

June 30, 1942.

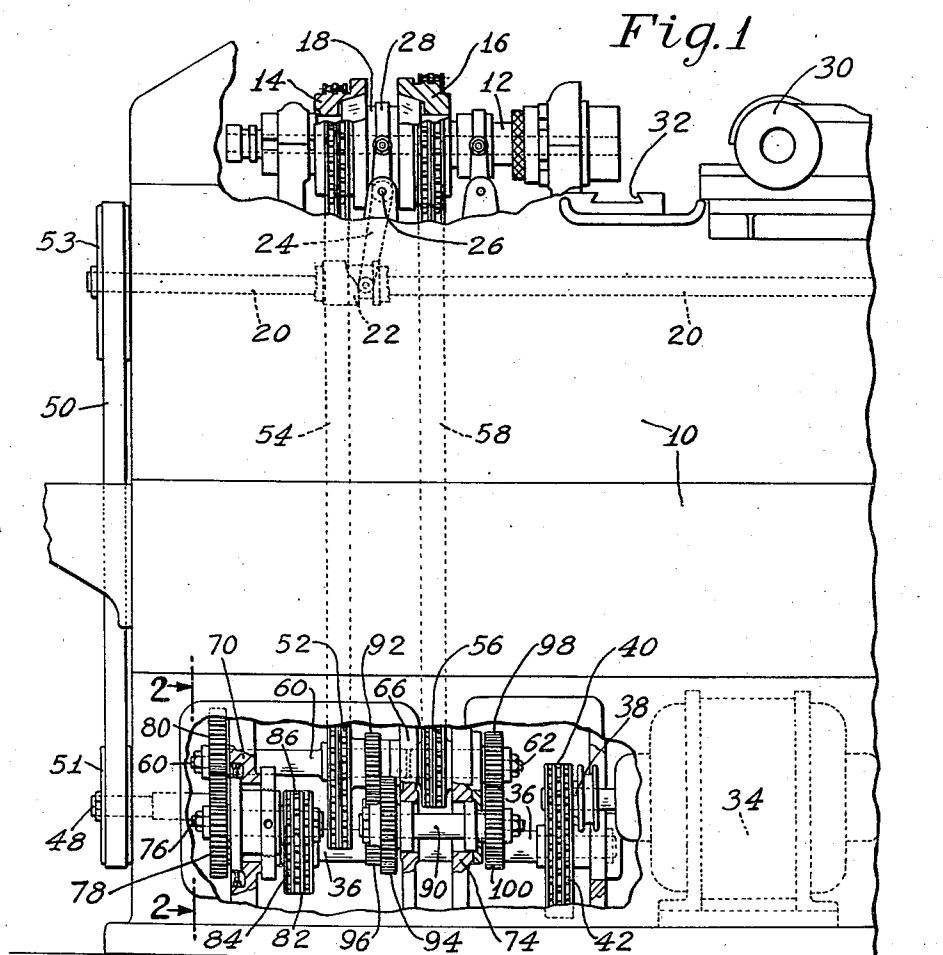
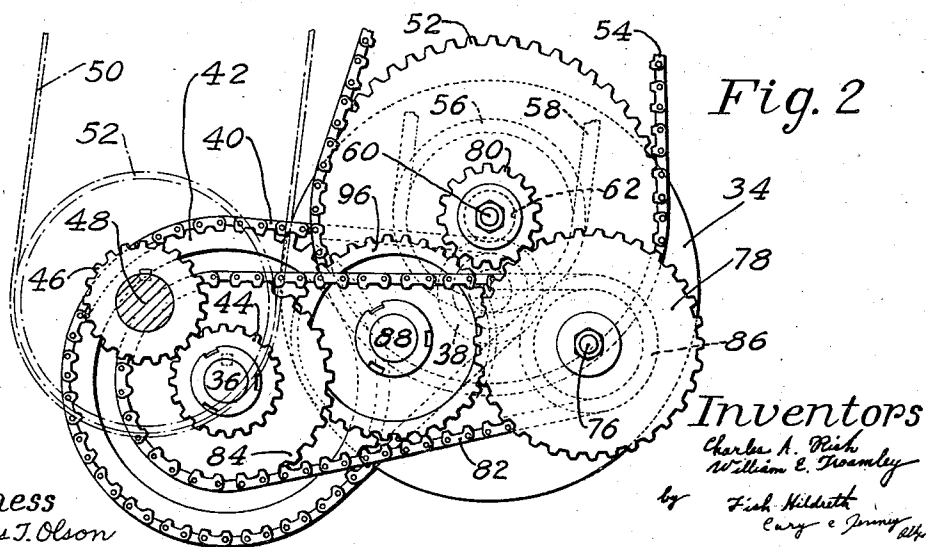
C. A. RICH ET AL

2,288,254

SPINDLE DRIVING MECHANISM FOR SCREW AND SIMILAR MACHINES

Filed Feb. 26, 1940

2 Sheets-Sheet 1



June 30, 1942.

C. A. RICH ET AL

2,288,254

SPINDLE DRIVING MECHANISM FOR SCREW AND SIMILAR MACHINES

Filed Feb. 26, 1940

2 Sheets-Sheet 2

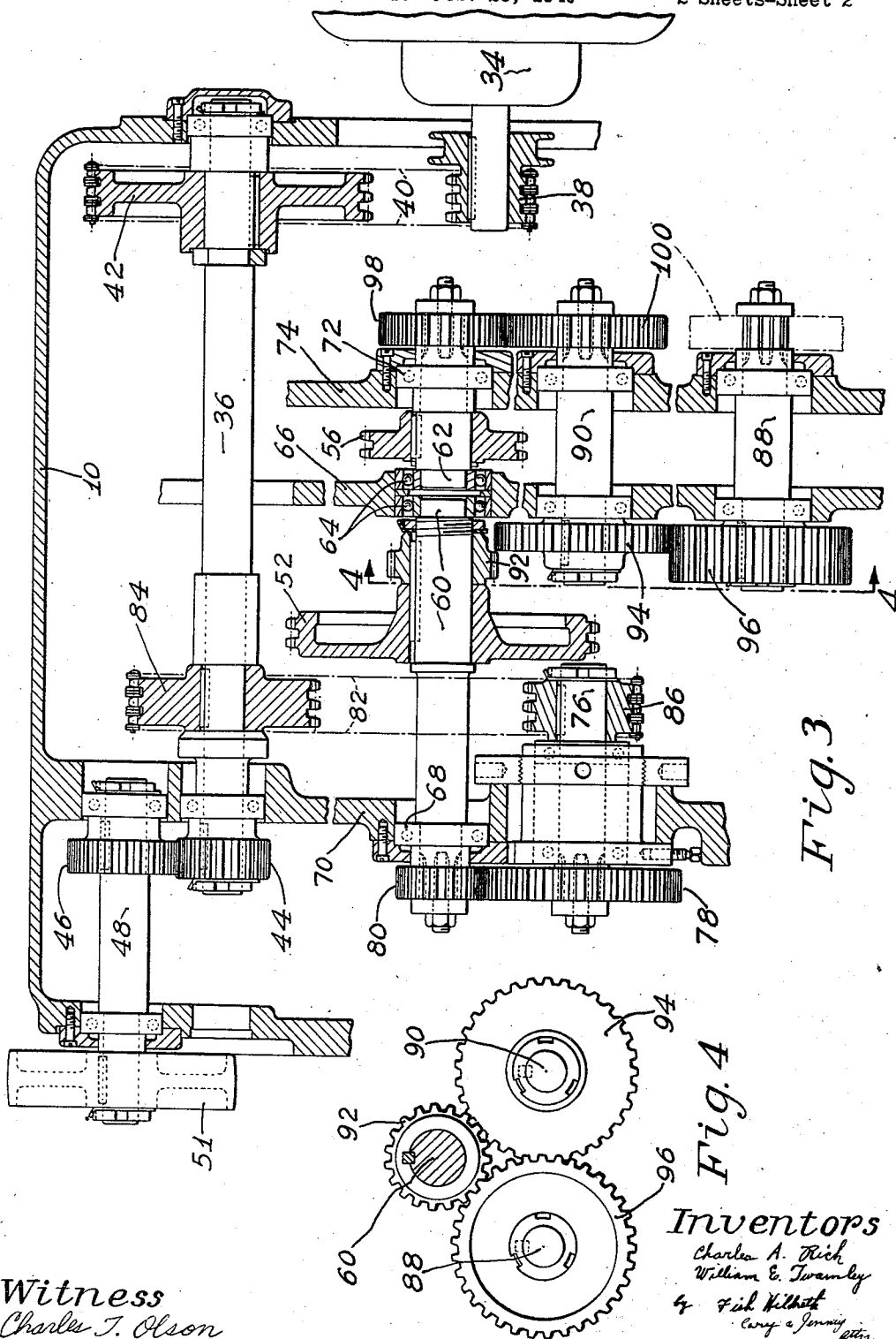


Fig. 3

Fig. 4

Inventors

Charles A. Rich
William E. Twamley

By Rich Willett
Carey & Jenney
Attys.

Witness

Charles J. Olson

UNITED STATES PATENT OFFICE

2,288,254

SPINDLE DRIVING MECHANISM FOR SCREW
AND SIMILAR MACHINES

Charles A. Rich and William E. Twamley,
Providence, R. I., assignors to Brown and
Sharpe Manufacturing Company, a corpora-
tion of Rhode Island

Application February 26, 1940, Serial No. 320,752

12 Claims. (Cl. 74—325)

The present invention relates to improvements in automatic screw and similar machines, and more particularly to an improved driving mechanism for the work spindle.

The mechanism for driving the work spindle in machines of this general type conventionally comprises two driven elements, usually sprocket wheels or pulleys loose on the rotatable work spindle, and clutching means interposed between the driven elements shiftable to cause the spindle to be driven alternatively by one or the other of them. These elements are continuously driven by mechanism located in the base of the machine, the direction and rate of drive of each element being selectively determined by the set-up of the driving mechanism in accordance with the requirements of the work. Automatic clutch shifting means is provided for controlling the operation of the spindle clutch for imparting the desired rate and direction of drive to the work spindle for the performance of successive operations of different character on the same piece. It will be understood that adjustments relating to the rate and direction of drive of the driven elements are made preferably in setting up the machine for the particular job, and not while the machine is in actual operation because of the relatively heavy weight and speed of operation of the driving connections.

In driving mechanisms of this type previously developed, the number of adjustments available both in the basic operating speed and in the ratio of operating speeds of the two driven elements in setting up the machine for operation upon widely divergent types of work, has been seriously limited by the complexity of mechanism and by the relatively great number of replacement parts required for effecting these changes. In the interest of avoiding such complication, it has been the usual practice to provide separate machines for working on brass and similar free cutting metals for which speed changes within a relatively fast range of speeds are required, and for operating on steel and similar slow cutting metals in which speed changes within a much slower range of speeds are required.

It is a principal object of the present invention to provide a variable speed spindle drive adapted for use in machines of this general type, which is simplified and improved both in construction and mode of operation, and is readily adaptable for driving the work spindle over an extremely wide range of operating speeds, and in accordance with a considerably greater number of speed ratios as determined by the position of the spindle

clutch, and thereby to provide a machine which is well adapted for universal use in metal cutting.

It is a further object of the present invention to provide in a variable speed spindle drive of this general description, a simple and readily accessible device for reversing the direction of drive of one of the driven elements on the work spindle with relation to the other, and in accordance with any desired ratio of rotating speeds of said driven elements as may be desired in accordance with the requirements of the work and the set-up of the operating tools in the machine.

More specifically, it is an object of the invention to provide a novel construction and arrangement of the mechanism for driving the two driven elements with their associated clutching means on the rotary work spindle, in which a maximum number of changes may be made in the driving rate of both driven elements, in the ratio of the driving rate of one driven element with relation to the other, and in the relative direction of rotation of the two driven elements through the interchangeable location of exchangeable spur gears in two pairs on appropriate driving centers for effecting all of the above noted adjustments.

With these and other objects in view, the several features of the invention consist in the devices, combinations, and arrangement of parts hereinafter described and claimed, which together with the advantages to be obtained thereby will be readily understood from the following description taken in connection with the accompanying drawings, in which Fig. 1 is a view in front elevation of a portion of an automatic screw machine with a portion of the casing broken away to illustrate particularly the spindle driving mechanism, only so much of the machine having been disclosed as is believed necessary to illustrate the connection of the present invention therewith; Fig. 2 is an enlarged detail sectional view taken on the line 2—2 of Fig. 1, illustrating particularly the spindle driving mechanism located in the base of the machine; Fig. 3 is a plan view of the spindle driving mechanism shown in Fig. 2, but with the reversible driving connections between the two spindle driving sprockets shown in a developed position for clarity of illustration; and Fig. 4 is a detail sectional view on the line 4—4 of Fig. 3, showing particularly the gears through which the two lay shafts of the reversing mechanism are driven from the large driving sprocket wheel and supporting shaft.

Applicants' spindle driving mechanism comprises two driven elements in the form of sprocket wheels of equal diameter, and a spin-

dle clutch which may be of ordinary description keyed on the spindle, and arranged to be shifted axially into clutching engagement alternatively with either sprocket. It will be understood that a belt and pulley drive may be substituted for the illustrated sprocket chain and sprocket wheel drive if so desired, the term "wheel" as herein-after employed in the claims being intended to cover the use of either a sprocket wheel or pulley. The driven sprocket wheels are continuously driven by means of sprocket chains which pass around driving sprocket wheels forming part of the spindle driving mechanism located in the machine base. In accordance with the usual practice, applicants provide a large and a small driving sprocket wheel providing an initial ratio of fast and slow rotating speeds for the driven sprockets.

In accordance with one feature of the present invention, applicants provide a simplified, improved and extremely compact construction and arrangement of the spindle driving mechanism which comprises driving connections to the large driving sprocket including a pair of exchangeable spur gears, and driving connections from the large to the small driving sprocket including a second pair of exchangeable spur gears, and in which the centers for the two sets of spur gears are arranged equal distances apart, so that the two pairs of spur gears are freely interchangeable. This construction and arrangement of the driving mechanism has the advantage that a maximum number of changes may be effected in the basic driving speeds of both driving sprockets, and also in the driving speed ratio between the driving sprockets by merely shifting the relative positions of the four gears comprising the two pairs. Furthermore, a single set of replacement gears may be employed to effect desired changes both in the basic driving speed of the large sprocket and the small sprocket driven therefrom, and also in the driving speed ratio between the two sprockets. In this manner, a very large number of speed changes are possible with a relatively small number of replacement gears. This may be illustrated as follows: With each machine it is proposed to provide twelve change gears, which gears in combination will render 132 available speeds. With this combination of gears, in other words, there will be available 120 low speeds in combination with twelve high speeds.

Another feature of the invention consists in a simplified and improved arrangement of the spindle driving mechanism including the large and small driving sprocket wheels, their supporting shafts, and the change speed driving mechanisms which is simple and compact in construction, and is also readily accessible by the operator for the replacement of change gears of either pair. In accordance with this feature of the invention, the two driving sprockets are mounted on supporting shafts in axial alignment with one another. Driving connections to the large sprocket supporting shaft include a short power shaft and a pair of change gears mounted in meshing relation respectively on the power shaft and large sprocket supporting shaft, these parts being located entirely at one side of the large sprocket, and driving connections from one to the other of the sprocket supporting shafts located entirely at the other side of the large sprocket, and including a second pair of ratio change gears mounted respectively on a lay shaft driven from the large sprocket shaft and on the small sprocket supporting shaft. With this con-

struction and arrangement of the driving mechanism in which the ratio change driving connections to the small driving sprocket supporting shaft pass through the axis of the large driving sprocket, there is the further advantage that the centers on which both pairs of change gears are mounted may be located relatively close together, so that relatively small gears may be employed, and a compact construction of the whole mechanism is achieved.

In accordance with another feature of the invention, applicants provide a novel and efficient mechanism particularly adapted for use in a spindle driving mechanism of this description for reversing the direction of drive of one of the driven sprockets on the work spindle. In the illustrated construction, a pair of ratio change gears are arranged to be mounted respectively on the small sprocket supporting shaft and on either of two lay shafts which are located equal distances from the axis of rotation of the small sprocket, and are continuously driven in opposite directions from the large sprocket supporting shaft. In the preferred form of the invention illustrated in the drawings, the lay shafts referred to, are located with relation to the driving sprocket supporting shafts so that their centers form an isosceles triangle, the drive from the large sprocket supporting shaft being taken through a gear on said shaft, a gear out of alignment therewith on one of the lay shafts, and a third gear on the other of said lay shafts of sufficient width for meshing engagement with both of said gears.

Referring more specifically to the drawings, Fig. 1 discloses an automatic screw machine which may be of ordinary construction comprising with a casing 10, a rotary hollow work spindle 12 having loosely mounted thereon two driven sprocket wheels 14 and 16 and a clutch element 18 keyed to the shaft and arranged to be shifted alternatively into clutching engagement with one or the other of said driven sprockets 14 and 16. In accordance with the usual practice in these machines, the position of the clutch 18 is automatically controlled from a cam shaft 20 and shift cam 22 by means of a cam actuated clutch shift lever 24 mounted on a stationary pivot 26 and having connection at its upper end with a clutch shifting collar 28 on the clutch member 18. Also shown in Fig. 1 is a tool carrying turret head 30 and cross slide ways 32 of ordinary description.

The machine drive is taken from an electric motor 34, to a driving countershaft 36, and thence by means of a sprocket 38 on the armature shaft of the motor, a sprocket chain 40, and a sprocket 42 on the countershaft 36. As shown in Figs. 1 and 3 of the drawings, the cam shaft 20 is driven from the countershaft 36 through driving connections which include a gear 44 on the shaft 36, and a gear 46 meshing therewith carried on a shaft 48. The shaft 20 is directly driven from the shaft 48 by means of a belt 50 passing over a pulley 51 on the shaft 48 and a pulley 53 on the shaft 20.

Applicants' improved variable speed mechanism for driving the work spindle comprises a large driving sprocket wheel 52 connected by means of a sprocket chain 54 with the driven sprocket wheel 14, and a small driving sprocket wheel 56 connected by means of a sprocket chain 58 with the driven sprocket wheel 16. The driving sprocket wheels 52 and 56 are rigidly mounted on supporting shafts 60 and 62 respectively, as best

shown in Fig. 3 of the drawings. These supporting shafts 60 and 62 are in axial alignment, being supported at their adjacent ends in ball bearings 64 in a bracket 66. The supporting shaft 60 is further supported at its outer end in a ball bearing 68 formed in a wall 70 of the machine casing. The supporting shaft 62 is similarly supported at its outer end in a ball bearing 72 carried in a wall 74 of the machine casing. The large driving sprocket 52 and its supporting shaft 60 are driven from the countershaft 36 through connections including a power shaft 76 and change gears 78 and 80 carried respectively on the power shaft 76 and shaft 60. A sprocket chain 82 passing over a sprocket 84 on countershaft 36 and over a sprocket 86 on the power shaft 76, connects the power shaft to be driven from the countershaft 36 and motor 34.

The small driving sprocket 56 and its supporting shaft 62 are driven from the large sprocket supporting shaft 60 through driving connections which include two lay shafts 88 and 90 which are arranged in parallel relation to the aligned supporting shafts 60, 62, and with their centers equal distances from the shaft 60 in the form of an isosceles triangle. As will be further evident from an inspection of Figs. 2 and 3, the power shaft 76 is also in alignment with the lay shaft 90, so that the distance between centers of the power shaft 76 and large driving sprocket supporting shaft 60 is the same as that between the lay shafts 88, 90, and small driving sprocket supporting shaft 62. The lay shafts 88, 90 are continuously driven in opposite directions from the large sprocket supporting shaft 60 through gear connections comprising a driving gear 92 secured adjacent the right hand end of the shaft 60, a gear 94 on lay shaft 90 arranged out of alignment with gear 92, and a gear 96 on the lay shaft 88 which is of the same diameter as gear 94, but is of sufficient width for meshing engagement with both the driving gear 92 and gear 94. The small driving sprocket 56 and its supporting shaft 62 are arranged to be driven alternatively in one or the other direction through the connections above described, by means of a pair of change gears 98 and 100, one of these gears, as that indicated at 98, being mounted on a shaft 62, and the other of said gears, as that indicated at 100, being supported on either of the lay shafts 88 or 90, depending upon the direction of drive which is desired for the slow speed driven sprocket 16 on the work spindle 12.

Examples of different types of work within the range of adjustment of applicants' variable speed spindle driving mechanism, may be given as follows. In each case there is a turning operation followed by a threading operation. The actual spindle speeds are given for working on steel and on brass.

In the first example, it is assumed that the work $\frac{3}{8}$ " in diameter is to be turned down and threaded to provide a screw thread having $\frac{1}{8}$ " diameter and 40 turns to the inch. In this instance a ratio of three to one is employed. The spindle speeds for the turning and the subsequent threading operations are listed as follows:

For brass—4150 R. P. M. and 1390 R. P. M.
For steel—870 R. P. M. and 290 R. P. M.

In Example 2, it is assumed that the work also $\frac{3}{8}$ " in diameter is to be turned down and threaded to provide a $\frac{3}{8}$ " screw thread with 16 turns to the inch. In this example, a ratio of spindle speeds of five to one is employed. The actual

spindle speeds for the turning and subsequent threading operations are given as follows:

For brass—4150 R. P. M. and 840 R. P. M.
For steel—870 R. P. M. and 175 R. P. M.

In Example 3, it is assumed that a worm thread is being cut $\frac{3}{8}$ " in diameter, and with twelve turns to the inch. In this example where a fine finish is required, a ratio of ten to one is employed, the actual speeds for the successive turning and threading operations being listed as follows:

For brass—4150 R. P. M. and 415 R. P. M.
For steel—1640 R. P. M. and 164 R. P. M.

In each of these instances, it is assumed that a right hand thread is being cut, and that an opening die holder is employed so that both the turning and threading operations may be performed with the work rotating in a forward direction. The selected spur gear 100 will in the examples supposed, be located on the lay shaft 88 instead of on the lay shaft 90 as shown. In the event that a plain type of die holder is employed, it would be necessary to reverse the work direction to cause the die to back off the threaded portion of the work, such reversal being effected by the location of the selected spur gear 100 on the lay shaft 90.

It will be understood that the invention is not limited to the specific embodiment shown, and that various deviations may be made therefrom without departing from the spirit and scope of the appended claims.

What is claimed is:

1. For use in automatic screw and similar machines, the combination with a work spindle, a pair of driven elements loose on said spindle, and means for clutching said driven elements alternatively to drive the spindle, mechanism for continuously driving said driven elements including a driving element having connection with one driven element, a second driving element having connection with the other driven element, a prime mover, gear connections including a pair of exchangeable spur gears for driving both of said driving elements from the prime mover at adjustable speeds, driving connections including a second pair of exchangeable spur gears locatable for driving one of said driving elements at adjustable speeds in alternate directions with relation to the other driving element, and supporting centers for each pair of spur gears including alternatively available reverse driving centers for said second pair of spur gears.

2. For use in automatic screw and similar machines, the combination with a work spindle, a pair of driven elements loose on said spindle, and means for clutching said driven elements alternatively to drive the spindle, mechanism for continuously driving said driven elements including a driving element having connection with one driven element, a second driving element having connection with the other driven element, a prime mover, gear connections including a pair of interchangeable spur gears for driving both of said driving elements from the prime mover at adjustable speeds, driving connections including a second pair of spur gears locatable for driving one of said driving elements at adjustable speeds and in alternate directions with relation to the other of said driving elements, and supporting centers for each pair of spur gears including alternatively available reverse driving

centers for said second pair of spur gears, the supporting centers for each pair of spur gears including said reverse driving centers being arranged equal distances apart whereby all of said spur gears are freely interchangeable to effect all of said speed and directional adjustments.

3. For use in automatic screw and similar machines, the combination with a work spindle, a pair of driven wheels loose on said spindle, and means for clutching said wheels alternatively to drive the spindle, driving means for said wheels including a large driving wheel and a supporting shaft having connection with one of said driven wheels, a small driving wheel and a supporting shaft in axial alignment with said large driving wheel and its shaft and having connection with the other of said driven wheels, means for driving said large driving wheel and shaft, a lay shaft arranged parallel to said supporting shafts, gears connecting the lay shaft to be driven by the large wheel supporting shaft, and exchangeable spur gears arranged on the lay shaft and on said small wheel supporting shaft in meshing relation.

4. For use in automatic screw and similar machines, the combination with a work spindle, a pair of driven wheels loose on said spindle, and means for clutching said driven wheels alternatively to drive the spindle, driving means for said wheels including a large driving wheel and a supporting shaft having connection with one of said driven wheels, a small driving wheel and a supporting shaft in axial alignment with said large driving wheel and shaft and having connection with the other of said driven wheels, means for driving said large driving wheel and shaft including a power shaft, and interchangeable spur gears on said power shaft and on said large driving wheel supporting shaft in meshing relation, a lay shaft arranged parallel to said supporting shafts, gears connecting the lay shaft to be driven by the large wheel supporting shaft, and exchangeable spur gears arranged on the lay shaft and small wheel supporting shaft in meshing relation.

5. For use in automatic screw and similar machines, the combination with a work spindle, a pair of driven wheels loose on said spindle, and means for clutching said driven wheels alternatively to drive the spindle, driving means for said wheels including a large driving wheel and a supporting shaft having connection with one of said driven wheels, a small driving wheel and a supporting shaft in axial alignment with said large driving wheel and shaft and having connection with the other of said driven wheels, means for driving said large driving wheel and shaft including a power shaft, and interchangeable spur gears on said power shaft and large driving wheel supporting shaft in meshing relation, a lay shaft arranged parallel to said supporting shafts, gears connecting the lay shaft to be driven by the large wheel supporting shaft, and exchangeable spur gears arranged on the lay shaft and on the small wheel supporting shaft in meshing relation, said power shaft and lay shaft being located equal distances from the axes of said supporting shafts to permit the interchanging of said pairs of spur gears.

6. In automatic screw and similar machines, the combination with a work spindle, a pair of driven wheels loose on said spindle, and means for clutching said wheels alternatively to drive the spindle, and driving means for said wheels including a driving wheel and a supporting shaft

having connection with one of said driven wheels, a second driving wheel and a supporting shaft having connection with the other of said driven wheels, means for driving said first driving wheel and shaft including a pair of interchangeable spur gears, a pair of lay shafts arranged parallel to said second driving wheel supporting shaft and equi-distant therefrom, means connecting said lay shafts to be driven by the first driving wheel supporting shaft in opposite directions, and a pair of exchangeable spur gears arranged on said second wheel supporting shaft and on either of said lay shafts in meshing relation for driving said second driving wheel alternatively in opposite directions with relation to said first driving wheel.

7. For use in automatic screw and similar machines, the combination with a work spindle, a pair of driven wheels loose on said spindle, and means for clutching said wheels alternatively to drive the spindle, and driving means for said wheels including a driving wheel and supporting shaft having connection with one of said driven wheels, a second driving wheel and supporting shaft in axial alignment with said first driving wheel and shaft and having connection with the other of said driven wheels, means for driving said first driving wheel and shaft, a pair of lay shafts arranged parallel to said supporting shafts and equidistant therefrom, gears connecting the lay shafts to be driven in opposite directions from the first wheel supporting shaft, and exchangeable spur gears arranged on the second wheel supporting shaft and on either of said lay shafts in meshing relation to drive the small wheel shaft alternatively in opposite directions with respect to the first driving wheel and its shaft.

8. For use in automatic screw machine, the combination with a work spindle, a pair of driven wheels loose on said spindle, and means for clutching said driven wheels alternatively to drive the spindle, and driving means for said wheels including a driving wheel and supporting shaft having connection with one of said driven wheels, a second driving wheel and supporting shaft in axial alignment with said first driving wheel and shaft and having connection with the other of said driven wheels, a pair of lay shafts and a power shaft arranged parallel to said supporting shafts and equi-distant therefrom, gears connecting the lay shafts to be driven in opposite directions from the first wheel supporting shaft, exchangeable spur gears arranged on the power shaft and on the first wheel supporting shaft in meshing relation, and exchangeable spur gears similarly arranged on the second wheel supporting shaft and on either of said lay shafts in meshing relation to drive the small wheel shaft alternatively in opposite directions with respect to the first driving wheel and its shaft, all of said spur gears being freely interchangeable with one another.

9. For use in automatic screw and similar machines, the combination with a work spindle, a pair of driven wheels loose on said spindle, and means for clutching said wheels alternatively to drive the spindle, and driving means for said wheels including a large driving wheel and a supporting shaft having connection with one of said driven wheels, a small driving wheel and a supporting shaft having connection with the other of said driven wheels, means for driving said large wheel and shaft including a pair of interchangeable spur gears, a pair of lay shafts arranged parallel to said small driving wheel supporting

shaft and equi-distant therefrom, gears connecting said lay shafts to be driven by the large driving wheel supporting shaft in opposite directions, and a pair of exchangeable spur gears arranged on said small wheel supporting shaft and on either of said lay shafts in meshing relation for driving the small driving wheel alternatively in opposite directions with relation to said large driving wheel.

10. For use in automatic screw and similar machines, the combination with a work spindle, a pair of driven wheels loose on said spindle, and means for clutching said wheels alternatively to drive the spindle, and driving means for said wheels including a large driving wheel and a supporting shaft having connection with one of said driven wheels, a small driving wheel and a supporting shaft in axial alignment with said large driving wheel and shaft and having connection with the other of said driven wheels, means for driving said large driving wheel and shaft, a pair of lay shafts arranged parallel to said supporting shafts equi-distant from said supporting shafts, gears connecting said lay shafts to be driven by the large wheel supporting shaft and in opposite directions, and exchangeable spur gears arranged on the small wheel supporting shaft and on either of said lay shafts in meshing relation for driving the small driving wheel alternatively in opposite directions with relation to the large driving wheel.

11. For use in automatic screw and similar machines, the combination with a work spindle, a pair of driven wheels loose on said spindle, and means for clutching said wheels alternatively to drive the spindle, and driving means for said wheels including a large driving wheel and a supporting shaft having connection with one of said driven wheels, a small driving wheel and a supporting shaft in axial alignment with said large driving wheel and shaft and having connection with the other of said driven wheels, means for driving said large driving wheel and shaft including a power shaft, and exchangeable

spur gears on the power shaft and on the large wheel supporting shaft in meshing relation, a pair of lay shafts parallel to the supporting shafts equi-distant therefrom and from each other, and with one of said lay shafts in axial alignment with said power shaft whereby all of said spur gears are freely interchangeable, means for driving the lay shafts in opposite directions from the large wheel supporting shaft including a gear on the large wheel supporting shaft, a gear on one of the lay shafts out of alignment therewith, and a gear on the other of said lay shafts meshing with both of said gears, and exchangeable spur gears arranged on the small wheel supporting shaft and on either of said lay shafts for driving the small driving wheel alternatively in opposite directions with relation to the large driving wheel.

12. For use in automatic screw and similar machines, the combination with a work spindle, a pair of driven wheels loose on said spindle, and means for clutching said driven wheels alternatively to drive the spindle, driving means for said driven wheels including a driving wheel and a supporting shaft having connection with one of said driven wheels, a second driving wheel and a supporting shaft in axial alignment with said first-mentioned driving wheel and its shaft and having connection with the other of said driven wheels, a prime mover, gear connections including a pair of exchangeable spur gears and driving centers for the same for driving said first-mentioned supporting shaft and wheel, and driving connections for driving the last-mentioned supporting shaft and wheel from the first-mentioned supporting shaft and wheel including a second pair of spur gears locatable for driving said second shaft from the first shaft at adjustable speeds, and in alternate directions with relation to said first-mentioned supporting shaft and wheel, and alternatively available reverse driving centers for said second pair of spur gears.

CHARLES A. RICH.

WILLIAM E. TWAMLEY.