

April 18, 1939.

H. W. ZIMMERMAN

2,155,072

MACHINE FOR SIZING AND FINISHING BORES

Filed Feb. 8, 1936

6 Sheets-Sheet 1

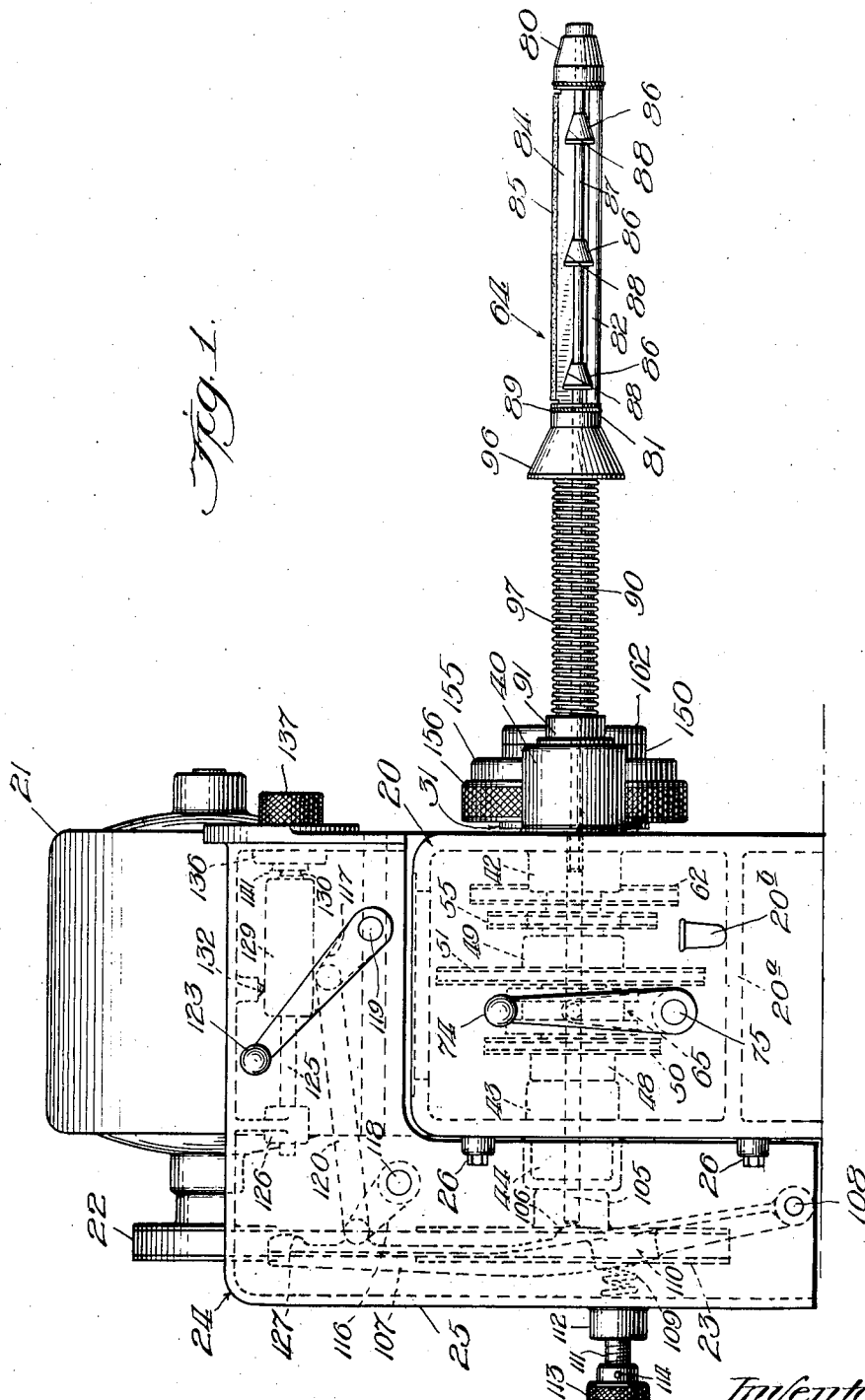


Fig. 1.

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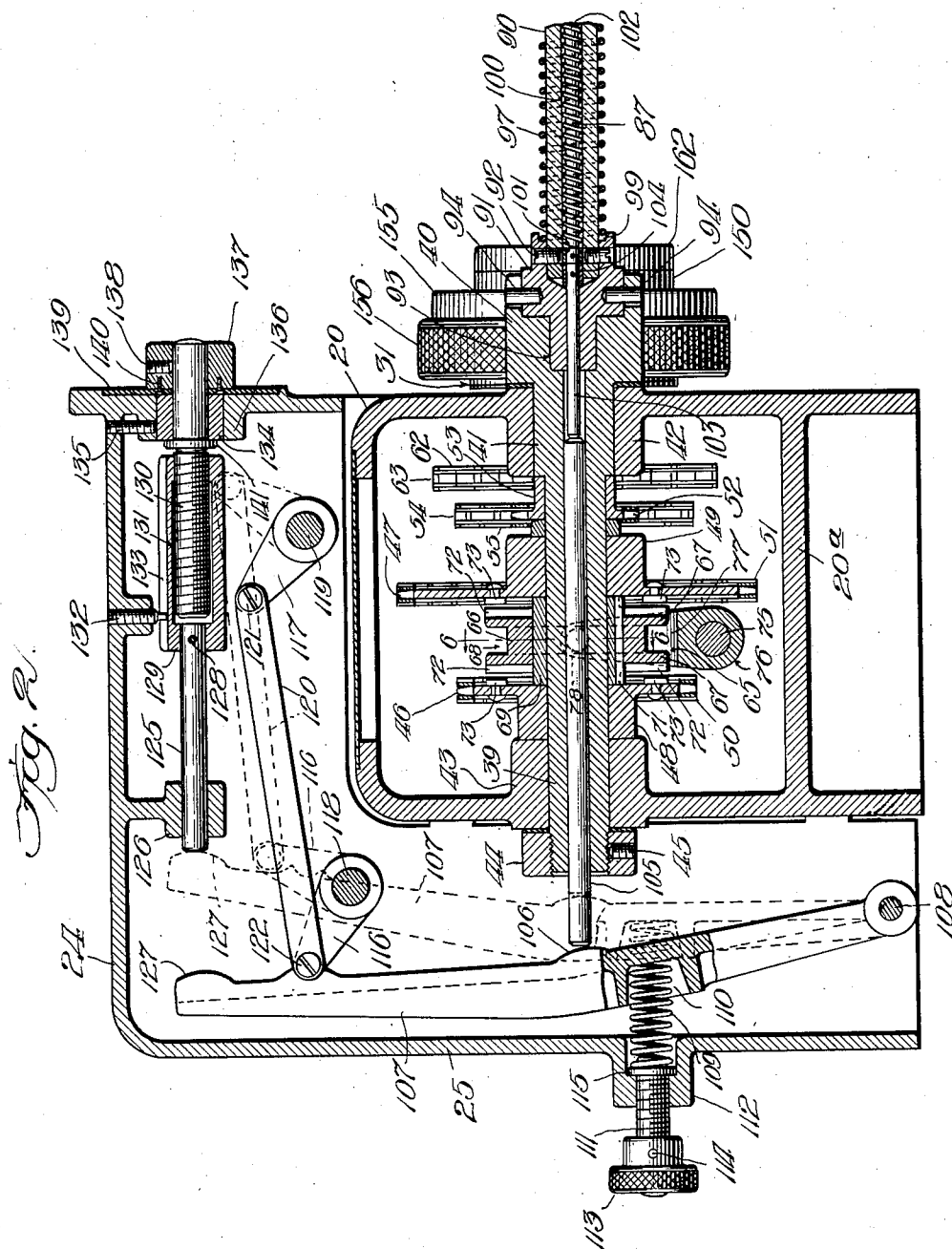
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6 Sheets-Sheet 2



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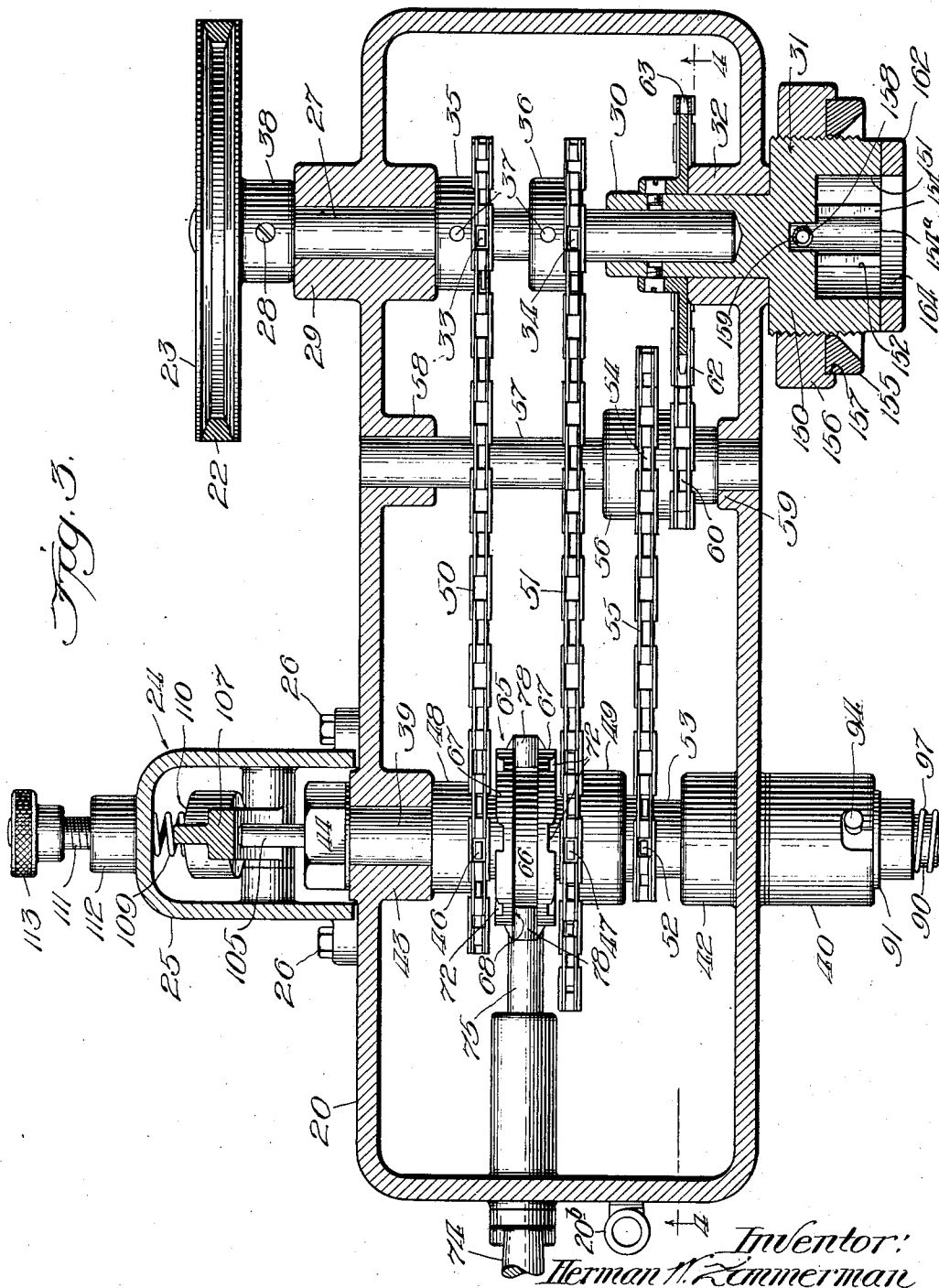
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MACHINE FOR SIZING AND FINISHING BORES

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6 Sheets-Sheet 3



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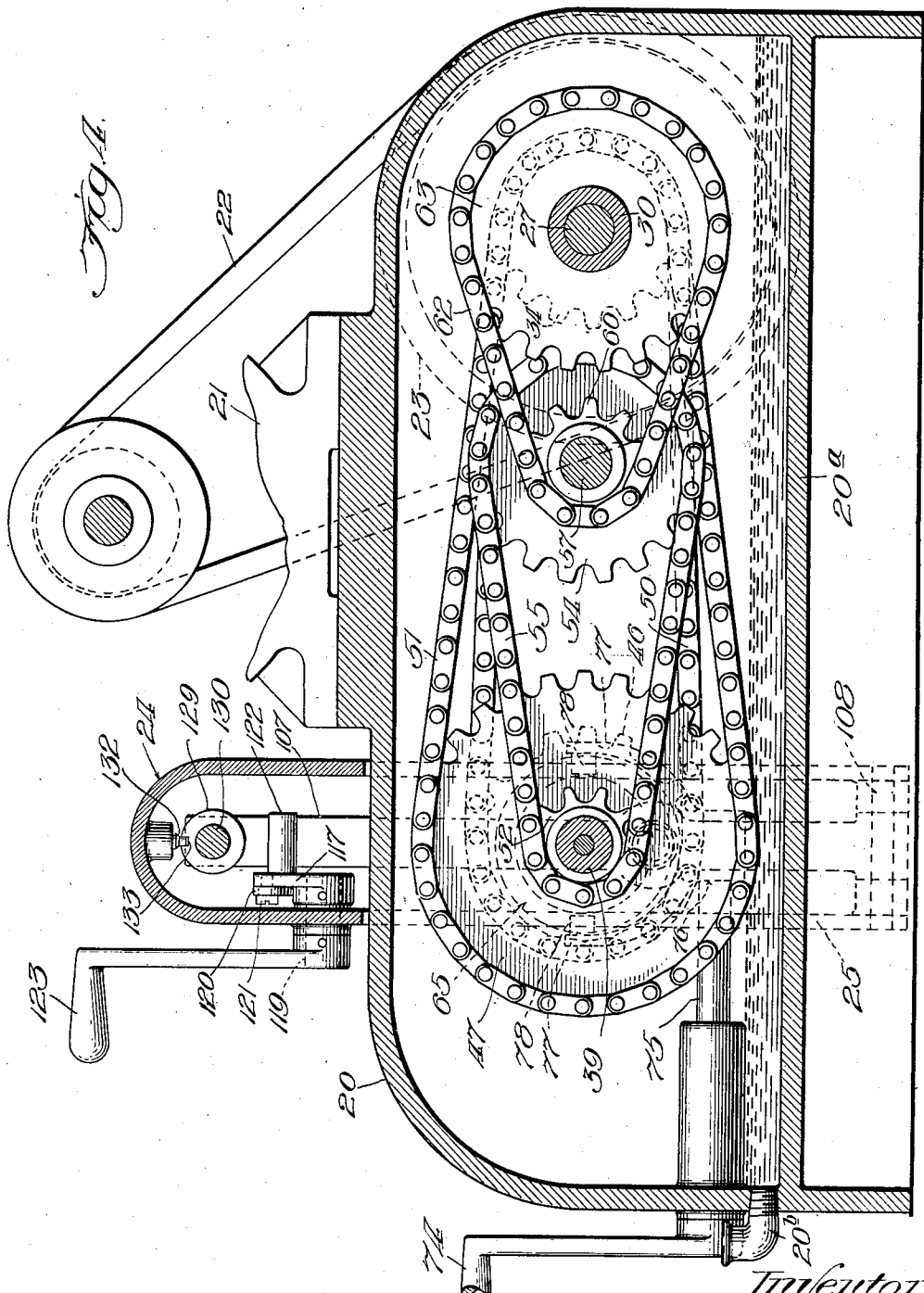
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MACHINE FOR SIZING AND FINISHING BORES

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6 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

2,155,072

MACHINE FOR SEIZING AND FINISHING
BORES

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Application February 8, 1936, Serial No. 62,904

16 Claims. (Cl. 51-72)

My invention relates to a machine for sizing and finishing bores and it has to do more particularly with a structure adapted for supporting and operating tools for treating bores and especially, though not exclusively, small bores, such as those employed for piston pins, water pump bushings, hydraulic brake cylinders and king bolt bushings.

One of the objects of my invention is to provide a machine of the foregoing character that is arranged for detachably supporting different kinds of bore treating tools (for example honing and reaming tools) and for selectively operating the same at variable speeds dependent upon the character of the work and the kind of tool used thereon.

Another object is to provide an improved honing machine including novel means for automatically adjusting the tool during operation and within preset, but variable, limits.

A further object is to provide, as a single self-contained unit, means for supporting different kinds of bore treating tools, means for driving such tools at variable speeds, and means for automatically adjusting the tools during operation within predetermined limits, all such means being interlockingly and cooperatively arranged in a compact form that is readily portable.

Still another object is to provide power driven structure of the foregoing character which is quite simple in construction; is inexpensive to manufacture, operate and maintain in use; is easy to operate; and is adapted for very rapid bore treatment with increased efficiency even when used by unskilled workmen.

An additional object is to provide an improved chuck structure for centering and attaching tools to the machine.

Other objects and advantages will become apparent as this description progresses and by reference to the drawings wherein—

Figure 1 is a side elevational view of one form of machine embodying my invention and to which a hone or finished tool is attached, certain of the machine parts being illustrated in dotted lines in an inactive position such as they may assume when the honing tool is in fully contracted condition;

Fig. 2 is an enlarged longitudinal vertical sectional view of the structure shown in Fig. 1;

Figure 3 is a horizontal sectional view taken at a position near the top of the machine;

Fig. 4 is a section taken substantially on the line 4-4 of Fig. 3;

Fig. 5 is a skeleton-like view of the adjustment

mechanism shown in Fig. 1, the parts of such mechanism being illustrated in positions that they may assume when the tool is inserted within the bore to be honed and then expanded into operative engagement therewith;

Fig. 6 is an enlarged vertical sectional view of the structure shown in Fig. 2, which figure is taken substantially on line 6-6 of Fig. 2;

Fig. 7 is an enlarged front elevational view of the adjusting dial structure shown in Figs. 1 and 2;

Fig. 8 is a front elevational view of one form of my improved chuck structure, such as may be used for example for supporting a reamer at the right-hand side (as viewed in Fig. 3) of the machine;

Fig. 9 is a section taken substantially on line 9-9 of Fig. 8;

Fig. 10 is a section taken substantially on line 10-10 of Fig. 9;

Fig. 11 is a section taken substantially on line 11-11 of Fig. 9;

Fig. 12 is a front elevational view of the chuck body member shown in Figs. 8 and 9; and

Fig. 13 is a detached perspective view of one of the check jaws used in connection with the structure shown in Figs. 8 to 12, inclusive.

A machine constructed in accordance with my invention is well suited for the automotive service field for the servicing of piston pin mountings, water pump bushings, hydraulic brake cylinders and king bolt bushings, but it is to be understood that it has utility in every instance where the advantages thereof are sought. In the servicing of parts of the character above mentioned, it is found desirable at times to merely hone the same and at other times to first ream the bore and then finish the reamed surface by honing. My invention provides a structure by which either or both of these operations may be carried out with a single device, which device is selectively operable to provide speed changes such as may be required by the particular kind of work and the particular kind of tool employed.

The machine that I have chosen to illustrate my invention comprises a somewhat shallow and rectangularly-shaped casing 20 in which is mounted a speed-change type of driving mechanism power driven by a motor 21 (Fig. 1) through a belt and pulley construction 22, 23 (Figs. 3 and 4).

The casing 20 supports another and L-shaped casing 24 in which is mounted tool adjusting mechanism which will be described more fully hereinafter. The vertical leg 25 of the casing 24

is secured to the rear wall of the casing 20 by bolt and nut devices 26 (Fig. 1), and the horizontal leg of this casing extends forwardly above the top of the casing 20.

The speed-change driving or transmission mechanism (Figs. 2, 3 and 4) housed within the casing 20 includes a rotatable shaft 27 having the pulley 23 secured to the outer end thereof by a lock screw, or the like, 28. This shaft 27 finds bearing support in a boss 29 formed in one end of the casing 20 and it extends through the casing where it is rotatably supported within the shank 30 of a chuck device 31 which, in turn, is rotatably supported in a boss 32 formed in the other end wall of the casing 20 directly opposite the boss 29. The shaft 27 supports similar sized sprocket wheels 33 and 34 having hubs 35 and 36 rigidly secured thereto by pins or other suitable devices 37. The sprocket hub 35 and a hub 38 on the pulley 23 engage opposite ends of the boss 29 and thereby secure the shaft 27 rotatably in its bearings against longitudinal displacement.

The driving mechanism further includes, at the other side of the casing 20, a rotatable shaft 39 (Figs. 2 and 3). This shaft 39 is somewhat T-shaped in longitudinal section with its T-head end portion 40 projecting beyond the forward end of the casing. The T-stem portion of this shaft 39, immediately adjacent its head portion 40, as at 41, is slightly enlarged for rotatable support within a boss 42 formed in the forward wall of the casing 20. The other end of the shaft 39 is of slightly reduced diameter and is rotatably received within a boss 43 formed in the rear wall of the casing 20. The rear end of the shaft 39 is threaded for reception of a lock nut 44, which may be securely fastened thereto by a lock screw pin, or the like, 45 so that the shaft 39 may be rotatably supported by the bosses 42 and 43 without endwise displacement. The shaft 39 (Fig. 2) is hollow for reception of part of the adjusting mechanism which will be described hereinafter.

The shaft 39 supports sprocket wheels 46 and 47 (Figs. 2, 3 and 4) which have hub portions 48 and 49, respectively, mounted for free rotation upon such shaft. The sprocket wheels 33 and 46 are drive-connected by a sprocket chain 50 while the sprocket wheels 34 and 47 are drive-connected by a sprocket chain 51 so that the sprockets 46 and 47 are rotatably driven upon their shaft 39 when the pulley-supporting shaft 27 is rotated.

The shaft 39 also supports a sprocket wheel 52 (Figs. 2, 3 and 4) having a hub 53 fixedly secured thereto for rotation therewith in any desired manner. The sprocket wheel 52 is connected to another and intermediate sprocket 54 by a sprocket chain 55. The sprocket 54 is provided with a hub 56 rotatably mounted in any desired manner upon a shaft 57 having its ends supported in bosses 58 and 59 at the opposite ends of the casing 20. The sprocket hub 56 also supports a sprocket 60 and this sprocket is connected by a sprocket chain 62 to a sprocket 63 fixedly secured to the hub 30 of the chuck device 31.

The bottom portion of casing 20 serves as an oil reservoir. This casing is provided with a false bottom 20^a to locate the bottom wall in close proximity to the speed-change gearing so that a minimum depth of oil may be used. The oil level is indicated in Fig. 4, and it is such that only the larger sprocket 47 and its sprocket chain 51 move therein. This arrangement causes sufficient splashing and throwing of oil to properly lubricate the other moving parts within the casing

20. Oil is admitted to, and the level thereof determined by an oil cup 20^b at one side of the casing.

The forward or T-head end 40 of the shaft 39 is arranged for attachment thereto of a hone device 64 (Fig. 1) which will be referred to in detail hereinafter. This honing device is adapted to be rotated at a desired speed for honing the work at hand. The chuck device 31, in the particular machine disclosed, is adapted, preferably, to support a reamer device which is desirably rotated at a lower speed than the honing device. This speed differential is accomplished through the sprocket gearing above described and, particularly, by employing a sprocket 46 of sufficient size to normally rotate the shaft 39 and honing device 64 at, for example, approximately 500 revolutions per minute, while the sprocket 47 is of larger size and adapted, comparatively, for speed reduction of the shaft, and rotation of the honing device, to approximately 300 revolutions per minute. A clutch device 65 (Figs. 2, 3 and 6) is employed for selectively connecting the sprockets 46 and 47 to the shaft 39. The reamer device (not shown) and its chuck 31 are rotatably driven from the shaft 39 through sprockets 52, 54, 60 and 63 and their drive sprocket chains 55 and 62. The sprockets of this latter drive structure are of a character adapted for speed reduction so that, for example, when the shaft 39 is driven through the sprocket 46, the reamer will be rotated at approximately 90 revolutions per minute and when the sprocket 47 is connected to the shaft 39, the speed of reamer rotation will be reduced to about 54 revolutions per minute. It is to be understood that the speeds and the speed change relationships above mentioned may be varied to suit particular conditions of use.

The clutch device 65 (Figs. 2 and 6) includes a clutch body 66 having enlarged circular end flanges 67 defining an annular groove 68. The clutch member 66 is provided with an axial opening of sufficient size to snugly receive a bushing 69 rigidly secured to the shaft 39 by screws or pins 70 (Fig. 6), and there is a spline connection 71 between the clutch member 66 and bushing 69 that permits axial slide movement of the clutch member over the bushing while positively connecting the clutch member for rotation with the shaft 39. Movement of the clutch to the left, as viewed in Fig. 2, connects the same with the sprocket 46 for high speed rotation, and movement of the same in an opposite direction connects it with the sprocket 47 for lower speed operation. The connection between the clutch member and the sprockets 46, 47 is accomplished by radially-directed slots 72 on the clutch member flanges that are interlockingly engaged or meshed with laterally-extending lugs 73 secured by riveting, or otherwise, to the faces of the sprockets 46 and 47 adjacent to the clutch member 66.

The clutch 65 is manually actuated by a handle 74 (Fig. 4) secured to the end of a shaft 75 rotatably mounted in the casing 20. The inner portion of the shaft 75 supports an upstanding yoke member 76, the arms 77 of which support pins 78 that engage in groove 68 of the clutch member.

When the clutch member 66 is moved to the left (Fig. 2) through its handle 74 and the slot-and-pin connection 68, 78, the sprocket 46 is positively connected to the shaft 39 so that such shaft is directly rotated from the power source through the shaft 27; and when the clutch mem-

ber is shifted in the opposite direction the shaft 39 is driven through the sprocket 47 with a speed reduction as above explained. When the shaft 39 is rotated the reamer chuck 31 is likewise rotated, but at a reduced speed, through the sprockets 52, 54, 60 and 63; and the speed of the chuck 31 and the tool carried thereby may be varied by shifting the clutch member 65 to connect one or the other of the sprockets 46 and 47. If desired, the clutch member may be moved by its handle 74 to a neutral position, in which case the shaft 39 and the tool or tools driven thereby remain at rest. If desired, means (not shown) may be provided for positively holding the handle in that as well as the other positions.

The honing device 64 preferably takes the form shown in Figs. 1 and 5, which is quite similar to the hone shown in my Letters Patent No. 1,936,612, granted on November 28, 1933. This hone includes end members 80 and 81 rigidly connected together by annularly spaced posts 82. The end members 80, 81 are provided with radial grooves 83 which support the end portions of radially expandible and contractible carrier members 84 that support an abrading material 85 for honing purposes. Expansion of the carrier members 84 is accomplished by cone-shaped spreaders 86 fixedly secured to a stem 87 supported for axial shift movement in bores suitably provided in the end plates 80, 81. The inner edges of the carrier members 84 are provided with notches 88 that are shaped complementally to the cone spreader surfaces with which they engage. When the adjusting stem 87 is moved in one direction (to the right in Fig. 5) the tool is expanded, and when it is moved in the opposite direction, spring rings 89 encircling the opposite exterior end portions of the carrier members 84 contract the tool.

The honing device 64 is provided with elongated and hollow drive shaft 90 (Figs. 1 and 5) which, preferably, takes the form of an extension of the end plate 81, although this shaft may be connected with the honing tool frame in any suitable manner so as to drive the latter rotatably. The outer end of the shaft 90 is provided with an enlarged head 91 secured thereto by one or more locking screws or pins 92. The head 91 is of such shape as to constitute a T-shaped drive extension for the shaft 90, and the T-head portion of the shaft 39 is provided with a similarly-shaped socket 93 in which the head 91 is received. The head 91 is drive connected in the socket 93 by a bayonet slot-and-pin connection 94 (Figs. 3 and 5) so that the honing device may be readily detached from the driving mechanism. In this way, the hone is directly driven by the shaft 39.

In Fig. 5, I have illustrated the hone as applied to, and expanded into operative engagement with the wall 95 of a bore such, for example, as a piston pin hole. The tool is aligned with bore 95 by a cone-shaped guide 96 slidably mounted upon the hone shaft 90 having its cone surface adapted to engage the outer and squared end surface of the bore to be honed. To insure proper and constant engagement of the cone device with the work, I mount a spring 97 around the shaft 90, with one end of this spring received in a recess 98 in the cone guide 96 and its other end received in a recess 99 formed in the adjacent shank portion of the drive head 91. The spring 97 is normally confined under slight compression between the head 91 and guide 96 and, in operation, with the guide 96 engaged with

the work, the spring will be further compressed and it will hold the guide 96 in proper position for centering the tool as it is reciprocated in operative engagement with the work.

In carrying out my invention, I provide for automatic expansion of the hone during operation, thereby eliminating the skill of the operator in this regard, and I further provide an automatic stop arrangement whereby the bore will be honed within predetermined and proper limits under the control of the automatic expansion means.

In carrying out the foregoing feature, the hone adjusting shaft 87 is of sufficient length to extend through the hone driving shaft 90 to substantially the outer end thereof. The outer part of the opening 100 in shaft 90 is somewhat larger than the adjustment shaft 87 and the remainder of such opening is such as to provide a rather snug slide fit for the shaft 87. A sleeve 101 is secured to the outer end of the shaft 87 and it is adapted to fit slidably within the enlarged part of the opening 100. A spring 102 is mounted upon the shaft 87 within the opening 100 and it is confined therein normally under tension by the sleeve 101. The spring 102 constantly tends to move the adjusting stem 87 in a direction to contract the tool so that when the tool parts are released for contraction such action will be rapidly and positively carried out.

The adjustment shaft 87 is moved in tool expansion direction by adjustment mechanism including a shaft 103 passing slidably through an opening in the tool drive head 91 and having a sleeve 104, similar to the sleeve 101, slidably received within the shaft 90 and normally in engagement with the adjacent end of the adjusting shaft 87. The short shaft 103 is, in turn, engaged and actuated in axial direction by another shaft 105 slidably supported within the drive shaft 39. The shaft 105 has its rear end portion projecting beyond the rear end of the shaft 39 where it engages an arcuate pad-like portion 106 of an arm 107 hingedly supported at its lower end by a pin 108 carried by the casing 24 (Figs. 2 and 5). The upper end of the arm 107 is free and this arm is constantly urged in forward direction against the end of shaft 105 by a spring 109 having one end received in a recess 110 (Figs. 2 and 5) in the rear part of the arm 107. The other end of spring 109 is guidingly seated upon a flange 115 at the inner end of an adjusting screw 111 in screw-threaded engagement with a rear, socket portion 112 of the casing 24. The screw 111 is provided with a knurled adjusting wheel 113 fixedly secured thereto by a pin 114. The spring 109 is of greater strength than the spring 102 so that the tool parts are normally moved in an expanding direction.

The spring 109 is normally of sufficient length and under such tension as to yieldably move the arm 107 throughout a certain range of expanding movement, and to also apply sufficient expanding pressure to effect a predetermined engagement between the honing device and the bore being honed. By rotating the screw device 111 in clockwise direction the tension of the spring 109 may be increased to increase the pressure of the hone against the bore. This is a desirable feature accommodating the finishing of various kinds of bore surfaces and it tends to increase the speed of the honing action. With the parts as shown in Fig. 5, the pressure exerted by the spring 109 is transmitted to the adjusting shaft 87 through the shaft connections or members 105 and 103 so that the tool is expanded. As the honing oper-

ation is carried on, the spring 109 gradually and continuously expands the tool to a predetermined extent.

When the honing tool is not in operation, and for the purpose of facilitating application of the tool to the work, I provide means for moving and latching the arm 107 against expanding action so that the tool contracting springs 102 and 89 are permitted to contract the tool. Specifically, I employ a pair of swingable arms 116, 117 (Fig. 5) mounted in somewhat vertical offset relation upon shafts 118 and 119 rotatably carried in any suitable fashion by one of the walls of the casing 24 (Fig. 4). The arms 116 and 117 are connected together for simultaneous swing movement by link 120, swingably connected thereto by pins 121, 122. This arm-and-link structure is adapted to be swung rearwardly and forwardly by a handle 123 secured to an end of the shaft 119 projecting through the wall of casing 24.

As the link and arm structure 116-120 is swung rearwardly, the upper end of the arm 107 is moved rearwardly for contraction of the tool. More particularly, the link-connecting pin 122 is extended laterally opposite the arm 107, and this pin, when the arm and link structure is swung rearwardly, engages the arm 107 to move it rearwardly. The arm 116 may be moved sufficiently to throw it past the center of shaft 118 (Fig. 2), at which time the extension of pin 122 is engaged in a notch 124 in the arm 107 and the arm is held positively in a fully contracted position as shown in Fig. 2. Slight movement of the arm and link structure in forward direction by means of the handle 123 will release the pin 122 from the arm notch 124 and free the arm 107 for forward expanding movement.

To limit the expanding and honing action of the tool, I provide the stop structure shown in Figs. 2 and 5. Specifically, the structure illustrated includes a stop stem 125 slidably supported by a hanger-type boss 126 carried by the casing 24. The stem 125 projects into the path of the upper pad-like end portion 127 of the arm 107 and limits the forward movement of such arm. The stem 125 is arranged for longitudinal adjustment so as to vary the extent of forward movement of the arm 107 and, in turn, extent of the hone expansion. To this end, the forward end of the stem 125 is rigidly connected, as by a pin 128 to a sleeve-like member 129 having an enlarged central bore and a slightly reduced threaded opening in its forward end in which a screw stem 130 is threadably received. The enlarged portion 131 of the sleeve bore permits free movement of the screw 130 within the sleeve member 129 so that screw-adjustment operation may be accomplished with ease. The sleeve 129 and stop stem 125 are prevented from rotation by a casing-carried screw member 132 having its inner end portion slidably received within a slot 133 in the upper or adjacent portion of the sleeve 129. The screw stem 130 is rotatably supported within a bushing 134 locked by a screw 135 within a boss portion 136 in the upper forward portion of the casing 24. That portion of the screw stem 130 supported in the bushing 134 is not threaded and its outer projecting end portion receives an adjusting member 137 secured thereto by a lock screw 138. An enlarged circular dial member 139 is secured to the inner side of the adjusting device 137 by pins 140 or other suitable fastening devices, and this structure, together with an annular flange 141 on the other side of the bushing 134, holds the screw stem 130 against longitudinal

displacement as it is rotated. The dial member 139 (Fig. 7) is provided with graduations 142, each of which may represent any desired amount of expansion in the honing tool. This dial member is also set into a shallow recess formed in the adjacent wall of casing 24 so that graduations 142 may register flush with an indicating mark 143 above the dial member on the casing wall.

In the operation of the stop mechanism, rotation of the adjusting device 137 in clockwise direction moves the stop stem 125 forwardly to increase the expansion range of the arm 107, and vice versa, when such device is rotated in counterclockwise direction. By way of example, assuming that it is desired to remove .001 inch of material from the work, the contracted tool may be inserted in the work, after which the tool is permitted to expand into firm engagement with the work, the device 137 being adjusted to permit that action, if that is found necessary. After the tool is expanded into engagement with the work, the adjusting device 137 is rotated in the proper direction into engagement with the end 127 of the arm 107. At that time one of the dial member graduations will register with or have a certain relation to the mark 143. The adjusting device is then rotated in clockwise direction an extent corresponding to that required to remove .001 inch of material from the work. As the honing action is carried on, the tool being constantly expanded under the influence of spring 109, the arm 107 will eventually move into engagement with the end of the stop stem 125 and, although the drive of the tool may be continued, the honing action will be discontinued because the tool cannot expand further. In compensation for wear of the abrasive material of the honing device, the dial member may be rotated a short additional extent after the stop stem is engaged as described and the honing operation continued until movement of the arm 107 is again stopped. In this way, the work may be honed with great accuracy and without danger of over-honing and without the necessity of measuring the honed surface at intervals during operation to determine its size and condition.

In the use of a reamer device in connection with power-driven structure of this character, it is essential that such device be rigidly and securely supported. It is also desirable that such device be readily and quickly detachable, as well as foolproof with respect to proper centering and supporting actions. I, therefore, employ a novel chuck device, one form of which is found in the chuck 31 (Fig. 3). Specifically, this particular form of my invention includes a cup-shaped chuck body 150 having a reduced hollow extension adapted to be rotatably received in the boss 32 of the casing 20 and also arranged to rotatably receive the shaft 27. The chuck body is provided with a cylindrical opening 151 and upper, and lower diametrically opposed slots 152, 153 are provided in its wall for snug, slidable reception of chuck jaw members 154 (Figs. 10 and 13). These jaw members are movable toward and from each other to engage and release the tool to be held thereby, the facing surfaces of the jaw members being provided with notches 154^a to receive and hold the shank of such tool.

The jaw slots 152, 153 extend entirely through the wall of the chuck body and outward movement of the jaws 154 is normally limited by a ring 155 having its lower and forward edge beveled or cut away at an angle to engage a complementally-shaped outer wedge-shaped surface

on the jaws 154. The ring 155 is held in operative engagement with the tapered surface of the jaws 154 by a nut 156 screw-threadedly mounted upon the outer part of the chuck body rearwardly of the ring 155. The nut 156 is provided with an annular recess 157 in its forward wall of sufficient size to snugly embrace the rear portion of the ring 155 for properly and positively positioning the latter against the opposed chuck jaws 154. The jaws 154 are normally held apart in expanded condition and in operative engagement with the ring 155 by a spring 158 mounted in a comparatively narrow and rectangularly-shaped recess 159 in the inner bottom portion of the chuck body. The opposite ends of the spring 158 are engaged within the reduced rear ends or tongues 160 on the chuck jaws which slidably fit within the correspondingly-shaped spring-receiving recess 159. The chuck surfaces just described cooperate with the walls of the recess 159 and the bottom of the chuck body to hold the jaw members 154 against cocking and in squared alignment for properly receiving, centering and holding the tool.

The front ends of the jaw slots 152, 153 are closed by a plate member 162 secured to the front end of the chuck body 159 by screws, or other suitable fastening devices, 163. The central portion of the plate member 162 is provided with a rectangular opening 164, the walls of which are arranged parallel with the adjacent walls of the jaw notches 154. The opening 164 permits the ready insertion of the shank of the tool to be held by the jaw members 154.

In the use of the chuck structure just described, the adjusting nut 156 is adjusted rearwardly, freeing the jaw members 154 for movement of the same to an expanded position by the spring 158, as illustrated in Figs. 8 and 9. The shank of the tool to be held by the chuck is then inserted through the opening 164 and into alignment with the jaw notches 154, whereupon the nut 156 is screwed forwardly, in turn moving the ring 155 forwardly along the tapered wall of the jaw members, causing the latter to move inward into contracted holding engagement with the tool shank. In this way the tool is securely held in properly centered relation with respect to its driving mechanism and it will be retained in that condition until the nut 156 is adjusted to release the same.

I believe that the operation and advantages of my invention will be readily understood from the foregoing. When it is desired to first ream and then hone a piece of work, the proper size reamer (the chuck device 31 accommodating different size reamers) is secured in the chuck device 31, and if the character of the material to be reamed is such as to require high-speed reaming operation, the clutch device 65 is moved to cut in and drive the transmission mechanism through the sprocket 46. If the material worked upon is of such a character as to require a lower speed, the clutch device 65 is moved to cut in the sprocket 47. After the reaming operation has been completed, the work is removed from the reamer and it is then applied to the honing device, which is adjusted thereto as hereinabove described. The clutch device is then actuated for high or lower speed operation, as above mentioned. Either reaming or honing operations alone may be carried out or, if desirable, both reaming and honing operations upon different pieces of work may be carried out simultaneously.

It is to be understood that, although I have

shown and described only one form of structure embodying my invention, changes in details and arrangements of parts may be made therein without departing from the spirit and scope of my invention as defined by the claims that follow.

1. In structure of the class described, a power driver, a shaft rotatably driven by said driver, a second shaft, speed-change drive connections including manually operable clutch means between said first and second shafts, a tool supporting member carried directly by and driven by said second shaft, a second tool supporting member, and speed reducing drive connections between said second shaft and said second tool supporting member whereby said second tool supporting member is driven at speeds different from the respective speeds of said first tool supporting member.

2. In structure of the class described, a power drive, a shaft driven thereby, a second shaft, a tool supporting member carried by and driven by said second shaft, a pair of gear members fixed on said first shaft, a pair of gear members rotatable on said second shaft and of different sizes for speed-change purposes, means drive-connecting the gears on said first shaft with the gears on said second shaft, respectively, clutch means rotatable with said second shaft and shiftable to engage one or the other of said gears on said second shaft, a second tool supporting member, and speed reducing drive connections directly between said second shaft and said second tool supporting member.

3. In structure of the class described, an expandable tool, and means for rotatably driving and expanding said tool which includes an elongated hollow driven shaft on said tool, a tool expanding shaft passing through said hollow driven shaft, a tool driving shaft detachably connected to said driven shaft, drive connections on said drive shaft, another tool expanding shaft in said drive shaft normally engaged with said first expanding shaft and extending through and beyond said drive shaft, spring urged means engaged with the extending part of said second-mentioned expanding shaft and urging said expanding shafts in tool expanding direction while said shafts are rotated, and spring means of reduced strength acting directly upon said first expanding shaft and yieldably opposing expanding movement of said expanding shafts.

4. In structure of the class described, an expandable tool, and means for rotatably driving and expanding said tool which includes a hollow driven shaft attached to said tool, a hollow and axially aligned driving shaft detachably connected at its forward end to said driven shaft, means including drive connections on said driving shaft for rotating both said shafts and tool, a sectional tool expanding shaft extending through both said shafts and projecting from the rear end of said driving shaft, spring means directly acting on and urging said expanding shaft in contracting direction, and stronger spring means urging said expanding shaft in expanding direction, said expanding shaft being shiftable independently of rotation of said driving and driven shafts.

5. In structure of the class described, an expandable tool, and means for rotatably driving and expanding said tool which includes a hollow driven shaft attached to said tool, a hollow and axially aligned driving shaft detachably connected at its forward end to said driven shaft,

means including drive connections on said driving shaft for rotating both said shafts and tool, a sectional tool expanding shaft extending through both said shafts and projecting from the rear end of said driving shaft, spring means in said hollow driven shaft engaging and urging said expanding shaft in contracting direction, stronger spring means urging said expanding shaft in expanding direction, and means positively limiting the extent of movement of said expanding shaft in expanding direction.

6. In structure of the class described, an expansible tool, and means for rotatably driving and expanding said tool which includes a hollow driven shaft attached to said tool, a hollow and axially aligned driving shaft detachably connected at its forward end to said driven shaft, means including drive connections on said driving shaft for rotating both said driving and driven shafts, tool expanding and contracting means including a sectional expanding shaft extending through both said drive and driven shafts, the arrangement being such that part of said expanding shaft is retained in said driven shaft and part in said driving shaft when said latter shafts are detached from each other means including a spring-actuated member for urging said expanding shaft in expanding direction, and means for moving said member away from said expanding shaft to permit contraction of the tool.

7. In structure of the class described, a tool including carriers mounted for expansion and contraction movements, means engaged with said carriers for expanding and contracting the same, and means for actuating said first means including an elongated shaft, spring means urging the tool parts in contracting direction, stronger spring means including a spring-actuated member swingably mounted for movement toward and from said shaft for moving said shaft and carriers in expanding direction, means operable at will for holding said member against movement toward said shaft, and means adapted to be engaged by said member for limiting the extent of expanding movement of said shaft when said member is released from said holding means.

8. In structure of the class described, a tool including carriers mounted for radial expansion and contraction movements, means engaged with said carriers for expanding and contracting the same, and means for actuating said first means including an elongated shaft, a spring constantly urging said shaft in contracting direction, stronger spring means including a shiftable member for constantly urging said shaft in expanding direction, and means for relieving the action of said stronger spring means and permitting said other spring means to move said shaft in contracting direction, including a manually operable member movable to engage and shift said first member to an inactive position.

9. In structure of the class described, a tool including bore treating members mounted for radial expansion and contraction movements, means engaged with said members for expanding and contracting the same, and means for actuating said first means including an elongated shaft connected to said first means, an arm engaging the end of said shaft opposite said tool, a spring urging said arm toward said shaft to move the latter in an expanding direction, manually operated means connected to said arm for moving it away from said shaft and for rendering said spring inactive, means for adjusting the

tension of said spring, and stop means for limiting the extent of expanding movement of said arm.

10. In structure of the class described, a tool including bore treating members mounted for radial expansion and contraction movements, means engaged with said members for expanding and contracting the same, spring means yieldably holding said members engaged with said first means, and means for actuating said first means including an elongated shaft, a spring acting independently of said spring means for constantly urging said shaft in contracting direction, an arm engaging the end of said shaft opposite said tool, a spring stronger than said first spring constantly urging said arm toward said shaft tending to expand the latter, means for adjusting the tension of said stronger spring, and adjustable stop means for variably limiting the extent of movement of said arm toward said shaft.

11. In structure of the class described, a honing tool including abrasive carriers mounted for radial expansion and contraction movements, means engaged with said carriers for expanding and contracting the same, and means for actuating said first means including a shaft, a spring acting directly upon and constantly urging said shaft in contracting direction, an arm abutting the end of said shaft opposite said tool, a spring stronger than said first spring constantly urging said arm toward said shaft, and means for moving said arm away from said shaft permitting said first spring to move said shaft in tool contracting direction.

12. In structure of the class described, a tool including bore treating members mounted for radial expansion and contraction movements, means engaged with said members for expanding and contracting the same, and means for actuating said first means including a shaft, an arm engaging the end of said shaft opposite said tool, a spring urging said arm and shaft in tool expanding direction, means urging said shaft in a contracting direction, and means for moving said arm away from said shaft and for latching it in a position wherein said shaft is moved by said contracting means to and held in a contracted position.

13. Mechanism for adjusting an expansible and contractible tool of the class described, which includes a shaft shiftable in one direction to expand the tool and shiftable in the opposite direction to contract the tool, spring means constantly urging said shaft in contracting direction, an arm engaging said shaft, a spring stronger than said first spring acting on said arm and constantly urging it in a direction to move said shaft in expanding direction, means limiting the extent of expanding movement of said arm and shaft, and independent means for relieving the pressure of said second spring permitting said first spring to move said shaft in contracting direction.

14. Mechanism for adjusting an expansible and contractible tool of the class described, which includes an elongated shaft shiftable in one direction to expand the tool and shiftable in the opposite direction to contract the tool, spring means urging said shaft in contracting direction, an arm pivotally supported at one end and engaging said shaft, a spring stronger than said first spring acting on said arm and constantly urging it in a direction to move said shaft in expanding direction, means disposed in the path

of the other end of said arm and adjustable for variably limiting the extent of expanding movement of said arm and shaft, and separate means for moving said arm away from said shaft to permit said first spring to move said shaft to a tool contracted position.

15. Mechanism for adjusting an expansible and contractible tool of the class described, which includes a shaft shiftable in one direction to expand the tool and shiftable in the opposite direction to contract the tool, spring means urging said shaft in contracting direction, an arm engaging said shaft, another spring acting on said arm and constantly urging it against the pressure of the first spring in a direction to move said shaft in expanding direction, means for moving said arm away from said shaft thereby relieving the pressure of said second spring permitting said first spring to move said shaft in contract-

ing direction, and means for latching and holding said arm in a pressure-relieving position as desired wherein said first spring is free to move said shaft to a fully contracted position.

16. In structure of the class described, power drive means, a rotatable member driven by said power drive means, an adjustable tool member directly supported by said rotatable member, a second rotatable member, a tool supported by said second rotatable member, means by which said second rotatable member is driven by said first rotatable member, means associated with said first rotatable member and engaging said first tool for adjusting the latter, and means for changing at will the speed of rotation of said rotatable members without changing the speed of said power drive means.

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