Oct. 15, 1957 D. W. ORCHARD 2,809,566

KEY DUPLICATING MACHINE

Filed June 11, 1954 3 Sheets-Sheet 1

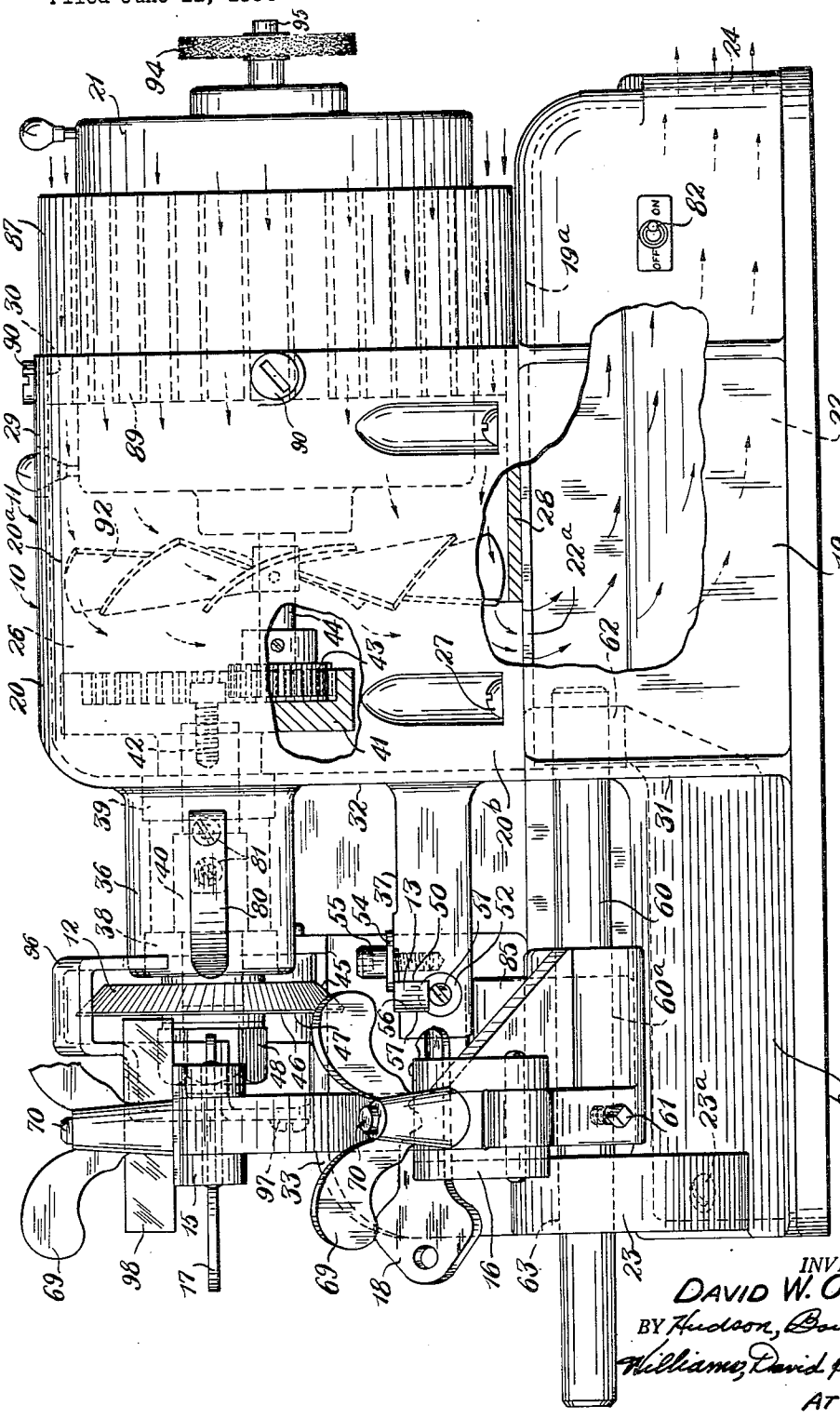


FIG. 1

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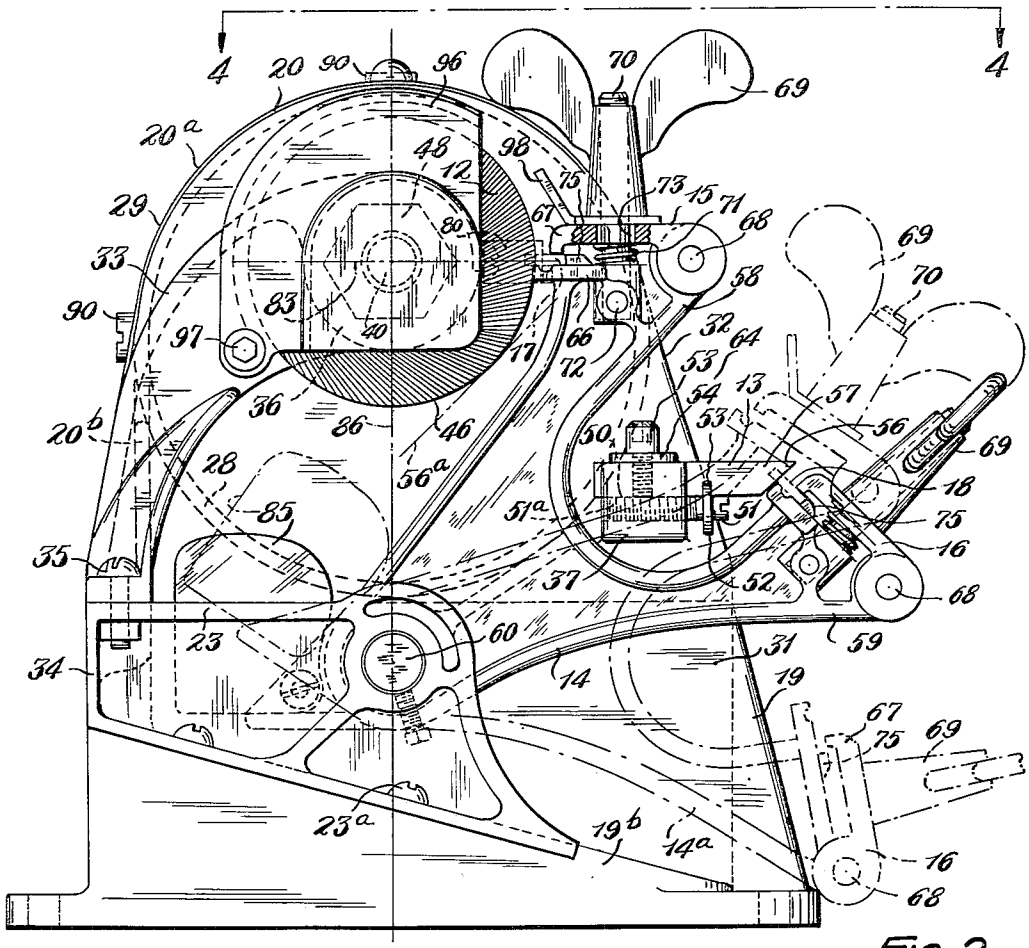


FIG. 2

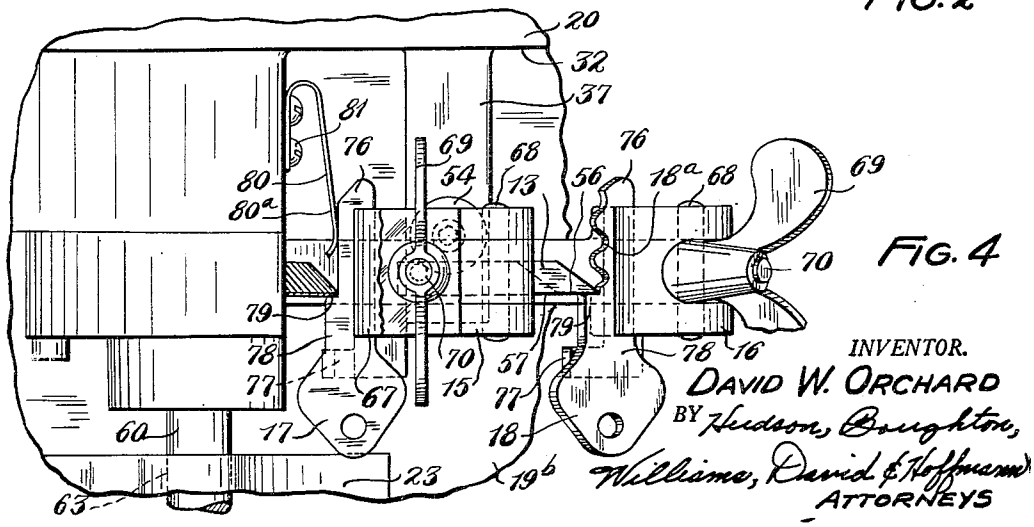


FIG. 4

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Filed June 11, 1954 3 Sheets-Sheet 3

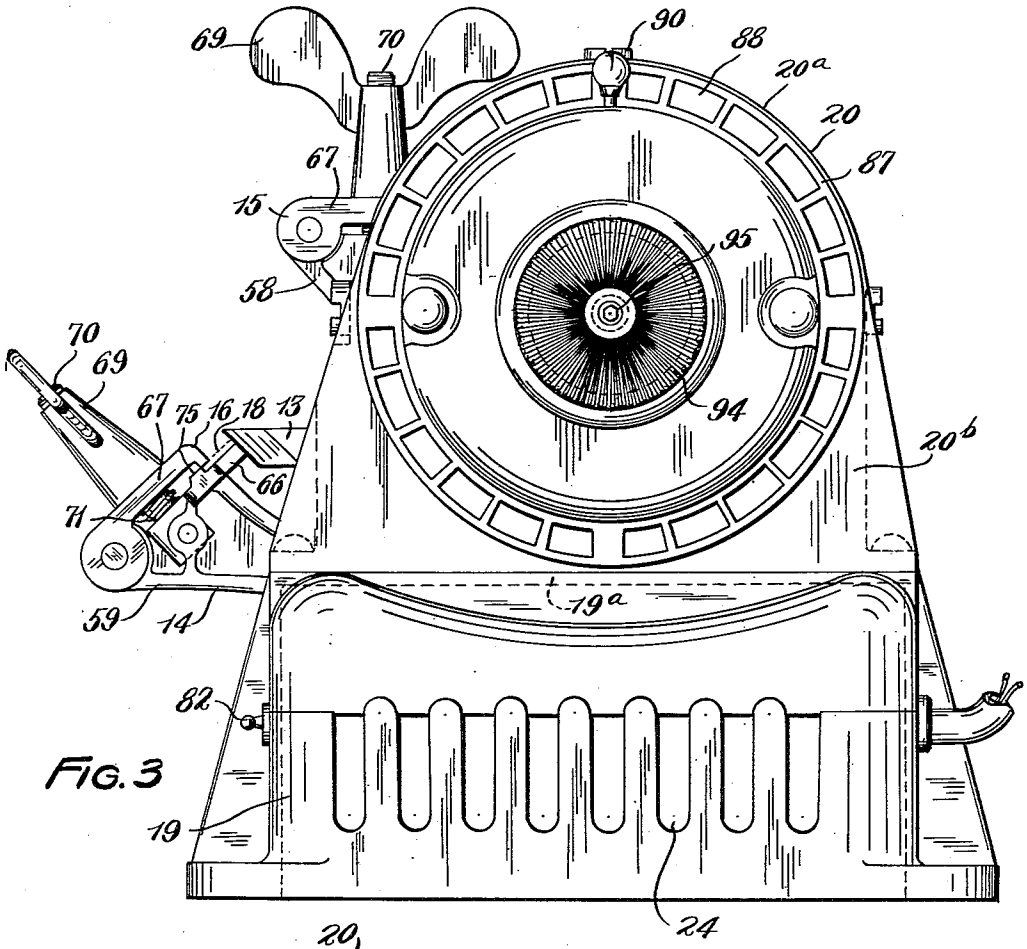


FIG. 3

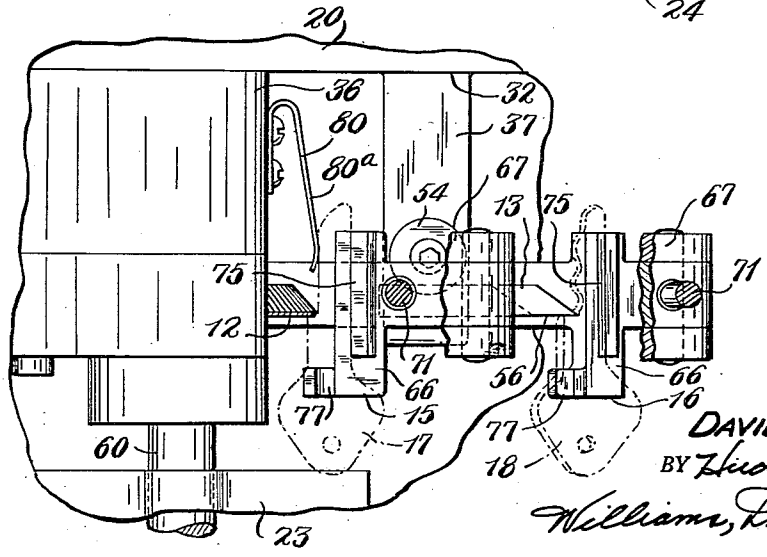


FIG. 5

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United States Patent Office

2,809,566

Patented Oct. 15, 1957

2,809,566

KEY DUPLICATING MACHINE

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Application June 11, 1954, Serial No. 435,968

1 Claim. (Cl. 90—13.05)

This invention relates to key duplicating machines of the kind in which a desired profile is cut on a key blank to correspond with the profile of a key to be duplicated, and as one of its objects, aims to provide an improved machine of this kind which is of a simple, compact and economical construction and which is accurate in its performance and requires no unusual skill for its operation.

Another object is to provide an improved key duplicating machine having a workholder or carriage adapted to receive key members thereon comprising a key blank and a key to be duplicated, and in which the carriage is mounted for both swinging and translatory movements for engaging the key members with a rotary cutter and a cutting guide respectively.

Still another object is to provide a key duplicating machine of the character mentioned in which the engagement of the key members with the cutter and guide is accomplished with the key members in such relation thereto as to minimize the error, and the accumulation of error which has heretofore been prone to occur in duplicating operations performed by machines of this kind.

A further object is to provide a key duplicating machine of the character above mentioned in which the carriage has spaced arm portions extending forwardly of the cutter and guide and carrying clamping devices for the key members, and in which such arm portions straddle the guide support during at least a portion of the translatory movement of the carriage.

Yet another object is to provide such an improved key duplicating machine in which the carriage is biased, preferably by counterweight means, toward extreme positions of its permissible swinging movement in response to initial manual movement away from a neutral or intermediate position.

As another of its objects, this invention provides a duplicating machine of the character above indicated in which the clamping devices of the carriage are constructed for ease of operation, and in which they engage and support the key members so as to avoid bending or twisting of those members.

It is also an object of this invention to provide such an improved key duplicating machine in which the driving motor is a shaded pole motor and in which the frame structure defines passage means for a forced flow of air for cooling the motor.

Additionally, this invention provides an improved duplicating machine of the kind indicated above in which the frame structure has an end opening into which a motor unit is insertable and in which the passage means for the cooling air includes an annular group of axial ports surrounding the motor and forming one end of the air passage.

The invention can be further briefly summarized as consisting in certain novel combinations and arrangements of parts hereinafter described and particularly set out in the claims hereof.

In the accompanying sheets of drawings forming a part of this specification:

Fig. 1 is a front elevation of a key duplicating machine embodying the present invention;

Fig. 2 is an end view of the machine as seen from the cutter end thereof;

Fig. 3 is an end elevation of the opposite end of the machine;

Fig. 4 is a partial plan view further illustrating the carriage and the cooperation of the key members with the cutter and cutter guide; and

Fig. 5 is a partial plan view similar to Fig. 4 but with the upper jaws of the clamping devices broken away and with only a phantom showing of the key members.

The key duplicating machine **10** comprises in general a frame structure **11** having a cutter **12** and a cutting guide **13** supported thereon, and a workholder comprising a carriage **14** carrying clamping devices **15** and **16** which are adapted to receive and hold a key blank **17** and a key to be duplicated **18**. The carriage **14** is mounted so as to have both swinging and translatory movements, as will be further explained hereinafter, for simultaneously engaging the key blank **17** and the key **18** with the cutter **12** and the cutting guide **13** respectively.

The frame structure **11** comprises a pair of connected lower and upper frame members **19** and **20**, of which the lower frame member forms the base of the machine and the upper frame member forms a support section on which an electric driving motor **21** is mounted. The base **19** is a generally rectangular hollow member having pairs of upright side and end walls and a partial top wall **19***a*. The base contains a chamber or space enclosure **22** having a top opening **22***a*. The base **19** also has a laterally extending carrier portion **19***b* at one end thereof and on which a bearing bracket **23** is secured by the screws **23***a*. The end wall of the base remote from the carrier portion **19***b* is provided with a grill formation defining a row of vertical air ports **24** communicating with the chamber **22**.

The upper frame member **20** is a hollow member which is seated on the base **19** such that the chamber or space enclosure **26** of this upper member overlies the chamber **22** of the base and communicates with the latter through a portion of the opening **22***a*. The upper frame member **20** has a longitudinally extending transversely rounded top portion **20***a* which merges with an upright lower portion **20***b* of a generally quadrangular shape. The lower portion **20***b* is secured against the top of the base **19** by suitable screws **27**. The upper frame member **20** also includes a transversely curved inner wall **28** which cooperates with the rounded top portion **20***a* in defining a substantially cylindrical hollow axial barrel portion **29** having an end opening **30** into which the driving motor **21** is adapted to be inserted.

When the frame members **19** and **20** are in their connected relation shown in the drawings, the end walls **31** and **32** of these members are in a substantially vertically aligned relation. The upper frame member **20** also includes an upwardly and forwardly curved wall **33** projecting laterally therefrom above the carrier portion **19***b* of the base. The lower edge of this laterally projecting wall **33** engages the top of the upstanding rear wall **34** of the carrier portion **19***b* and the top of the bearing bracket **23** and is secured to the latter parts by screws **35**.

The upper frame member **20** has a pair of integrally formed projections **36** and **37** thereon which extend laterally from the end wall **32**. The projection **36** is a mount for the rotary cutter **12** and the projection **37** is a mount for the cutting guide **13**. The projection **36** has the upper edge of the curved wall **33** integrally joined thereto.

The projection **36** is a substantially cylindrical hollow projection having suitable axially spaced bearings **38** and **39** therein rotatably supporting a drive shaft or arbor **40** carrying the cutter **12**. The inner end of the shaft **40** extends into the chamber **26** of the upper frame member **20** and has a ring gear **41** secured thereto as by means of the screw **42**. A drive pinion **43** suitably mounted on the shaft **44** of the electric motor **21** meshes with the ring gear **41** so as to provide a geared drive for the cutter **12**.

The cutter **12** is a cutting wheel of a conventional shape and construction having a beveled annular face **45** defining a peripheral cutting edge **46** adjacent the flat outer side face **47**. The cutter is suitably secured on the outer end of the shaft **40** as by means of the clamping nut **48**.

The projection **37** comprises an arm or bracket located below and to the front of the cutter shaft projection **36** and is provided with a transverse slot **50** adjacent its outer end in which the cutting guide **13** is mounted. The guide **13** comprises a bar of a substantially rectangular cross-sectional shape which is engaged in the slot **50** and projects forwardly from the support **37** in substantially right-angle relation thereto.

The guide **13** is endwise shiftable in the slot **50** by means of an adjusting screw **51** having its stem threadedly engaged in an opening **51***a* of the projection **37** and also having a circular thrust collar **52** engaged in a transverse slot **53** of the guide. By rotating the screw **51** in the threaded opening **51***a* of the projection **37**, the collar **52** will impart a longitudinal adjusting movement to the guide **13**. When the guide **13** has been thus adjusted by the screw **51**, it is adapted to be clamped to the projection **37** by the collar **54** of a clamping screw **55**. This adjustment for the guide **13** moves the reference edge **56** relative to the cutter axis so as to vary the distance of this reference edge from the cutter axis substantially in a direction radially of the cutter.

The cutting guide **13** can be in the form of a section of suitable length cut from bar stock of appropriate cross-sectional shape, preferably square as shown in the drawings. The outer end of this guide is beveled on an inclined plane so as to provide a relatively sharp, straight reference edge **56** lying in the vertical plane of the flat side face **57** of the guide. The reference edge **56** is inclined downwardly and rearwardly at an angle of approximately 45 degrees such that this edge lies in an inclined plane which is parallel to a plane which is tangent to the peripheral edge **46** of the cutter. This tangent plane is represented by the line **56***a*.

The carriage **14** is in the form of a substantially Y-shaped bracket having a pair of spaced arms **58** and **59** which extend forwardly and upwardly adjacent the cutter **12** and guide **13** respectively. The clamping device **15** for the key blank **17** is carried by the arm **58**, and the clamping device **16** for the key **18** is carried by the arm **59**. The lower end of the carriage **14** is secured to a slide shaft **60** which extends in parallel relation to the cutter shaft **40**.

The carriage **14** has an opening **60***a* in its lower end through which the shaft **60** extends and in which this shaft is secured by means of the set screw **61**. The shaft **60** forms a pivot shaft for the transverse swinging movement of the carriage **14** and also forms a slidable support for the translatory movement of the carriage in the direction of the axis of the cutter shaft. For this purpose, the shaft **60** is rockably and slidably mounted in a pair of axially spaced bearings **62** and **63**. The bearing **62** is formed on or supported by the end wall **31** of the base **19** and the bearing **63** is in the bearing bracket **23**.

The space **64** between the arm portions **58** and **59** of the carriage **14** is such that these arm portions will straddle the guide support **37** during at least a portion of the axial translatory movement of the carriage and also provides sufficient clearance to accommodate the cutting guide **13** and the guide support **37** during the transverse swinging movement of the carriage in engaging the key members **17** and **18** with the cutter and cutting guide. The spacing of the bearings **62** and **63** and the length of the pivot shaft **60** are such that the carriage **14** will be movable in a direction away from the wall **31** for a sufficient distance to permit the upper arm portion **58** to move past the outer end of the guide support **37** during swinging of the carriage downwardly from its cutting position, shown in full lines in Fig. 2, to its initial or unloading position represented by the broken line showing **14***a*.

The clamping devices **15** and **16** are substantially identical in construction, and each comprises a generally flat lower support jaw **66** formed integral with the carriage **14** and against which the key or key blank is adapted to be clamped by a movable upper clamping jaw **67**. The lower jaws **66** are formed on the carriage **14** so as to lie in planes which are disposed in a substantially 45-degree angular relation to each other. The movable clamping jaw **67** is swingably connected with the carriage by a transverse pivot pin **68**. A wing nut **69** provided on a clamping screw **70** is engageable with the movable jaw **67** for actuating the same into clamping engagement with the key member in opposition to the action of a compression spring **71** disposed around such screw and located between the jaws.

The screw **70** has one end thereof pivotally connected with the carriage **14** by means of a pivot pin or trunnion member **72** such that the clamping screw and wing nut can accommodate themselves to the different angular positions assumed by the movable jaw **67**. A clearance opening **73**, provided in the movable jaw and through which the screw **70** extends, permits this self-adjusting swinging movement of the screw. By reason of this pivotal connection of the clamping screw **70** with the carriage and the provision of the clearance opening **73**, neither the screw nor the movable jaw **67** will be subjected to cramping or bending, and accordingly, the clamping device will be very easy to actuate and will have a positive gripping action on the key member.

The clamping devices **15** and **16** also include a transversely extending abutment or reference shoulder **75** formed on the lower jaw **66** and adapted to be engaged by an edge of the stem portion **76** of the key member for locating the key member in the clamping device. The clamping devices **15** and **16** also include a support lug or projection **77** formed as an integral extension of the lower jaw **66** and providing a relatively wide portion on this jaw which will be flatly engaged by and support the relatively wide body portion **78** of the key member when the latter is in its clamped position. This engagement of the relatively wide body portion of the key member with the support portion **77** prevents twisting or bending of the key member during the clamping of the same on the carriage and during the duplicating operation.

The key members **17** and **18** are of the kind having a reference shoulder **79** thereon at the junction of the stem portion **76** with the body portion **78**. When the key members are being mounted on the carriage **14**, the key **18** is inserted first in its clamping device **16** and while the edge of the stem is being held against the reference edge **56** of the cutting guide **13** and the shoulder **79** is being held against the side face **57**, the clamping nut **69** is tightened. Thereafter, the blank **17** is inserted into its clamping device **15** and, while the shoulder **79** is being held against the side face **47** of the cutter **12**, the clamping nut **69** is tightened.

It is important that the key blank **17** be firmly engaged with the shoulder **75** of the clamping device **15** prior to the tightening of the wing nut **69**. For this purpose a yieldable pressure means is provided on the frame structure **11** for pressing the blank **17** against this shoulder when the blank is engaged against the cutter and is being clamped in the device **15**. This pressure means is here shown as comprising a plate spring **80** secured to the frame

projection 36 by means of the screws 81 and having an arm 80a which is engageable by the exposed edge of the stem of the key blank, as shown in Fig. 4.

Swinging of the carriage 14 toward the cutter 12 while the key blank 17 is being located in the clamping device 15 will cause the spring arm 80a to engage the key blank and press the same against the shoulder 75, whereupon the wing nut 69 is tightened to lock the blank in the clamping device. The spring 80 thus automatically insures proper alignment of the key blank in the clamping device 15 such that a tilted position, which would result in improper cutting of the key blank, will be avoided.

When the key members have thus been located and secured in proper relation in the clamping devices 15 and 16, the carriage is swung down to its initial position 14a to disengage the key blank 17 from the cutter 12 until the motor 21 can be started by actuation of a suitable control switch 82 provided on the base 19. The carriage 14 is then swung upwardly to its full-line position to thereby engage the key members 17 and 18 with the cutter 12 and the guide 13 respectively for the performance of the cutting or profile duplicating operation on the key blank. During the cutting operation, the irregular profile 18a of the key to be duplicated is moved along the reference edge 56 of the cutting guide 13 by manual shifting of the carriage 14 such that a resulting combined swinging and translatory movement of the carriage will cause the cutter 12 to generate a similar profile on the key blank 17.

The location of the clamping devices 15 and 16 on the carriage 14 is such that the key blank 17 will be supported in the cutting position by the lower jaw 66 with the mid plane of the key blank coinciding substantially with a horizontal plane passing through the rotational axis of the cutter 12 and represented by the line 83. The location of the clamping device 15 is also such that the edge of the stem of the key blank 17 will be presented to the peripheral cutting edge 46 in a substantially normal relation thereto. Similarly, the location of the clamping device 16 on the carriage 14 is such that the key 18 will be supported by the lower jaw 66 so that the stem of this key will be presented edgewise to the reference edge 56 of the cutting guide 13 and in a substantially normal relation to such reference edge.

By having the clamping devices 15 and 16 located so as to support the key members in this relation, the movements imparted to the blank 17 during the cutting operation by the swinging of the carriage 14 will be very small movements lying substantially in the horizontal radial plane 83 such that a minimum amount of error will occur in the profile being cut as the result of such swinging movement. The edge of the profile being generated on the blank 17 will thus also extend transversely of the stem at right angles to the general plane of the stem. A more accurately formed key will thus be produced, and when a succession of keys are produced by duplication of one from another, the additive error will still be so small that the final key will have substantially the same profile as the first key of the series.

In accordance with another feature of this invention, the carriage 14 is subjected to a biasing force tending to move the same toward one or the other of the extreme limits of its swinging movement. This biasing force is preferably supplied by a counterweight 85 of a suitable size and shape and which is secured to or formed as a part of the carriage. The provision of the counterweight 85 causes the carriage to have a center of gravity which will move across a vertical neutral axis 86 on an arc located above the pivot shaft 60, during the transverse swinging movements of the carriage. The neutral axis 86 preferably extends through the axis of the cutter shaft 40 and the axis of the pivot shaft 60 of the carriage.

During the intermediate portion of the swinging movement of the carriage 14, its center of gravity will be on or near the neutral axis 86, but when the carriage is manually swung in either direction to cause the center of gravity to move away from the neutral axis, the counterweight 85 becomes effective to apply an actuating force to the carriage tending to move the same toward the extreme limit of its swinging movement. Thus, when the key members 17 and 18 have been mounted on the carriage as explained above and the carriage is swung upwardly toward the cutter 12, the counterweight 85 will become effective as the center of gravity moves toward the left across the neutral axis 86 such that the force supplied by the counterweight will assist in holding the key members in engagement with the cutter and cutting guide. Similarly, when the carriage is swung downwardly to its initial position 14a at the completion of the cutting operation, the force supplied by the counterweight 85 will become effective to assist in moving the carriage to its extreme lower position and will be sufficient to hold the carriage in such lower position until the first set of key members is removed therefrom and until the carriage is again manually swung upwardly preparatory to the mounting of another set of key members thereon. The intermediate position of the carriage 14 in which its center of gravity is located on the axis 86, can be referred to as its neutral or dead-center position.

The electric motor 21 is preferably a shaded pole motor, which is a very inexpensive form of motor. Such a shaded pole motor has been found to be a very satisfactory driving means for a key duplicating machine of this kind when sufficient cooling is provided for the motor. In the duplicating machine here shown, the chambers 25 and 26 of the frame members 19 and 20 are in communication through the opening 22a and define a passage for circulating cooling air through the frame structure and across the motor.

The housing of the motor 21 includes an intermediate ring member 87 which has an annular series of axially elongated air ports 88 therein. The ring member 87 has a relatively reduced end portion 89 of a size to be engageable in the end opening 30 of the frame member 20. The motor 21 is mounted on the frame 11 by such engagement of the reduced end portion 89 in the end opening 30 and by the retaining screws 90. When the motor 21 is mounted in this relation, the air ports 88 communicate with the air circulating passage and form the inlet end thereof. The grill openings 24 of the base 19 form the outlet end of the air circulating passage.

Although the air inlet ports 88 are described above as being in the housing of the motor 21, they could, if desired, be formed in an extension portion of the frame member 20 so as to surround the motor when the latter is inserted into the end opening 30.

Prior to the mounting of the motor 21 on the frame 11, an air impeller 92 and the drive pinion 43 are mounted on the motor shaft 44. The impeller 92 is here shown as being a fan of the propeller type and of a size to be rotatably operable in the barrel portion 29 of the frame member 20. The motor 21, together with the drive pinion 43 and impeller 92, constitutes a preformed motor unit which is assembled on the frame 11 by inserting one end of such unit through the end opening 30 to thereby engage the drive pinion 43 with the teeth of the ring gear 41.

When the motor unit has been mounted on the frame structure 11 as above explained, the running of the motor 21 will drive the impeller 92 simultaneously with the operation of the cutter 12 to thereby cause a flow of cooling air to be circulated through the frame structure in heat-exchange relation to the motor. The cylindrical barrel portion 29 of the frame member 20 forms a surrounding shroud for the impeller 92 such that the impeller will effectively produce a positive flow of the cooling air.

A wire brush 94 mounted on a suitable projection 95 of the motor shaft will be rotated by the motor and will be available for removing burrs from the processed key members when such members are engaged against such rotating brush.

A suitable hood or guard cover 96 is provided for the

cutter 12 and partially shields the same, as shown in Figs. 1 and 2. The guard 96 is swingably mounted on the frame member 20 by means of a pivot screw 97. A transparent chip guard 98 is also provided on the clamping device 15 so as to be located in front of the cutter 12 during the cutting operation.

From the foregoing description and the accompanying drawings it will now be readily seen that this invention provides a key duplicating machine of a very simple and compact construction comprising a relatively few number of parts which can be economically produced and assembled. The frame members 19 and 20 are preferably constructed as die-castings which are relatively light in weight and require a minimum amount of machining. The frame member 20 as above described is a one-piece member with the projections 36 and 37 formed as integral parts thereof. With this construction for this frame member, the cutter 12 and the cutting guide 13 will always have a desired predetermined relation which will not be subject to a variation as would be the case if the projections 36 and 37 were formed as separate parts to be subsequently assembled.

It will now also be understood that by reason of the above-described construction for the carriage and the work clamping devices thereof, this duplicating machine can be very easily operated and will be very accurate and reliable in its performance. Additionally, it will be seen that cooling means embodied in this machine for the driving motor permits of the use of a shaded pole motor which is very inexpensive.

Although the key duplicating machine of the present invention has been illustrated and described herein to a somewhat detailed extent, it will be understood, of course, that the invention is not to be regarded as being limited

correspondingly in scope, but includes all changes and modifications coming within the terms of the claims hereof.

Having thus described my invention, I claim:

In a duplicating machine, a base, a one-piece frame member connected with said base, a rotatable shaft having a cutter thereon, an electric motor including a motor housing, reduction gearing connecting said shaft with said motor to be driven thereby, a guide, a workholder adapted to receive thereon a key blank to be cut and a key to be duplicated, said workholder being movable to engage said blank and key with said cutter and guide respectively, and support projections formed as integral portions of said one-piece frame member and having said shaft and guide mounted thereon, said one-piece frame member forming a casing for said gearing and a hollow motor mount into which at least a portion of the housing of said motor extends.

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