July 9, 1963 K. SPOHN ETAL 3,096,673

AUTOMATIC WORKING TURNING MEANS FOR SCREW MACHINES

Filed June 8, 1959 4 Sheets-Sheet 1

Fig.1

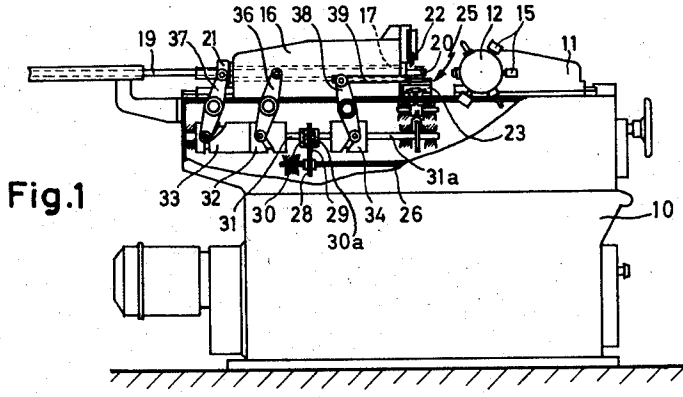


Fig.5

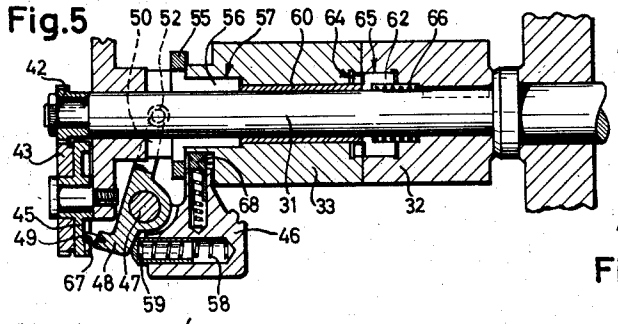


Fig.3

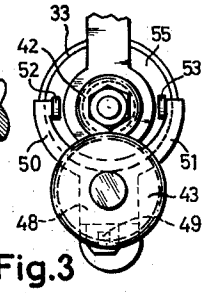


Fig.2

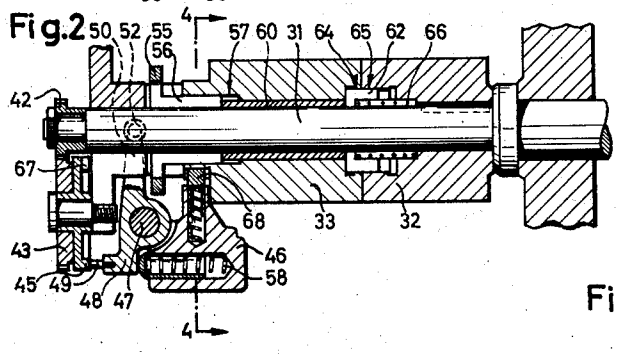


Fig.4

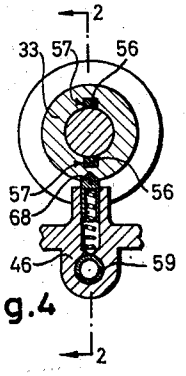
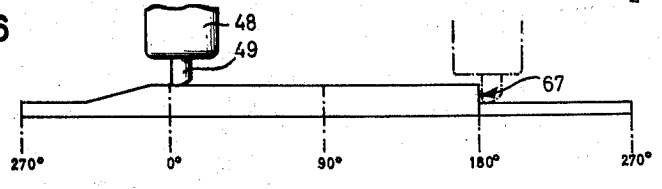


Fig.6



Inventors:
Karl Spohn
Hermann Walker
By Michael S. Striker
Attorney

July 9, 1963 K. SPOHN ETAL 3,096,673

AUTOMATIC WORKING TURNING MEANS FOR SCREW MACHINES

Filed June 8, 1959 4 Sheets-Sheet 2

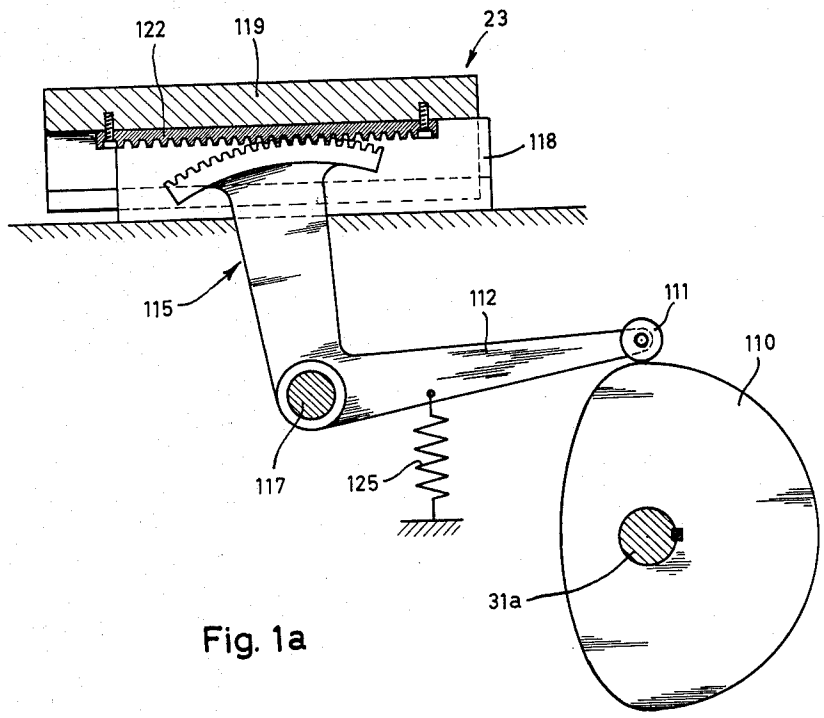


Fig. 1a

INVENTORS
Karl Spohn
Hermann Walker
BY
Michael S. Striker
Attorney

July 9, 1963 K. SPOHN ETAL 3,096,673

AUTOMATIC WORKING TURNING MEANS FOR SCREW MACHINES

Filed June 8, 1959 4 Sheets-Sheet 3

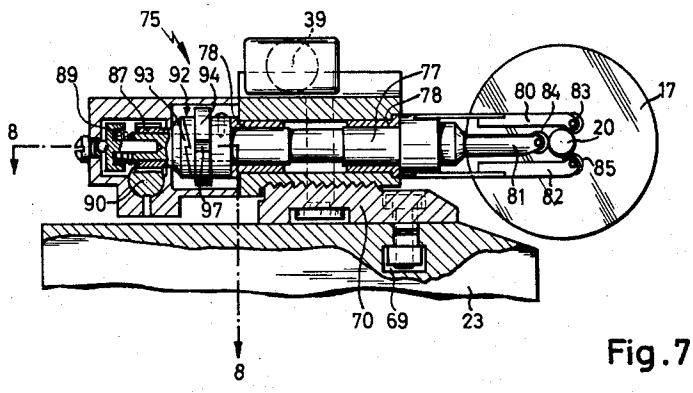


Fig.7

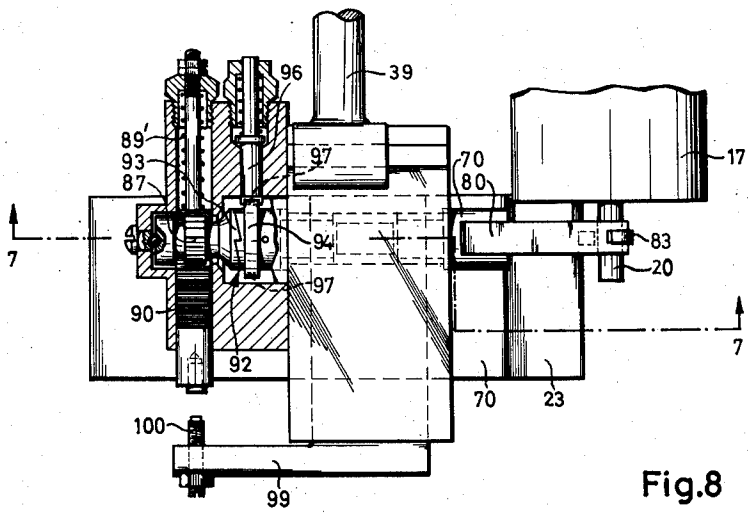


Fig.8

Inventors
Karl Spohn
Hermann Walker

By Michael S. Striker
Attorney

July 9, 1963 K. SPOHN ETAL 3,096,673

AUTOMATIC WORKING TURNING MEANS FOR SCREW MACHINES

Filed June 8, 1959 4 Sheets-Sheet 4

Fig.9

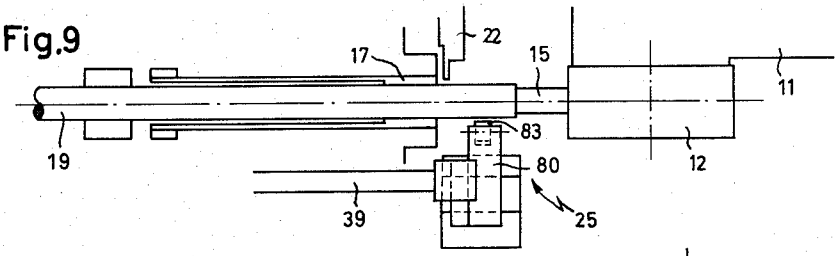


Fig.10

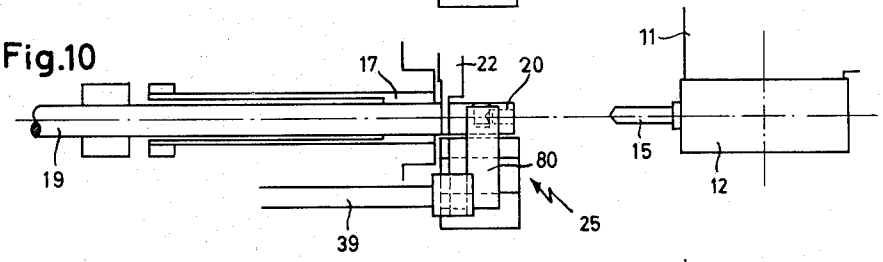


Fig.11

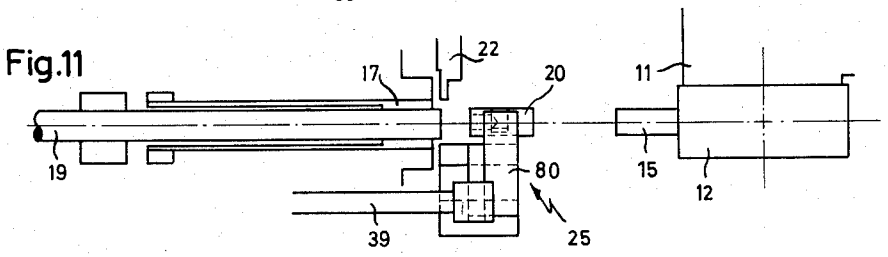


Fig.12

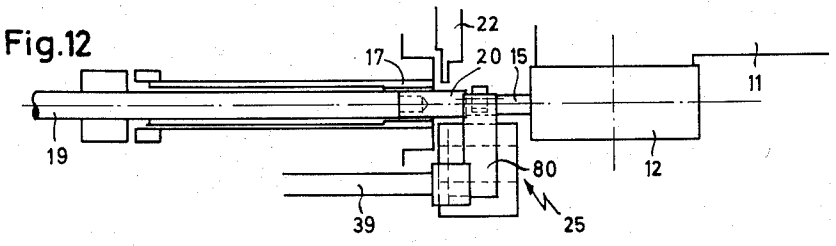
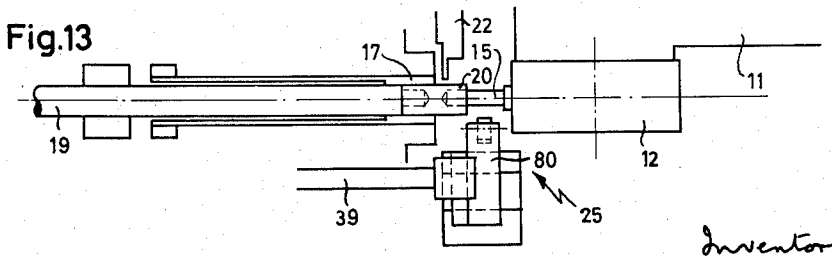


Fig.13



Inventors
Karl Spohn
Hermann Walker
By Michael S. Striker
Attorney

United States Patent Office

3,096,673
Patented July 9, 1963

3,096,673

AUTOMATIC WORKING TURNING MEANS FOR SCREW MACHINES

Karl Spohn, Damaschkestrasse 15, Oberesslingen, Germany, and Hermann Walker, Kuhsteige 28, Esslingen-Waldenbronn, Germany

Filed June 8, 1959, Ser. No. 818,712
Claims priority, application Germany June 6, 1958
7 Claims. (Cl. 82—2.5)

The present invention relates to machine tools.

More particularly, the present invention relates to that class of machine tools known as screw machines where a workpiece in the form of an elongated bar extends through a hollow spindle to be worked on by one or more tools carried by a turret.

It is often desirable to be able to reverse a workpiece so that operations which are performed on one end of the workpiece may then be performed on the opposite end of the workpiece. Thus far, a structure capable of automatically reversing the position of a workpiece of a screw machine of the above type has not been provided, although such a structure is clearly desirable.

One of the objects of the present invention is to provide a screw machine with a structure which is capable of turning each workpiece end for end so that the operations performed on one end portion of each workpiece can also be performed on the opposite end portion thereof.

A further object of the present invention is to provide in a screw machine a structure which will automatically control the sequence of operations of the structure of the machine tool so that the turning of each workpiece end for end will take place at the proper moment in the sequence of operations.

Another object of the present invention is to provide a screw machine of the above type with a structure which will guarantee that the work is not advanced during the time when a workpiece which has had operations performed on one end thereof is turned end for end so that these operations can be repeated at the other end thereof.

It is also an object of the present invention to provide structure capable of accomplishing all of the above objects and at the same time composed of simple and ruggedly constructed elements which are very reliable in operation.

With the above objects in view the present invention includes in a screw machine of the type referred to above a tool means for working on one end of a plurality of workpieces during a plurality of first cycles of operation and on the other end of the plurality of workpieces during a plurality of second cycles of operation which respectively alternate with the first cycles of operation. The screw machine of the invention includes a means for turning each workpiece end for end after the first cycle has been performed so that the second cycle can then be performed on the same workpiece directly after the performance of the first cycle. Also, in accordance with the present invention the screw machine includes a means which will feed the work only after the performance of each second cycle of operation.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

FIG. 1 is a partly broken away, schematic elevation of a screw machine provided with the structure of the present invention;

FIG. 2 is an axial sectional illustration of a pair of rotary cams which control the gripping and feeding of the work, respectively, FIG. 2 showing a clutch structure which controls the motion transmission between these rotary cams;

FIG. 3 is an end view of the structure of FIG. 2 as seen from the left side of FIG. 2;

FIG. 1*a* is a schematic elevation of the structure operating the carriage;

FIG. 4 is a transverse sectional elevation of the structure of FIG. 2 taken along lines 4—4 of FIG. 2 in the direction of the arrows, and it will be noted that FIG. 2 is a section taken along line 2—2 of FIG. 4 in the direction of the arrows;

FIG. 5 shows the structure of FIG. 2 in a different position from that illustrated in FIG. 2, the clutch of FIGS. 2 and 5 being disengaged in the position of the parts illustrated in FIG. 5 and being engaged in the position of the parts illustrated in FIG. 2;

FIG. 6 is a diagram showing a development of a cam of the structure of FIGS. 2 and 5 which controls the operation of the clutch;

FIG. 7 is a fragmentary sectional elevation of the work-turning structure of the present invention, FIG. 7 being taken along line 7—7 of FIG. 8 in the direction of the arrows;

FIG. 8 is a partly sectional plan view of the structure of FIG. 7, the part of FIG. 8 which is in section being taken along line 8—8 of FIG. 7; and

FIGS. 9–13 respectively illustrate schematically successive stages in the operation of the structure of the invention.

Referring now to FIG. 1, there is illustrated therein a screw machine which includes the bed **10**, the turret carriage **11** rotatably carrying the turret head **12** which in turn carries the several tools **15**, and there is also provided the spindle assembly **16** provided with the work gripping means in the form of a collet **17** diagrammatically illustrated. As is conventional with screw machines, the spindle is hollow and the work in the form of an elongated bar **19** is fed axially through the spindle from the rear to the front end thereof, collet **17** being located adjacent the front end of the spindle to grip the work. Thus, the front end portion of the bar **19** projects forwardly beyond the collet **17** so as to form the workpiece **20**. The screw machine further includes a work feeding means in the form of a work feeding carriage **21** shiftable parallel to the axis of the hollow spindle, and at its front end the spindle stock **16** carries a cut-off tool **22** for cutting off the workpiece **20**, as is conventional. The machine tool also includes a carriage **23** capable of moving back and forth in a direction perpendicular to the spindle axis, and this carriage **23** is provided with the work turning means of the invention which is capable of turning each workpiece end for end, this work turning means of the invention being indicated in its entirety by the reference character **25**.

The machine tool also includes a continuously rotating drive shaft **26** which through a pair of meshing gears **28** and **29** transmits a drive through the clutch **30**, which is only momentarily operated in a well known manner, on the one hand to a cam driving shaft **31** which serves to drive the rotary cams **32** and **33** in a manner described below, and on the other hand the clutch includes a clutch portion **30***a* of the same construction as the clutch **30** and also driven through the gears **28** and **29** from the drive shaft **26** for transmitting the drive through the shaft **31***a* to the rotary cam **34**. The rotary cam **32** controls the actuation of the collet or work-gripping means **17** through the conventional collet operating structure **36**, while the rotary cam **33** acts through the linkage **37** on the work feeding carriage **21**. The rotary cam **32** is provided with a camming groove and turns the bifurcated collet

control lever 36 which is supported for turning movement intermediate its ends, and the means 37 which controls the work feeding carriage is also in the form of a bifurcated lever whose turning movement is controlled by the rotation of the rotary cam 33 provided also with a camming groove. The rotary cam 34 serves through its camming groove to turn the bifurcated lever 38 which is pivotally connected at its upper end with a push-pull bar 39 connected to the work turning means 25 of the invention for actuating the latter in a manner described below.

The clutches 30 and 30*a* are so-called quick-action clutches and that means that they effect a coupling through a certain angle of rotation, whereupon the clutch is released. The clutch 30 is usually a 360-degree quick-action clutch and that means that the clutch is in operation through one complete revolution.

The quick-action clutch 30*a* is a 90-degree clutch and that means that the clutch is operated only through an angle of 90 degrees and then released.

Such a quick-action clutch for a complete revolution is for instance described and shown in the U.S. application of Karl Spohn "Control Device for Automatic Machine Tool and the Like," Ser. No. 802,990, filed March 28, 1959 and now abandoned. This quick-action clutch is designated by 48 in the aforementioned U.S. application and described in detail in FIGS. 8 to 10. The difference between a 90-degree quick-action clutch and this 360-degree clutch shown in the application consists in that the cam 30 has four equal portions arranged around the circumference and in the same manner there are four notches 86 arranged on clutch member 81. Furthermore, such a quick-action clutch is shown in the English catalogue of the Index-Werke K.G. Hahn & Tessky "Construction and Use" Index B30, B42, B60, B60F, vide especially pages 37 to 39, FIGS. 27 to 29.

Referring to FIG. 1*a*, in the following the operation of the carriage 23 will be described in some detail. On shaft 31*a* a cam 110 is fastened whose circumference is engaged by follower 111 of a follower arm 112 which is connected to a toothed segment 115 rotationally arranged on a shaft 117.

The carriage 23 consists of a lower carriage portion 118 and an upper carriage portion 119 which are slidably arranged on top of each other. The lower carriage portion 118 is stationarily attached to the machine frame and the upper carriage portion 119 has on its underside a rack 122 meshing with the teeth of the toothed segment 115. A tension spring 125 is attached to the follower arm and urges the follower 111 against the camming surface of cam 110.

From the foregoing it is evident that upon turning of cam 110 the toothed segment 115 will be rocked and thus the upper carriage portion 119 reciprocated back and forth. The arrangement is thus that upon operation of clutch 30*a* a 90-degree rotation of shaft 31*a* and cam 110 moves the upper carriage portion 119 into its forward position as shown in FIG. 1*a*. During the next 90-degree revolution of clutch 30*a* the upper carriage portion 119 remains in its forward position, while through rotary cam 34 bifurcated lever 38 is swung forwardly into its foremost position. During the next 90-degree revolution the upper carriage portion 119 is shifted back to its rearmost position and during this time cam 34 does not act on lever 38. During the last 90-degree revolution the upper carriage portion 119 remains stationary in its rearmost position, while through arm 34 lever 38 is swung backwardly as shown in FIG. 1.

The operation of side carriages, as for instance carriage 23, is well known in the art and may be achieved in different ways as incorporated in many automatic screw machines as built by Brown & Sharpe Mfg. Co., Providence, R.I., U.S.A., or Index-Werke K.G. Hahn & Tessky, Esslingen-on-Neckar. In the aforementioned catalogue of the latter company there is shown on page 165 a FIG. 74 showing the operation of a carriage which is designated there as cross slide I.

Concerning the structure and operation of a quick-action clutch and also the operation of the cross slide or carriage reference is further made to the U.S. Patents 2,632,353, 2,653,503, and 2,690,691.

Referring now to FIGS. 2–6, the structure for controlling the rotary cam means 32 and 33 is illustrated therein. The shaft 31 which drives the cam 32 fixedly carries at its left end, as viewed in FIG. 2, a pinion 42 which meshes with a gear 43 which is in turn fixed to a cam 45 having a right annular camming projection, as viewed in FIG. 2. The cam 45 is turnably supported by a stationary pin, as illustrated in FIG. 2. FIG 6 shows a development of the camming portion of the cam 45. The transmission ratio between the pinion 42 and the gear 43 is 1 to 2, so that the cam 45 turns through one revolution while the shaft 31 turns through two revolutions. A stationary pivot pin 47 turnably supports a lever 48 which at its bottom end carries a pin 49 the left free end of which, as viewed in FIG. 2, engages the camming portion of the cam 45 slidably. The upper end portion of the lever 48 is bifurcated, and the arms 50 and 51 (FIG. 3) of this upper portion of the lever 48 respectively turnably carry rollers 52 and 53 which engage a ring 55 which is fixed to a pair of axially slidable keys 56 which are located at diametrically opposed sides of shaft 31 extending axially therealong, as is evident from FIGS. 4 and 5. These keys 56 are axially slidable in mating grooves 57 formed in the tubular rotary cam 33 as illustrated in FIGS. 2, 4, and 5. With this construction the ring 55 can turn freely with respect to the lever 48 while remaining in engagement with the rollers 52 and 53. A spring 58 is carried by a stationary part 46 in a bore of the latter and urges a sleeve which is slidable in this bore to the left, as viewed in FIGS. 2 and 5, against the lever 48 to urge the latter in a clock wise direction around the stationary pin 47 as viewed in FIGS. 2 and 5, so as to maintain the cam follower pin 49 in engagement with the cam 45.

Between the shaft 31 and the rotary cam 33 is located a sleeve 60 which is axially slidable with respect to the shaft 31 and the cam 33, and the right ends of the keys 56 bear against the left end of the sleeve 60, as viewed in FIGS. 2 and 5. The right end of the sleeve 60, as viewed in FIGS. 2 and 5, bears against additional keys 62 which are respectively axially slidable in grooves 65 formed in the rotary cam 32. The cam 33 is formed with grooves 64 which when the cams 32 and 33 are in a predetermined angular position with respect to each other are respectively algined with and form extensions of the grooves 65 so that they keys 62 can be located in part in the grooves 65 and in part in the grooves 64 for interconnecting the cams 32 and 33 for rotation together, as illustrated in FIG. 2. A coil spring 66 is coiled around the shaft 31, bears with its right end against a shoulder formed in the interior of the rotary cam 32, and bears with its left end against the keys 62 to urge the latter to the left to the position illustrated in FIG. 2. Of course, when the sleeve 60 is shifted to the right, as viewed in FIGS. 2 and 5, from the position of FIG. 2 to that of FIG. 5, the keys 62 will be moved in opposition to the spring 66 to the position illustrated in FIG. 5 where the keys 62 no longer are located in the grooves 64 and thus the drive from the rotary cam 32 to the rotary cam 33 is disconnected in this way, so that this structure forms a clutch means for transmitting the drive from the cam 32 to the cam 33 when the clutch means is engaged as illustrated in FIG. 2 and for cutting off the drive between these cams when the clutch means in disengaged, as illustrated in FIG. 5. The rotary cam 32 is itself keyed directly to the shaft 31 for rotation therewith.

A spring-pressed detent means is provided for yieldably maintaining the rotary cam 33 in predetermined angular position, and this detent includes the spring-pressed pin 68 provided at its top end with an end portion of V-shaped

configuration, as shown most clearly in FIG. 4, adapted to enter into a mating notch formed in the rotary cam **33**, as illustrated in FIG. 4, for yieldably maintaining the latter in the angular position illustrated in FIG. 4.

Before proceeding to a description of the work turning structure of the invention, the operation of the structure of FIGS. 2–6 will be described.

In the position of the parts illustrated in FIG. 2, the rotary cam **33** which controls the feeding of the work and the rotary cam **32** which controls the gripping of the work are interconnected by the keys **62** so that the clutch formed by the keys is engaged and these cams rotate together. To perform an operation where the work will be gripped and fed, the clutch element **30** is momentarily engaged so as to transmit rotation of the gear **29** to the shaft **31**, and in this way the rotary cams **32** and **33** will be turned through one revolution inasmuch as the clutch structures **62, 64, 65** is engaged at this time. During this revolution of the shaft **31** the cam **45** will turn through only 180°. The lever **48** will, in accordance with the developed illustration of the cam shown in FIG. 6, arrive at the 180° position illustrated in FIG. 6 where the cam follower **49** has just shifted due to the movement of the shoulder **67** of the cam **45** just beyond the cam follower **49**. As a result, at this time the lever will have turned from the position of FIG. 2 to that of FIG. 5 so that the spring **58** will have expanded in order to shift the ring **55** together with the keys **56** from the position of FIG. 2 to that of FIG. 5, and of course the sleeve **60** has also shifted and the keys **62** are now shifted in opposition to the spring **66** so that they are located only in the grooves **65** and the drive will not be transmitted from the cam **32** to the cam **33**. Thus, the drive to the rotary cam **33** is disconnected and the feeding means **21** cannot be actuated at this time. At the time of the turning of the workpiece end for end in the manner described below, the clutch **30** is again actuated so as to provide one revolution of the shaft **31**, and in this way the rotary cam **32** will provide an opening and a closing of the collet **17** while the cam **33** will remain stationary and is prevented from being turned through frictional engagement with other elements as a result of the spring-pressed detent pin **68**. During this second revolution of the shaft **31** the cam **45** is again turned through 180°, and is evident from FIG. 6, shortly before the single revolution of the cam is completed the follower **49** is engaged by a rising portion of the camming surface so as to place the follower **49** in zero position illustrated in FIG. 6. During the movement of the follower **49** along the inclined camming portion illustrated in FIG. 6 just to the left of the zero degree position, the lever **48** turns back to the position of FIG. 2 and the spring **66** can expand so as to again cause the clutch means to couple the cams **32** and **33** to each other. Of course the spring **58** is stronger than the spring **66**. Thus, during the next revolution of the shaft **31** the work will again be fed.

The operation of the work-turning means **25** of the invention is brought about by momentary engagement of the clutch **30***a* which provides a rotation of the shaft **31***a* in order to cause the cam **34** to turn so as to actuate the work-turning means.

As is apparent from FIGS. 7 and 8, the work-turning means of the present invention includes a lower unit **70** adjustably carried by the transverse carriage **23** for adjustment along the groove **69** thereof. This groove is in the form of a T-slot as is conventional, and with this construction it is possible to fix the lower unit **70** in a desired position along the carriage **23**, and it will be noted that the T-slot **69** extends parallel to the spindle axis. This lower unit **70** carries an upper unit **75** which is guided by the V-ribs and grooves shown in FIG. 7 for movement relative to the lower unit in a direction parallel to the spindle axis, and the push-pull bar **39** which is actuated by turning of the lever **38**, as described above, is connected at its end distant from the lever **38** to the upper unit **75** in the manner shown most clearly in FIGS. 7 and 8. Thus, the unit **75** may be provided with an elongated projection of T-shaped configuration, for example, slidably received in a corresponding groove at the free end of the push-pull bar **39** so that the carriage **23** can be moved perpendicularly to the spindle axis while the unit **75** slides with respect to the push-pull bar **39** while at the same time the movement of the push-pull bar resulting in turning of lever **38** will result in shifting of the unit **75** with respect to the unit **70** in a direction parallel to the spindle axis.

This upper unit **75** turnably supports in its interior a work turning shaft **77** which extends perpendicularly to the spindle axis. Suitable bearings **78** are provided to support the work turning shaft **77** for rotation about its axis. At its right end, as viewed in FIG. 7, the work turning shaft **77** carries a work holding means in the form of three springy fingers **80, 81, 82** which are respectively provided at their free ends with rollers **83, 84, 85**. The rollers **83** and **85** carried by the springy fingers **80** and **82** engage the workpiece **20** on the right side of its axis, as viewed in FIG. 7, while the roller **84** engages the workpiece **20** at the left side of its axis, as viewed in FIG. 7, so that the work is securely held by these fingers. The collet **17** is diagrammatically illustrated in FIG. 7, and it is apparent that the work holding fingers **80–82** engage the workpiece **20** at a portion thereof which extends beyond the collet **17**.

A pinion **87** is turnably carried by the shaft **77** at its end distant from the fingers **80–82**. A spring **89** engages the left end face of the pinion **87** so as to urge the latter to the right, as viewed in FIG. 7. This pinion **87** meshes with a rack **90** which is supported by the unit **75** for movement parallel to the spindle axis, the rack **90** itself extending parallel to the spindle axis. The shaft **77** also turnably carries a one-way drive **92** in the form of a ratchet portion **93** fixed to the pinion **87** for turning movement therewith and a mating ratchet portion **94** fixed directly to the shaft **77**, the spring **89** acting through the pinion **87** on the left ratchet portion **93** of FIG. 7 to urge the latter into engagement with the right ratchet portion **94**. As is apparent from FIG. 7, this ratchet structure **92** will provide only a one-way direction of rotation of the shaft **77**.

As is most clearly shown in FIG. 8, a spring **89'** urges the rack **90** toward the stop **100** shown in FIG. 8, and the rod portion about which the spring **89'** is coiled is fixed at one end to the rack **90** and at its opposite end carries a pair of lock nuts to adjust the position of the rack **90**.

Also, as is shown most clearly in FIG. 8, a spring-pressed detent means is provided to cooperate through the ratchet portion **94** of the one-way drive **92** with the shaft **77** to prevent rotation of the latter due to frictional engagement of the elements **93** and **94** when the element **93** turns in a reverse direction during return of the parts to the position shown in FIG. 8. The spring-pressed pin shown in FIG. 8 extends into a notch formed in a peripheral portion of the element **94**, and a pair of notches **97** are provided for this purpose at diametrically opposed parts of the periphery of the element **94**, these notches as well as the free end of the detent pin **96** being of V-shaped configuration. Thus, the spring-pressed detent arrangement **96, 97** prevents turning of the shaft **77** at undesired moments.

The lower unit **70** which is directly carried by the carriage **23** fixedly carries an arm **99** to which the stop **100** is adjustable fixed, this stop being in the form of a screw member carrying a lock nut capable of fixing the stop **100** axially on the arm **99**. This stop **100** is coaxial with and located in the path of the rack **90**.

This structure of FIGS. 7 and 8 operates in the following manner, reference being had to FIGS. 9–13 which illustrate successive stages of the operation of the structure of the invention.

As soon as the operations of the tool means **11, 12, 15** on one end of the workpiece **20** is completed, the carriage

23 is moved up to the workpiece so that the work holding fingers 80–82 grip the workpiece. The means for feeding the work is out of operation at this time due to the disengagement of the clutch elements 62, as described above.

As soon as the work holding fingers 80–82 have engaged the work, the workpiece 20 is cutoff from the bar 19 by the cut-off tool 22. Now the upper unit 75 is shifted by the push-pull bar 39 in a direction parallel to the axis of the workpiece, to the right, as viewed in FIG. 1. The turret carriage 11 is now in its rearmost position illustrated in FIG. 1. During this movement of the upper unit 75 to the right, as viewed in FIG. 1, the end of the rack 90 will engage the stop 100, and thus the rack 90 will stop moving while the unit 75 will continue to move with respect to the rack so that the pinion 87 turns in order to turn the shaft 77 and thus turn the workpiece 20 end for end through 180°. When a 180 degree turn of the shaft and the workpiece therewith has been completed the pin 96 will have entered into the other notch 97. The end of the workpiece which has already been machined is now directed toward the collect 17 which now opens due to the synchronizing of the operation of the various cams. The turret now moves forwardly and presses the work with the tool 15 into the collet (FIG. 12). The turning of the work through 180° is illustrated in FIG. 11, while FIG. 9 shows the position of the parts just before the carriage 23 is moved toward the work to cause the fingers 80–82 to grip the work as illustrated in FIG. 10. The bar 19 can shift rearwardly since the collet 17 is in a disengaged position at this time, so that when the collet 17 is again actuated to grip the work, the already machined end of the workpiece 20 will be engaged by the tongues of the collet, and the other end of the workpiece will now be positioned for machining. Before such machining of the other end of the workpiece takes place, the carriage 23 with the structure of the invention is shifted away from the work to the position shown in FIG. 13. Also, at this time, the drive to the rotary cam 34 is cutoff due to the disconnection of the clutch 30*a*.

Turning of the pinion 87 and the element 93 therewith in a direction where the latter rides over the teeth of the element 94 will not frictionally turn the element 94 and the shaft 77 therewith due to the detent structure 96, 97, so that in this way the shaft 77 is limited to one direction of rotation.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of machine tools differing from the types described above.

While the invention has been illustrated and described as embodied in screw machines, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. In a screw machine, in combination, first rotary cam means rotating at a given speed and adapted to actuate a work-gripping means; second rotary cam means adapted to actuate a work feeding means; clutch means transmitting a drive from said first cam means to said second cam means when said clutch means is engaged; third rotary cam means cooperating with said cltuch means for controlling the engagement and disengagement thereof; and transmission means driving said third rotary cam means from said first rotary cam means at a speed which is half the speed of rotation of said first rotary cam means, so that during the time that said clutch is disengaged a workpiece may be reversed end for end to enable a tool to operate on both ends of a workpiece before the work is fed.

2. In a screw machine, in combination, first rotary cam means adapted to actuate a work-gripping means; second rotary cam means coaxial with said first rotary cam means and adapted to actuate a work-feeding means; clutch means cooperating with said first and second rotary cam means for transmitting a drive from said first to said second rotary cam means when said clutch means is in an engaged position; third cam means cooperating with said clutch means for controlling the engagement and disengagement thereof, said clutch means including a plurality of axially shiftable key members and spring means urging said key members to a rest position where they transmit the drive from said first to said second rotary cam means, so that said clutch means moves said key members in opposition to said spring means for disengaging the clutch; and transmission means driving said third cam means from said first cam means at one-half of the speed of said first cam means.

3. In a screw machine, in combination, first rotary cam means adapted to actuate work-gripping means; second rotary cam means coaxial with said first rotary cam means and adapted to actuate a work-feeding means; clutch means cooperating with said first and second rotary cam means for transmitting a drive from said first to said second rotary cam means when said clutch means is in an engaged position; third cam means cooperating with said clutch means for controlling the engagement and disengagement thereof, said first rotary cam means including a tubular cam and a drive shaft extending through said tubular cam and fixed thereto for rotating the latter, said clutch means including a plurality of keys shiftable along said drive shaft for engaging or disengaging said first and second rotary cam means, said second rotary cam means also being tubular and said drive shaft extending freely therethrough, said clutch means including a sleeve slidable on said shaft between the latter and said rotary cam means and engaging said keys for shifting the latter, said clutch means also including a ring surrounding said drive shaft and having axial projections engaging said sleeve and a pivotally supported fork member turned by said third rotary cam means and engaging said ring for axially shifting the latter along said drive shaft to actuate said clutch means; and transmission means driving said third cam means from said first cam means at one-half the speed of the latter.

4. In a screw machine, in combination, first rotary cam means adapted to actuate a work-gripping means; second rotary cam means coaxial with said first rotary cam means and adapted to actuate a work-feeding means; clutch means cooperating with said first and second rotary cam means for transmitting the drive from said first to said second rotary cam means when said clutch means is in an engaged position; third cam means cooperating with said clutch means for controlling the engagement and disengagement thereof; transmission means driving said third cam means from said first cam means at one-half the speed of the latter; and spring-pressed detent means cooperating with said second rotary cam means for maintaining the latter in a given angular position when said clutch means is in a disengaged position where said first rotary cam means does not drive said second rotary cam means.

5. In a screw machine, in combination, first rotary cam means adapted to actuate a work-gripping means; second rotary cam means adapted to actuate a work-feeding means which feeds an elongated workpiece to said work-gripping means to be gripped thereby; clutch means having an engaged position transmitting a drive from said

first cam means to said second cam means and a disengaged position where said first cam means rotates while said second cam means remains stationary; third rotary cam means cooperating with said clutch means for controlling the engagement and disengagement thereof; transmission means driving said third rotary cam means from said first rotary cam means at a speed which is half of the speed of rotation of said first rotary cam means so that said second rotary cam means actuates the work-feeding means to feed a workpiece to said work-gripping means only at every other actuation of the work-gripping means by said first rotary cam means; and means for turning end for end in timed relation with said clutch means, during the time that said clutch means is in said disengaged position thereof, a workpiece which has previously been gripped once by said work-gripping means after being fed thereto by said work-feeding means, and for placing, while said clutch means remains in said disengaged position thereof, the workpiece which has been turned end for end again in a position to be gripped by said work-gripping means at the next actuation thereof by said first cam means, so that the work is not fed while a workpiece is turned end for end, whereby each workpiece can have work performed on both of its ends while held by the same work-gripping means before additional work is fed to the work-gripping means by the work-feeding means.

6. In a screw machine, in combination, first rotary cam means adapted to actuate a work-gripping means; second rotary cam means adapted to actuate a work-feeding means which feeds an elongated bar to said work-gripping means to be gripped thereby; clutch means having an engaged position transmitting a drive from said first cam means to said second cam means and a disengaged position where said first cam means rotates while said second cam means remains stationary; third rotary cam means cooperating with said clutch means for controlling the engagement and disengagement thereof; transmission means driving said third rotary cam means from said first rotary cam means at a speed which is half of the speed of rotation of said first rotary cam means so that said second rotary cam means actuates the work-feeding means to feed the bar to said work-gripping means only at every other actuation of the work-gripping means by said first rotary cam means, so that the bar will be gripped by the work-gripping means only during alternate actuations thereof while during the remaining actuations thereof the bar will not be fed to and gripped by said work-gripping means; cut-off means located adjacent said work-gripping means and operating in timed relation therewith for cutting off from the bar, after each alternate actuation of the work-gripping means when it grips the bar and after operations have been performed on the end of the bar, a workpiece which is thus separated from the bar; and means for turning end for end in timed relation with said clutch means, during the time that said clutch means is in said disengaged position thereof, the workpiece which has been cut off from the bar and for reintroducing the workpiece which has been turned end for end back into the work-gripping means while displacing the bar with the thus-turned workpiece, so that at the next actuation of the work-gripping means the workpiece will be gripped thereby to enable operations to be performed on its opposite end.

7. In a screw machine as recited in claim 5, drive means common to and driving both said transmission means and said means for turning the workpiece end for end and for placing the workpiece in a position to be gripped a second time by the work-gripping means.

References Cited in the file of this patent

UNITED STATES PATENTS

2,076,635	Halstead	Apr. 13, 1937
2,128,186	Jones	Aug. 23, 1938
2,392,984	Gerst	Jan. 15, 1946
2,397,561	Petsch	Apr. 2, 1946
2,514,472	Cassidy	July 11, 1950
2,779,956	Butler et al.	Feb. 5, 1957