon the cam 25 will automatically urge said cam into continued engagement with the cam follower. It will be understood, therefore, that by virtue of the action of the spring member 35, the cam 25 will at all times remain in engagement with the cam follower 31. The net effect of all this is to produce a reciprocatory movement of the movable frame 11 and of everything said frame supports, axially of rod 12.

Fixedly mounted on the drive shaft 16 is the cutting wheel 40. This is a conventional cutting wheel and its speed of rotation is determined by the speed of the electric motor and the ratio between pulleys 17 and 18. Since cutting wheel 40 is affixed to drive shaft 16 and since said drive shaft is mounted on movable frame 11, all of the movements of said movable frame will be

transmitted to said cutting wheel. These movements of movable frame 11 may now be summarized as follows, since these movements are translated into corresponding movements of the cutting wheel 40: axial movement on rod 12 forward and back on said rod, and a pivotal movement on said rod controlled by the weight of the electric motor on one side of said rod and stabilized by spring 42 which interengages the movable and stationary frames 11 and 10 respectively on the other side of said rod 12. It will hereinafter be seen that another element which controls the pivotal movement of the movable frame 11 and the corresponding movement of the cutting wheel 40 is the pattern key follower 45.

Immediately above the cutting wheel 40, and forward of said cutting wheel, is a keyway 50 adapted to receive a key blank 51. Immediately above and slightly forward of key follower 45 is a second keyway 52 which accommodates a pattern key 53. Supporting the key blank 51 is a plate 54 and supporting the pattern key 53 is a similar plate 55. It will be noted in Fig. 2 that the key pattern and key blank are disposed in a vertical plane, the serrated edge of the pattern key and the corresponding edge of the key blank facing downwardly. The supporting plates 54 and 55 engage these edges of the two keys to support them in their respective keyways.

Reference to Fig. 4 will disclose the fact that these two supporting plates 54 and 55 are pivotally mounted on post 57 by means of pins 58 and 59 respectively. These pins extend on parallel, horizontal lines. The post 57 is itself pivotally supported by means of pin 60 on stationary frame 10. A tension spring 61 connected on one end to the stationary frame 10 and at its opposite end to the free end of post 57, tends to urge said post to pivot in the direction of the two keyways. A tension spring 63 connected to a bracket 64 on the pivotal post 57 and also connected to the plate 54 tends to urge said plate upwardly and in relatively tight contact with the key blank 51. A similar spring 65 affixed to bracket 66 on the pivotal post 57 and also affixed to the upper supporting plate 55 tends to hold said plate in relatively tight contact with the pattern key. When the two keys are slipped into their respective keyways, the two supporting plates are encountered and pushed out of the way against the action of springs 63 and 65 until the supporting plates are brought into the position shown in Fig. 3. It is clear, therefore, that when the supporting plates are brought into the position shown in Fig. 3, they are well adapted by virtue of the action of springs 63 and 65 upon them to support the two keys in place.

The pivoted post 57 is the means by which key supporting plates 54 and 55 are brought into and out of supporting engagement with the key and key blank. It is clear that the key follower 45 would not be able to engage the key 53 and the cutting wheel 40 would not be able to engage the key blank 51 if the key supporting plates 54 and 55 remained in the positions shown in Figs. 2 and 4. It is necessary, therefore, to move the supporting plates out of contact with the key and key blank before the cutting operation can take place. It will be seen in Figs. 3, 4, and 6 that the pivotally mounted post 57 is provided with a bracket 70 to which is affixed a cam follower 75. The cam follower 75 engages a cam 76 which is attached to the sleeve 77 which rides freely on

rod 12. Actually, the cam 25 is connected to sleeve 77 so that axial movement of said sleeve relative to said cam is precluded. It is evident, therefore, that when the cam moves back and forth upon the rod 12, the sleeve 77 will engage in corresponding movement. Such movement of the sleeve 77 results in engagement and disengagement of the cam 76 with the cam follower 75. It will be appreciated that when cam 76 moves into engagement with cam follower 75, the post 57 will be caused to pivot from its position shown in Fig. 3 to the position which it occupies in Fig. 4. In this latter position, the key supporting plates 54 and 55 are moved out of engagement with the key and the key blank. Said key and said key blank are now exposed for contact with the key follower and the cutting wheel.

It is essential that the key and key blank be held tightly in operative position after the key and key blank supporting members are removed therefrom. The means by which this is accomplished is the pair of clamps 80 and 81 respectively shown in greater detail in Fig. 5.

Clamps 80 and 81 are attached respectively to sleeves 82 and 83 mounted for rotation on pins 84 and 85. When these sleeves are caused to turn on their respective pin supports, they cause the clamps 80 and 81 to move from their solid line positions shown in Fig. 5 to their dotted line positions also shown in said Fig. 5, and back again to their solid line positions. The solid line positions shown in Fig. 5 correspond to the solid line positions shown in Fig. 3 and it will be seen in the latter figure that the clamp members in said solid line positions are out of engagement with the pattern key and the key blank. The dotted line positions in Fig. 5 correspond to the solid line positions in Fig. 4 and it will be seen that when the clamps occupy these positions, they are in clamping engagement with key and key blank. It is when the clamps are in these positions that the key and key blank are held tightly in operative condition.

The means by which the clamp members 80 and 81 are brought into and out of clamping engagement with the key and key blank is best shown in Fig. 5 and also in Fig. 1. It will be seen that sleeve 77 terminates in the form of a cam 90. Two cam followers 91 and 92 are positioned to engage said cam 90 when the sleeve 77 moves in their direction on rod 12. These cam followers are mounted respectively on brackets 93 and 94 which are connected to sleeves 82 and 83. It will be understood from this construction that when the cam sleeve 77 moves into engagement with the cam followers 91 and 92, these cam followers and the brackets which support them are wedged into the dot and dash line positions shown in Fig. 5. Since these brackets are connected to the sleeves 82 and 83 and since the clamp members 80 and 81 are connected to said sleeve members, the movement of cams 91 and 92 into the dot and dash line positions shown in Fig. 5 will be reflected by a corresponding movement of the clamp pieces 80 and 81 into their dotted line positions shown in said Fig. 5.

It will be apparent from the foregoing that a forward movement of the cam sleeve 77 against the cam followers effects a clamping action of clamps 80 and 81 against the pattern key and key blank. It will be noted that the movement of brackets 93 and 94 into the dot and dash line positions of Fig. 5 takes place against the action of a tension spring 97 which engages said brackets. In consequence, when the cam sleeve is retracted to a position out of contact with the cam followers 91 and 92, (see the solid line positions of said cam followers in Fig. 5) the spring 97 will draw said brackets 93 and 94 together and thereby move the clamp pieces 80 and 81 out of contact with the key and key blank.

It will be noticed that the action of the cam sleeve 77 upon the cam followers 91 and 92 is synchronized with the action of the cam 76 on cam follower 75. It is accordingly the case that the key and key blank supporting plates 55 and 54 respectively remain in supporting relation to the key and key blank until such time as the clamp members 80 and 81 take over, and themselves hold the key and key blank in place. By the same token, the clamp members remain in contact with the key and key blank until the supporting plates are moved into supporting position relative to said key and key blank. Since the cutting wheel 40 and the key follower 45 are mounted on the movable frame 11 and since said movable frame and the cam sleeve 77 move integrally with each other, it will be appreciated that the movement of said cutting wheel and said key follower with respect to the key blank and the pattern key is synchronized with the several movements above described with respect to the key clamps and the key supporting plates. More specifically, the key follower 45 and the cutting wheel 40 move into engagement with the key and key blank only after the key clamps have taken over the job of holding the key and key blank in place from the plate supports.

It will be observed in Fig. 2 that the key follower 45 is adjustably mounted on the movable frame 11. A screw member 100 enables the key follower to be raised or lowered relative to the pattern key. The screw member 101 enables said key follower to be moved backward or forward in respect of said pattern key. In Fig. 2, it will be seen that the key follower 45 has been moved far in advance of the cutting wheel 40. It will normally be found desirable to bring the key follower into position immediately above the cutting wheel to correspond to the position of the pattern key immediately above the key blank.

A complete key duplicating operation may now be described: the key and key blank are inserted into their respective keyways 52 and 53 and they are held in position in said keyways by supporting plates 55 and 54. By conventional means which need not be shown in the drawing, an electric circuit is closed through the electric motor and said motor is thereby set in operation. The belt and pulley system and the gear train are now actuated to cause rotation of the main cam 25. Since this cam is in engagement with the fixed cam follower 31, a forward movement of said cam and hence of the cam sleeve 77 will result. The cam 76 will engage the cam follower 75 and the cam 90 will engage the cam followers 91 and 92. In consequence of such action, the clamp members 80 and 81 will move into clamping engagement with the key and key blank and the supporting plates 55 and 54 will move out of supporting contact with said key and key blank. The serrated edge of the key and the corresponding edge of the key blank are now exposed for the cutting operation. Since the travelling frame 11 and the cam sleeve 77 move integrally with each other in the same direction and since the key follower and the cutting wheel are mounted on said travelling frame, they too will move integrally with the cam sleeve, also in the same direction. Shortly after the clamp members take over

the job of holding the key and key blank in place, the key follower encounters the key and simultaneously the cutting wheel enters into cutting engagement with the key blank. The weight of the electric motor which is applied to the travelling frame 11 on the opposite side of rod 12 now tends to hold the key follower in continuous and uninterrupted engagement with the serrated edge of the key, and the cutting wheel in continued and unbroken contact with the key blank. The travelling frame 11 together with the key follower and the cutting wheel move forwardly until the key follower reaches the end of the serrated portion of the pattern key. By this time, the key blank nas been cut in accordance with the pattern of the pattern key. The return movement of the travelling frame 11 now begins and the key blank cutting process is repeated. This second cutting process merely insures the accuracy of the original cutting operation. When the key follower and the cutting wheel clear the serrated edge of the key and the now serrated edge of the key blank, the backwardly travelling frame 11 moves the cams 76 and 90 out of engagement with the cam followers 75 and 91 and 92. The tension spring 61 now returns the pivotally mounted post 57 to the position which it is shown to occupy in Fig. 3. By virtue of this fact, the supporting plates 55 and 54 are brought back into the supporting positions under the key and key blank. (See Fig. 3.) At the same time, tension spring 97 draws the two brackets 93 and 94 together until they reach the solid line positions shown in Fig. 5. The effect of such movement is to remove the clamping members 80 and 81 from clamping contact with the key and key blank. When the travelling frame reaches its farthermost position away from the key and key blank, the electric circuit to which the electric motor is connected, is broken by conventional means which need not be shown. The key and key blank may now be withdrawn from the machine and the cutting operation is completed.

The foregoing represents a preferred embodiment of this invention and it must be clearly understood that the precise form which the invention has been permitted to take in this embodiment may be varied and changed in innumerable ways within the broad spirit and principles of this invention. An illustration of the manner in which this embodiment may be changed within the broad scope of the invention may be found in Fig. 7. A cam 110 and a cam follower 111 are shown there, which are adapted to take the place of cam 25 and cam follower 31. The sole essential difference between these two cams resides in the fact that cam 25 is provided with a single cam face whereas cam 110 is provided with a double cam face. This double cam face takes the form of a groove 112 in which the cam follower 111 rides. Since the cam follower 111 engages both faces of the groove 112, it causes cam 110 to move reciprocatorily on rod 12 in both directions, axially of said rod. Whereas in the first form of this invention it was necessary to use a tension spring 35 to retract the travelling frame to its original position as shown in Fig. 1, the present type of cam 110 eliminates the need for tension spring 35 or any other tension spring.

We claim:

1. A key duplicating machine comprising a frame, a carriage movable on said frame, a pair of slots in said frame for reception of a pattern and a blank, a pattern follower and a cutter mounted on said carriage and movable therewith, driven means operating between said carriage and frame for moving said carriage, follower and cutter toward and away from said pattern and blank, a pair of supports, one for said pattern and one for said blank movably mounted on said frame, operating means connected to said supports, means connected to said movable carriage for engagement with said operating means to move the supports out of supporting position relative to the slots when the carriage moves the follower and cutter into engagement with said pattern and blank, a pair of movable bars each forming one wall of one of said slots, arms connected to said bars, means connected to said movable carriage for engagement with said arms to move the bars into clamping position relative to said pattern and blank and tension means connected to the bars to move same out of clamping position relative to the pattern and blank when the supports are moved to operative position.

2. A key duplicating machine comprising a frame, a carriage movable on said frame, a pair of slots in said frame for reception of a pattern and a blank, a pattern follower and a cutter mounted on said carriage and movable therewith, driven cam means connected to said movable carriage for moving said carriage, follower and cutter toward and away from said pattern and blank, a pair of supports, one for said pattern and one for said blank movably mounted on said frame, tension means holding said supports in supporting position relative to said slots, cam following means connected to said supports, cam means connected to said movable carriage for engagement with said cam following means to move the supports out of supporting position relative to the slots when the carriage moves the follower and cutter into engagement with said pattern and blank, a pair of movable bars each forming one wall of one of said slots, follower means connected to said bars, cam means connected to said movable carriage for engagement with said followers to move the bars into clamping position relative to said pattern and blank and tension means connected to the bars to move same out of clamping position relative to the pattern and blank when the supports are moved to operative position.

3. A key duplicating machine comprising a frame, a carriage movable on said frame, a pair of slots in said frame for reception of a pattern and a blank, a pattern follower and a cutter mounted on said carriage and movable therewith, driven means operating between said carriage and frame for moving said carriage, follower and cutter toward and away from said pattern and blank, a pair of supports, one for said pattern and one for said blank movably mounted on said frame, operating means connected to said supports, and means connected to said movable carriage for engagement with said operating means to move the supports out of supporting position relative to the slots when the carriage moves the follower and cutter into engagement with said pattern and blank.

4. A key duplicating machine comprising a frame, a carriage movable on said frame, a pair of slots in said frame for reception of a pattern and a blank, a pattern follower and a cutter mounted on said carriage and movable therewith, driven cam means connected to said movable carriage for moving said carriage, follower and cutter toward and away from said pattern and said blank, a pair of supports, one for said pattern and one for said blank movably mounted

on said frame, tension means holding said supports in supporting position relative to said slots, cam following means connected to said supports, and a cam connected to said movable carriage for engagement with said cam following means to move the supports out of supporting position relative to the slots when the carriage moves the follower and cutter into engagement with said pattern and blank.

5. A key duplicating machine comprising a frame, a carriage movable on said frame, a pair of slots in said frame for reception of a blank and a pattern, a pattern follower and a cutter mounted on said carriage and movable therewith, driven means operating between said carriage and frame for moving said carriage, follower and cutter toward and away from said pattern and blank, a pair of movable bars each forming one wall of one of said slots, arms connected to said bars, means connected to said movable carriage for engagement with said arms to move the bars into clamping position relative to said pattern and blank and tension means connected to the bars to move same out of clamping position relative to the pattern and blank.

6. A key duplicating machine comprising a frame, a carriage movable on said frame, a pair

of slots in said frame for reception of a pattern and a blank, a pattern follower and a cutter mounted on said carriage and movable therewith, driven cam means connected to said movable carriage for moving said carriage, follower and cutter toward and away from said pattern and blank, a pair of movable bars each forming one wall of one of said slots, follower means connected to said bars, cam means connected to said movable carriage for engagement with said followers to move the bars into clamping position relative to said pattern and blank and tension means connected to the bars to move same out of clamping position relative to the pattern and blank.

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