B. M. W. HANSON.

GRINDING MACHINE.

APPLICATION FILED JUNE 13, 1908.

909,895.

Patented Jan. 19, 1909.

2 SHEETS—SHEET 1.

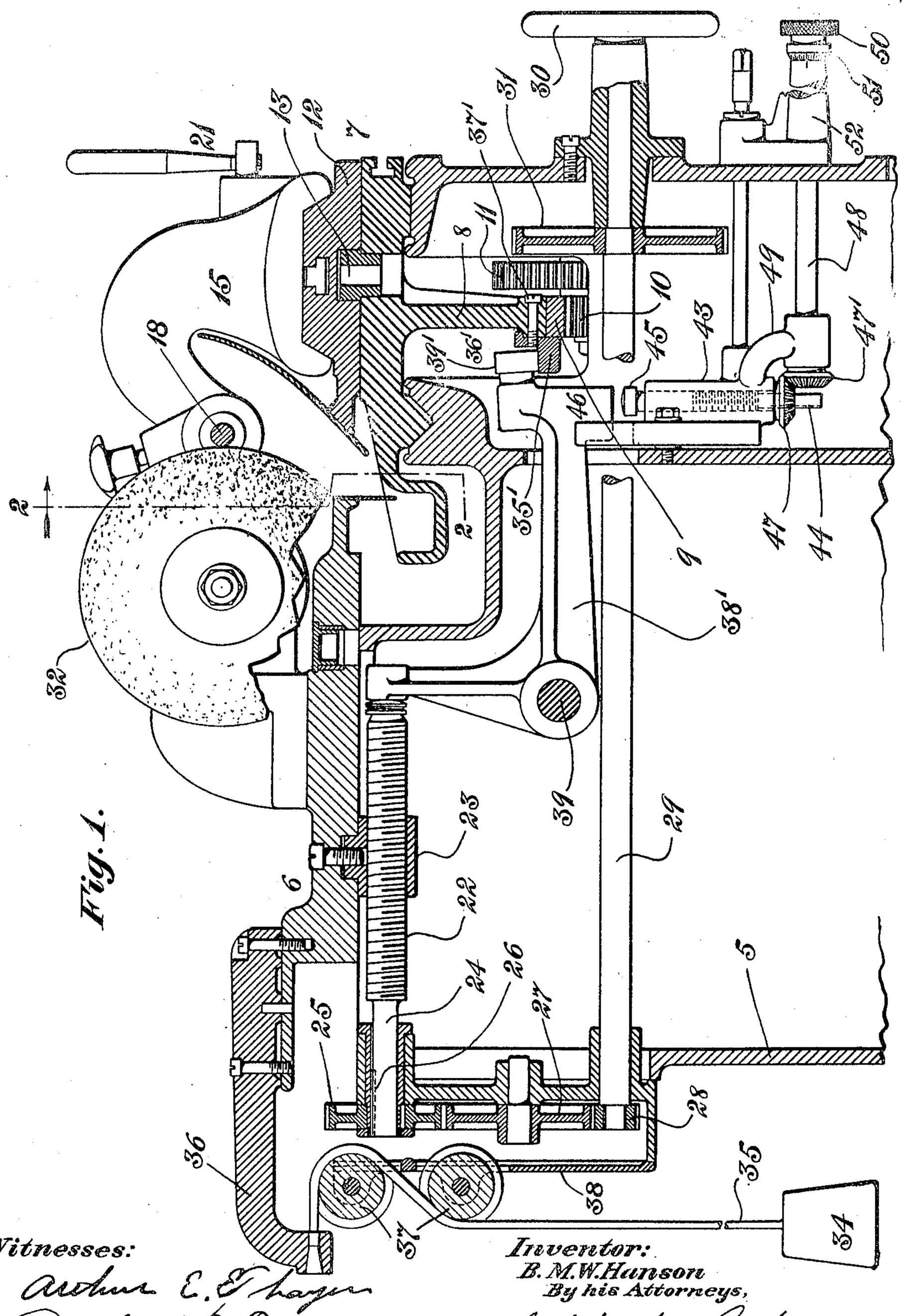


Fig. 1.

Witnesses:

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Inventor:

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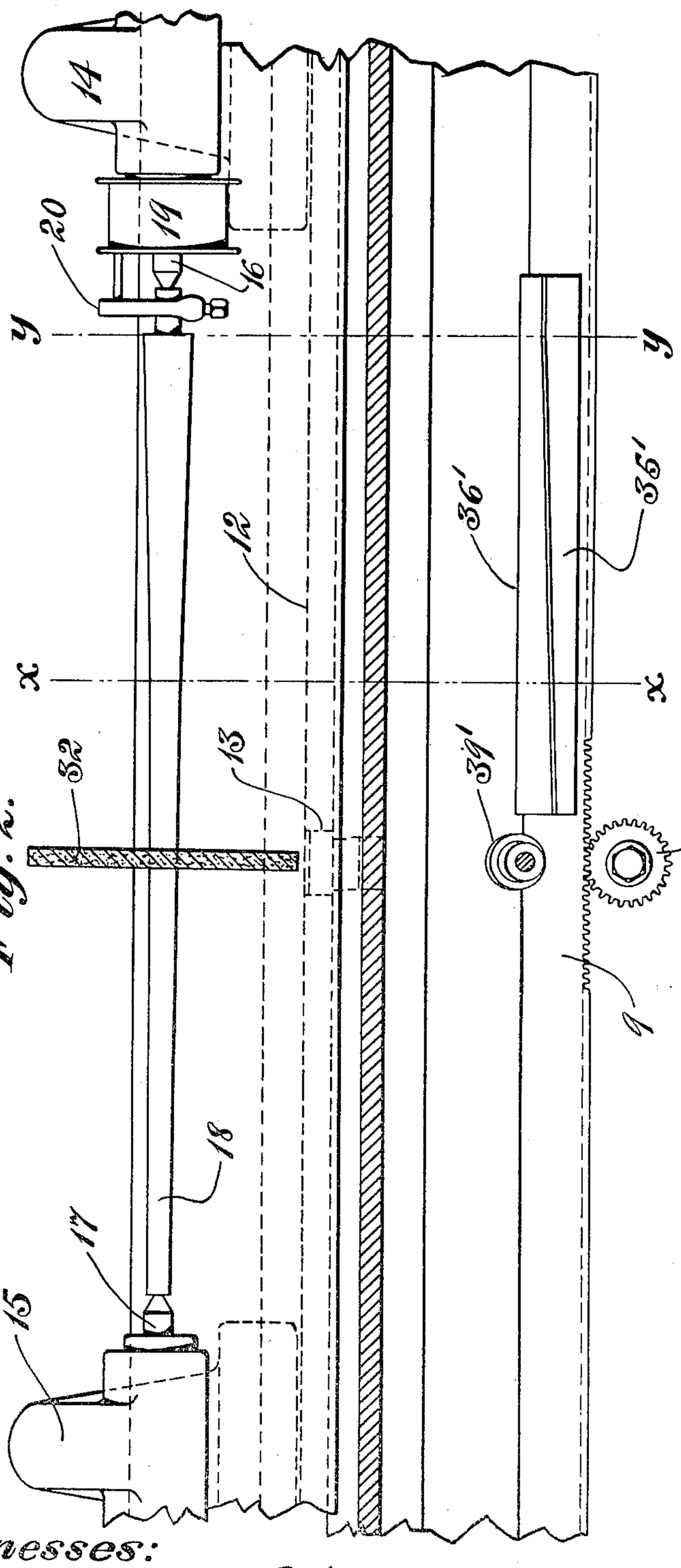


Fig. 2.

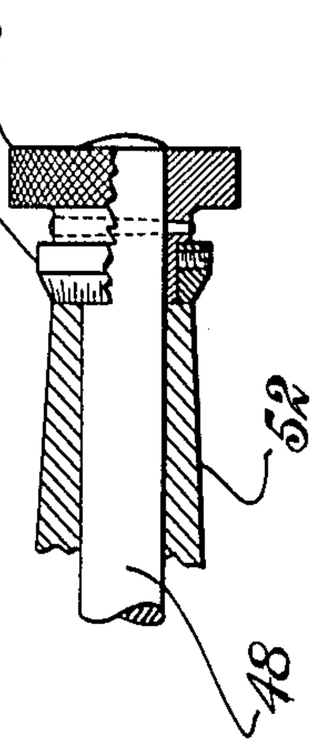


Fig. 4.

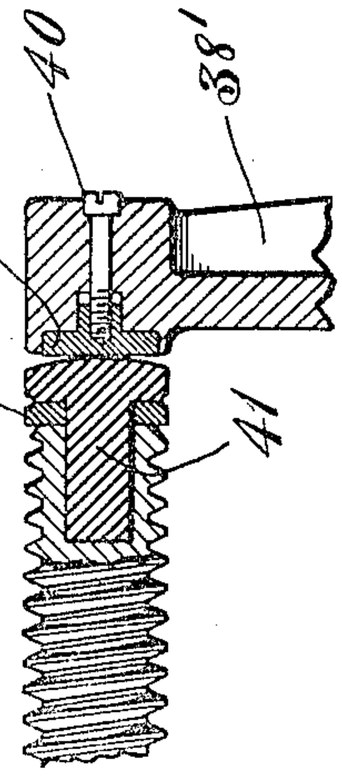


Fig. 3.

Witnesses:

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# UNITED STATES PATENT OFFICE.

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## GRINDING-MACHINE.

No. 909,895. Specification of Letters Patent. Patented Jan. 19, 1909.

Application filed June 13, 1908. Serial No, 438,390.

*To all whom it may concern:*

Be it known that I, BENGT M. W. HANSON, a citizen of the United States, residing at Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Grinding-Machines, of which the following is a specification.

This invention relates to grinding-machines the primary object of the invention being to provide an effective machine of this type especially adapted for grinding with precision taper articles of various characters.

The invention includes other advantageous features which with the foregoing will be set forth at length in the following description wherein is outlined that particular form of embodiment of said invention which I have selected for illustration in the drawings accompanying and forming part of the present specification while the novelty thereof will be covered in the claims succeeding said description.

Referring to said drawings, Figure 1 is a transverse section of a grinding-machine involving my invention, with a portion of the grinding-wheel removed. Fig. 2 is a sectional view on the line 2—2 Fig. 1, looking in the direction of the arrow. Fig. 3 is a detail sectional elevation of a portion of the lead-screw and power-transmitting lever, and, Fig. 4 is a detail view of a micrometer gage hereinafter more particularly described.

Like characters refer to like parts throughout the several figures.

The machine includes in its construction a framework which may be of any desirable nature; that shown is denoted in a general way by 5 and being of a familiar construction and in itself forming no part of the invention it is needless to describe the same in detail. The framework 5 serves to support two carriages hereinafter described, and certain of the other operative parts of the machine.

The two carriages to which allusion was just briefly made are denoted in a general way, respectively, by 6 and 7, the carriage 6 sustaining the tool while the carriage 7 carries the work and during the grinding operation one of these carriages has a movement with respect to the other; in the present case the carriage 7 has such an operation, it being fed or reciprocated in the direction of the axes of rotation of the grinding-tool and work respectively. It might be stated at this point that the top of the framework, which constitutes a suitable bed for the carriage 7, has ways of some convenient kind along which the carriage 7 travels longitudinally during the grinding-action. It is of course not essential that the work-carriage 7 should be operated relatively to the tool-carriage during grinding. I mention this to indicate that the invention does not reside in any particular carriage feed or relative operation of several carriages. It might be also well to mention that the top of the frame has suitable ways to receive the tool-carriage 6 and that the latter has a reciprocation transverse to the axes of rotation of the work and tool and also of the feed of the carriage 7.

The longitudinally sliding carriage 7 is represented as provided with a depending flange or fin as 8 to the underside of which is suitably fastened a rack-bar as 9 with the teeth of which a rotary pinion as 10 meshes, said pinion being operable either by hand or automatically to cause the traverse of the carriage 7. This rack-bar and pinion are common in grinding-machines so that a detailed showing of the hand-operable and automatically-operable means for actuating the said pinion need not be shown in detail or described although part of the automatic operating means is shown, viz., the gear 11 which like said pinion may be supported in any suitable manner upon the framework 5. It will be understood that during grinding of the stock on the carriage 7 the latter is moved back and forth the grinding tool hereinafter described, operating against the work during such back and forth motion of said carriage 7. Said carriage 7 in the present case moves exactly in the direction of the axis of rotation of the work or stock so that I cannot obtain from such motion a taper to the work or stock. This function is obtained, however, by the use of a platen as 12 which is angularly adjustable with respect to the grinding tool and which is pivoted at 13 to the carriage for motion about a vertical axis. By swinging the platen 13 around the angle of presentation of the work to the tool can be varied to provide for tapered work, the platen being clamped in an adjusted position by suitable clamping means (not shown.) The platen in effect

forms a part of the work-carriage and in the present instance directly sustains a head-stock as 14 and a tail-stock as 15, the former being provided with a live-spindle as 16 and the latter with a dead-spindle as 17 between which the work as 18 is centered and held. The spindle 16 is furnished with a driver as 19 consisting of a band wheel or pulley which serves to rotate through a dog as 20, the work 18. The work may be of any suitable nature although the machine is particularly adapted for grinding articles which have a double taper and especially where one of the tapered surfaces is along a curve such as in the case of a gun barrel or the stock from which such a device is to be made. I mention this simply as an illustration, however, as the machine is capable of a wide range of uses and some of the features may be employed even where the article being ground has not such a form. In any event, however, the action of the machine is attended by extreme accuracy or precisionized results. The head-stock 14 and tail-stock 15 are each adjustable longitudinally of the platen 12 to adapt them to articles of different lengths and they may be held in their adjusted positions by the customary clamping devices denoted in each case generally by the symbol 21.

The cross fed or tool carriage 6 is operated preferably by means comprising a feed-screw as 22 coöperative with a feed-nut as 23 depending from and suitably fastened to said carriage 6. When the feed-screw 22 is operated the carriage 6 will be transversely fed its motion depending upon the direction in which said feed-screw is turned. The outer end 24 of said feed-screw is slidable through a gear as 25 by virtue of which said feed-screw can move endwise relatively to said gear for a reason that will hereinafter appear. There is a rotative connection of some suitable kind between said feed-screw and gear for instance a spline or feather connection as 26. The gear 25 meshes with a gear as 27 rotatively supported upon the framework 5 below said gear 25 and which in turn meshes with a gear as 28 fastened to the rear or back end of a shaft as 29 extending entirely across the machine and which may have fastened at its forward or front end a hand-wheel as 30 constituting a convenient manually-operable device for turning said shaft 29 and thereby through the intermediate parts cross-feeding the tool-carriage 6. In addition to the manual operation of the shaft 29 means are provided for automatically-operating said shaft whereby the carriage 6 through the intervening parts may be fed inward step by step as the grinding progresses. I have only shown one member of this automatic mechanism; that is the gear 31 which is suitably fastened to said shaft and which operates in conjunction with automatically-regulable feed-devices (not shown) for controlling the amount of inward feed of the carriage 6. In operation the tool (hereinafter described) will commence its work at one end of the stock 18 and after this point the carriage 7 is moved longitudinally and when it has reached one end of its stroke the carriage 6 is fed inward one step and the carriage 7 is reversed, these operations occurring automatically, and continuing until the work or stock has been reduced to the necessary size at which time the various feeds are stopped. I do not think it necessary to illustrate and describe in detail the means whereby these functions can be made possible; they constitute no part of the invention. As a matter of fact I have hereinbefore briefly described a type of grinding machine in which my improvements can be advantageously incorporated.

The grinding tool may be of any desirable nature; for instance an emery disk as 32 the spindle or shaft of which is rotatively mounted upon the carriage 6 in any desirable way, for example by bearings as 33 only one of which is shown. In practice I provide means of a positive character for holding the grinding-wheel 32 firmly against the work or stock 18 and a weight as 34 answers very well my purpose, the said weight being shown as connected with the lower end of a band as 35 connected at its upper end with the outer curved depending end of an arm as 36 fastened suitably to the carriage 6 and passing in a curved manner between its ends around the vertically alined guide sheaves or pulleys 37 rotatively supported by the boxing 38 on the framework 5. The weight as will be clear constantly urges the carriage 6 inward, by reason of which the emery wheel 32 is held firmly against the outer surface of the stock or work 18.

There are certain classes of work which have double tapers and a gun barrel for which my machine is peculiarly adapted for grinding is a type of such. A gun-barrel or the blank from which such a device is made has not only two tapers but one of these tapers is of curved form, and my machine can accurately grind a gun-barrel by which of course I mean the blank from which such a barrel is ultimately made. A gun-barrel has commencing with its muzzle end and continuing to a point between its ends an outward taper which is straight. Beyond this point the taper though still outward is upon a curved plane, the arc usually being of considerable radius although the latter may be varied; in fact it is not essential that it be upon a curve for I am alluding to a gun-barrel of a certain nature which my machine is adapted to grind. I preferably obtain the initial or outer straight taper of the gun-barrel by the angular adjustment of

the platen 12. The second taper is preferably obtained by a relative lateral motion between the two carriages 6 and 7 preferably by a lateral motion of the carriage 6 during the traverse of the carriage 7 by means of a forming-device or templet one suitable kind of which will be hereinafter described and although said forming device may be carried by or upon either of said carriages it is preferably supported by the carriage 7 so that the effect thereof can be transferred to the feed-screw 22 by reason of which simplicity in construction is assured.

A forming device or templet such as will suffice for my purposes is illustrated in the drawings and is denoted in a general way by 35′, said forming device having an upstanding flange as 36′ rigidly connected as by screws 37′ with the inner face of the depending flange or fin 8. In the forming device illustrated the upper or working face thereof is upon an inclined arc, the entering end of said working face being the lowest and said face gradually rising from said entering end toward the rear thereof.

In connection with the forming device I employ preferably a power-transferring member which transfers the effect of said forming device to the carriage 6 to gradually feed the latter outward during what might be considered the advancing movement of the carriage 7 or that which said carriage pursues in traveling from the left toward the right in Fig. 2 whereby a taper may be given to the work corresponding to the angle of said forming device. The forming device is removable so that one of a radically different type from that shown may be substituted therefor.

An oscillatory lever as 38′ serves satisfactorily as a power-transferring device, one branch thereof coöperating with the active face of the forming device 35′ while the other branch thereof acts against the feed-screw 22. The lever 38′ is shown as being of the "angle" type it being loosely supported for swinging movement at its elbow by a stationary shaft as 39 sustained by the framework 5. The substantially horizontally-disposed arm of said lever 38′ is shown as equipped with an anti-friction roller 39′ which is adapted to operate against the working face of the forming device or templet 35′ while the substantially upright branch of said lever is provided with a wear-plate as 39″ made in the form of a disk and fastened by a screw as 40 against the outside of said upright arm. The wear-plate 39″ is adapted to engage against the circular head of a plug as 41 driven into the inner end of said feed-screw, said wear-plate and plug being usually made of some hard metal. Between the head of said plug 41 and the feed-screw is interposed a washer 42 subserving its usual purpose.

It will be assumed that the grinding wheel 32 is being rotated, that it is in contact with the extreme left end (Fig. 2) of the work 18 and that the carriage 7 is being given its working stroke or moved toward the left in Fig. 2. Initially of course the anti-friction roller 39′ is not against the active face of the forming device or templet 35′. When, however, the carriage 7 has advanced a predetermined distance the roller 39′ will be brought against the active face of the templet or forming device 35′, the result being that the normally-horizontal arm of the lever 38′ is swung upward while the other arm is swung outward, the motion being a gradual one and continuing until the roller 39′ reaches the end of the working face of said forming device or templet. As the upper or normally upright arm of said lever 38′ is swung outward said arm acting against the feed-screw thrusts the latter in an endwise outward direction so as to feed the carriage 6 automatically outward by reason of which the tapered surface of the work can be precisely ground.

The lever 38′ is controlled by an adjustable stop hereinafter described against which the said lever normally bears and by the adjustment of which the time of engagement thereof with the working face of the forming-device 35′ can be regulated. In the present case the roller is so adjusted as to engage said working face at a point intersected by the dotted line *x* in Fig. 2. The lever however might be so adjusted as to engage said working face at any point in the length thereof so that I can thereby regulate the point at which the automatic tapering operation is to commence. The dotted line *y* in Fig. 2 indicates where the automatic tapering operation is concluded, such line intersecting on the forming device the junction of the working face of the forming device and a horizontal face thereon which two faces merge, the roller engaging said horizontal face at the close of the automatic tapering.

Inside the holiow framework 5 I have shown as mounted a bracket as 43 which supports a spindle as 44, the spindle being shown as vertically-disposed and as externally threaded to engage internal threads in a bore or opening formed in said bracket, the latter by virtue of its threads serving in effect as a feed-nut for the spindle. The spindle constitutes a convenient adjustable stop for controlling the time of engagement between the anti-friction roller 39′ and the forming device 35′ having for the purpose an enlarged head as 45 adapted to engage a pendent enlargement as 46 on the normally horizontal arm of the rocking lever 38′. The adjustable stop or spindle 44 is represented as being so positioned as to cause the roller to engage the active face of the

forming-device 35′ at a point crossed by the line *x*. Should said adjustable stop be elevated this will mean that the said roller will engage the said active face at a point further to the right in Fig. 2 while should it be lowered the contrary will be the case. I can therefore regulate the time and place at which the automatic taper means shall commence to act. The spindle 44 is shown as provided at the lower portion thereof with a bevel gear 47 meshing with a bevel gear as 47′, the bevel gear 47 being rotatively connected with said spindle and the bevel gear 47′ being likewise connected with a shaft as 48 supported rotatively by the front wall of the framework 5 and also by a bearing as 49 forming part of the bracket 43. The shaft 48 may be turned in any suitable manner so as to raise or lower through the intermediate parts the adjustable stop or spindle 44; for this purpose I have shown as operatively connected with said shaft a knob as 50 peripherally milled to facilitate its being turned. The shaft 48 may also have fastened thereto a graduated disk as 51 the graduations of which coöperate with an index mark on a stationary sleeve as 52 connected with the framework and through which said shaft extends.

The lever 38′ in addition to being the medium between the two carriages hereinbefore described whereby automatic tapering is possible also serves as a convenient device for imparting a downward thrust to the carriage 7 to hold the latter firmly against or upon its seat presented by the ways on the top of the framework 5 whereby said carriage 7 can travel without undue noise or vibration. This point is therefore one of the features of my invention, viz., means for holding a traveling carriage to its seat by a thrust or pressure in a direction toward said carriage and transverse to the line of motion thereof.

What I claim is:

1. In a grinding-machine, the combination of a work-carriage, a tool-carriage, the former having means for rotatively sustaining the work, one of said carriages being movable in the direction of the axis of rotation of said work and one of said carriages being movable transversely to said axis, a forming-device on one of the carriages, and a lever for transferring the effect of the forming device to the other carriage to cause a relative lateral motion thereof and tapering of the work.

2. In a grinding-machine, the combination of a work-carriage, a tool-carriage, the former having means for rotatively sustaining the work, one of said carriages being movable in the direction of the axis of rotation of the work and one of said carriages being movable transversely to said axis, a forming device on one of the carriages, and a rocking lever supported by the framework of the machine for transferring the effect of the forming device to the carriage which is not equipped with the same to cause a relative lateral motion thereof and tapering of the work.

3. In a grinding-machine, the combination of a pair of independently movable carriages, a feed-screw for operating one of the carriages, a forming-device on the other carriage, and means for transferring the effect of said forming device to said feed-screw to cause a relative operation of the carriages.

4. In a grinding-machine, the combination of a pair of relatively-movable, independently-supported carriages, a feed-screw for operating one of said carriages, a forming-device, and means for transferring the effect of the forming device to said feed-screw to cause relative motion of the carriages.

5. In a grinding-machine, the combination of a pair of relatively-operable carriages, a feed-screw for operating one of said carriages, a forming-device on the other carriage, a device for transferring the effect of the forming device to said feed-screw to cause a relative motion of the carriages, and means for regulating the time of cooperation between said transferring device and the forming device.

6. In a grinding-machine, the combination of a pair of relatively-movable carriages, a forming-device on one of the carriages, a device for transferring the effect of the forming device to the other carriage, and means for regulating the time of coöperation between said transferring device and the forming device.

7. In a grinding-machine, the combination of a work-carriage having means for rotatively sustaining the work and movable in the direction of the axis of rotation of said work, a tool-carriage movable transversely to said axis, a feed-screw for operating the tool-carriage, a forming device on the work-carriage, and means for transferring the effect of said forming-device to said tool-carriage to cause a lateral motion of the latter.

8. In a grinding-machine, the combination of a work-carriage having means for rotatively sustaining the work and movable in the direction of the axis of rotation of said work, a tool-carriage movable transversely of said axis, a feed-screw for said tool-carriage, a forming device on the work-carriage, and a lever supported by the framework of the machine, engaging and operable by the forming device and adapted also to engage said feed-screw to thereby move the tool-carriage laterally when the said lever is being operated by said forming device.

9. In a grinding-machine, the combination of a pair of relatively movable car-

riages, a forming device on one of the carriages, a device for transferring the effect of said forming device to the other of said carriages to cause a relative motion thereof, a threaded spindle, a stationary part having a threaded portion engageable by the threads of said spindle; and means for operating the spindle to cause the same to engage said transferring device.

10. In a grinding-machine, the combination of a pair of relatively movable carriages, a forming device on one of the carriages, and a device for transferring the effect of said forming device to the other carriage to cause a relative motion thereof, said other carriage through said transferring device serving to hold the companion carriage to its seat.

11. In a grinding-machine, a traveling carriage, a device supported independently of said carriage, and a movable part operating on said device and the latter in turn acting against said carriage to hold the latter to its seat.

12. In a grinding-machine, a pair of traveling carriages, a forming device on one of the carriages, and a device for transferring the effect of said forming device to the other carriage and also serving as a means for holding one of said carriages to its seat by power derived from the companion carriage.

13. In a grinding-machine, a work-carriage having means for rotatively sustaining the work and movable in the direction of axis of motion of said work, a tool-carriage movable transversely to said axis, a forming device on the work-carriage, and a device for transferring the effect of the forming device to the tool-carriage to cause the latter to move laterally and said tool-carriage through said device serving to impart a thrust to the work-carriage to hold the same against its seat.

In testimony whereof I affix my signature in presence of two witnesses.

BENGT M. W. HANSON.

Witnesses:
W. M. STORRS,
EVERETT E. ARNOLD.