C. T. RAULE.

AUTOMATIC SIZING DEVICE.

APPLICATION FILED JULY 20, 1915.

1,225,858.

Patented May 15, 1917.

2 SHEETS—SHEET 1.

FIG. 1.

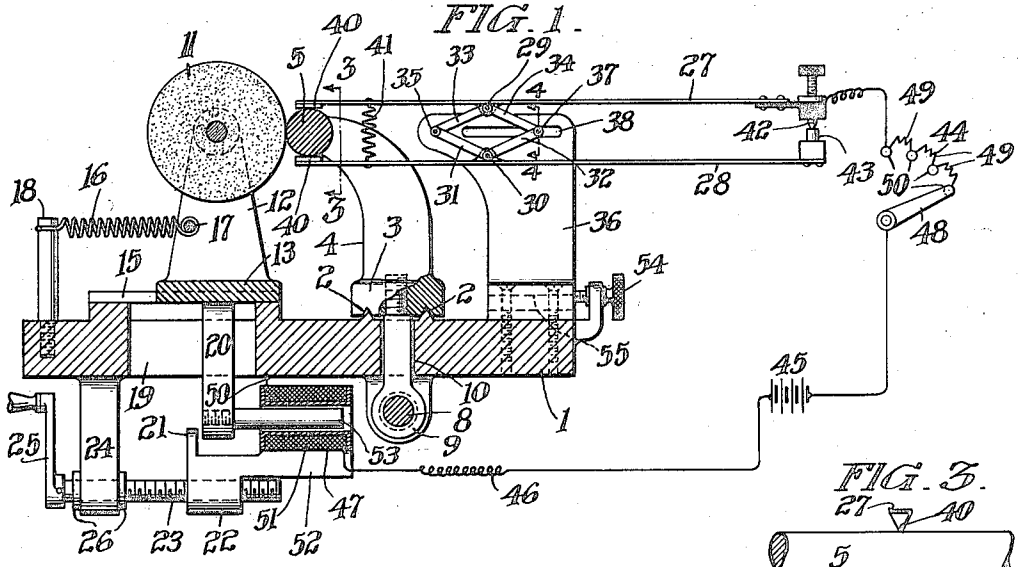


FIG. 3.

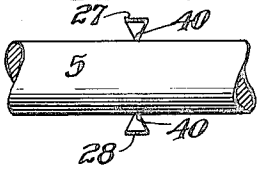


FIG. 4.

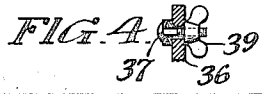
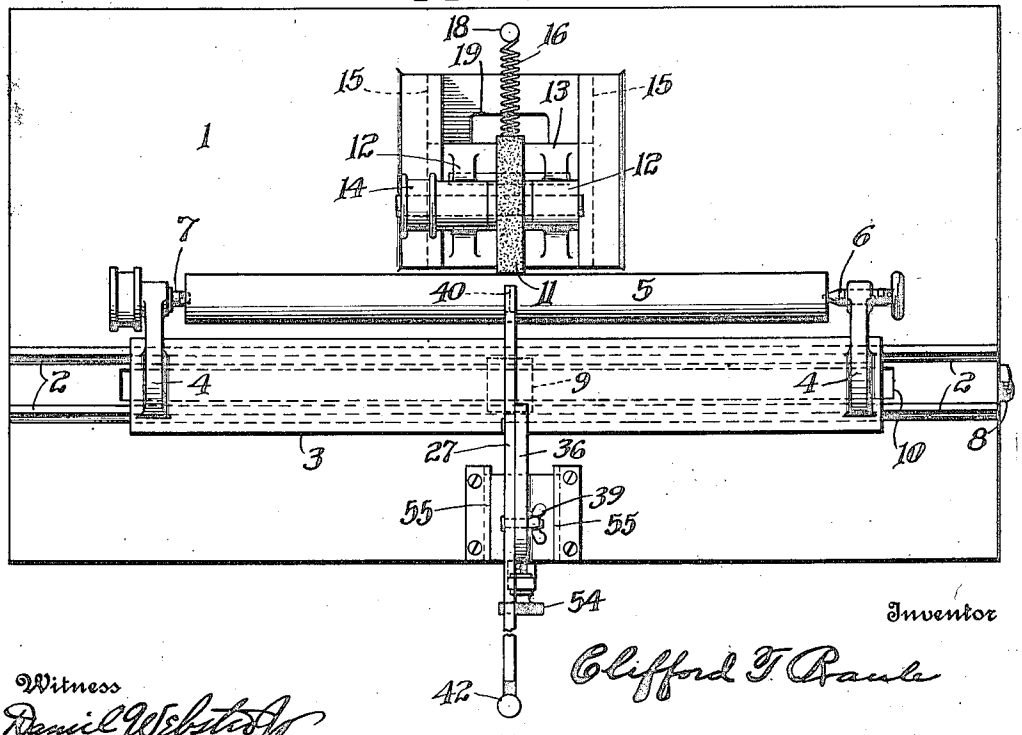


FIG. 2.



Witness

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2 SHEETS—SHEET 2.

FIG. 5.

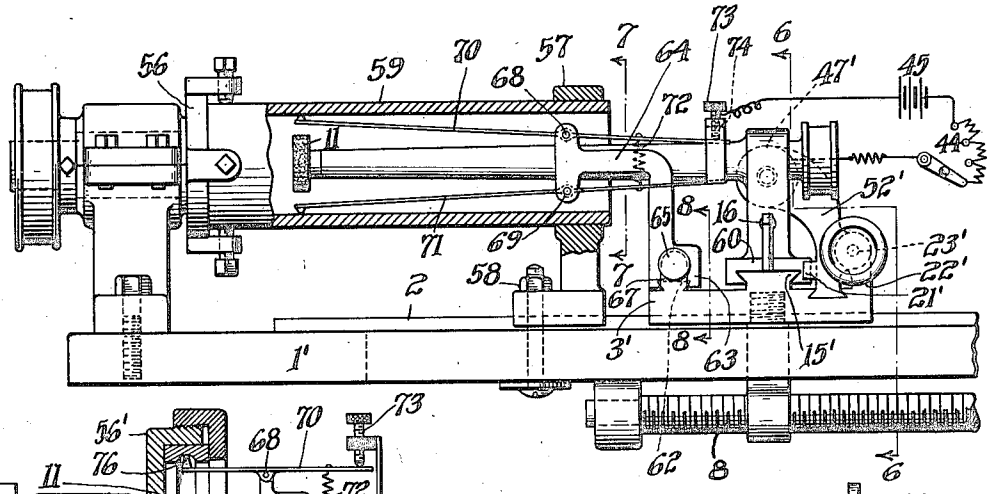


FIG. 6.

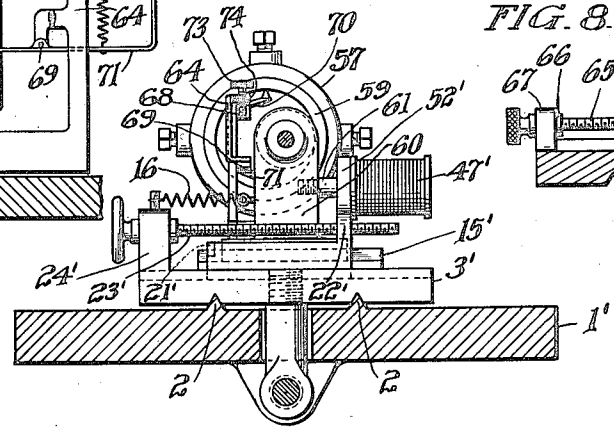


FIG. 8.

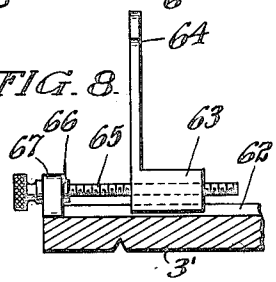


FIG. 9.

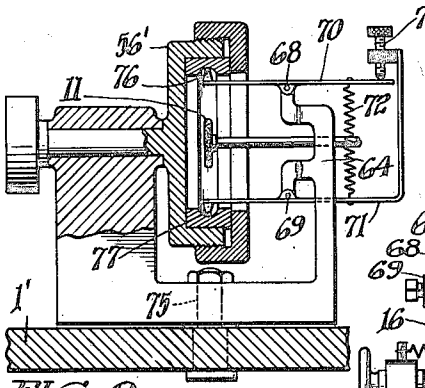
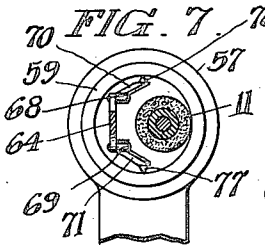


FIG. 7.



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AUTOMATIC SIZING DEVICE.

1,225,858. Specification of Letters Patent. Patented May 15, 1917.

Application filed July 20, 1915. Serial No. 40,832.

To all whom it may concern:

Be it known that I, CLIFFORD T. RAULE, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented a certain new and useful Automatic Sizing Device, of which the following is a specification.

My invention relates to grinding machines and has for its chief purpose the production of uniform diameter of the ground product, notwithstanding defects in the mechanical grinding machine.

A further purpose of my invention is to provide two feeds for a grinding wheel, one mechanical and the other capable of feeding in advance thereof and subject to electric control by reason of the diameter of the work.

A further purpose of my invention is to apply a magnetic pull to the feed of the grinding wheel, determined by the diameter of the work and so long as its diameter exceeds the diameter intended.

A further purpose of my invention is to continuously caliper the work and to close an electric circuit when the diameter exceeds that intended, by which circuit the grinding operation is begun or maintained.

A further purpose of my invention is to hold a grinding wheel against the forced feed provided therefor resiliently and to draw the grinder against the work in opposition to the resilient means automatically when the required diameter has not yet been reached.

A further purpose of my invention is to provide varying strengths of magnetic pull where the intended diameter of the material ground has not yet been reached, utilizing for rough or finished cut, as desired.

I further provide a take-up for the wear of the grinding wheel.

Further purposes of my invention will appear in the specification and the claims hereof.

I have preferred to illustrate my invention in connection with only one example of the exterior grinder and with but two of the interior grinder, selecting forms which are practical, efficient and relatively inexpensive and which at the same time well illustrate the principles of my invention.

Figure 1 is a vertical cross section through the table, showing a preferred form of my invention.

Fig. 2 is a top plan view of the structure shown in Fig. 1.

Fig. 3 is a section showing the shaft and calipers only and taken upon line 3—3 of Fig. 1.

Fig. 4 is a detail section upon line 4—4 of Fig. 1.

Fig. 5 is a side elevation, partly in section, showing the application of my invention to a straight internal grinder.

Figs. 6, 7 and 8 are sections of Fig. 5 upon lines 6—6, 7—7 and 8—8, respectively.

Fig. 9 is a side elevation, partly in section of my invention applied to an oscillating head form of grinder.

Similar numerals of reference indicate like parts.

Describing the external grinder first:— The bed 1 of the grinder is shown as supplied with longitudinal guides 2, 2 for the carriage 3, whose standards 4 support the shaft 5 to be ground.

The standards carry the adjustable dead center 6 and any suitable driving pulley for the live or driving head 7. The carriage and shaft are moved along the guides 2, 2 by engagement of the feed screw 8 with the nut 9, which is connected with the under side of the carriage through slot 10. This mechanism is old, and is intended to typify merely any means for supporting, rotating and longitudinally feeding the shaft for the grinding operation.

The grinding wheel 11 is mounted in standards 12, 12 upon a transversely movable carriage 13 and is rotated by means of a pulley 14. The grinding wheel is ordinarily not fed longitudinally where the work is fed. Either may be fed longitudinally of the shaft in the external form and in the first construction illustrated. I have, therefore, not considered it necessary to make provision for such movement.

The bed is provided with transverse undercut guides 15 for the carriage 13. This carriage is resiliently pulled rearwardly by a spring 16, here secured to a pin between the standards at 17 at one end and to a post 18 in the bed at the other end. The bed is slotted transversely at 19 for movement of a depending bar 20 attached to the carriage, and the spring 16 holds this bar normally against the lug 21 upon a nut 22.

This nut is the cross feed nut for the forced feed of the wheel and may be fed transversely to the axis of the shaft by

feed screw 23 turned in bracket 24 by hand lever 25. Collars 26 upon the shaft prevent end movement. Against the retracting pull of spring 16 the grinding wheel can move forward a short distance without corresponding movement of the nut and lug.

In order to apply the automatic feed of the grinding wheel, as hereinafter described, against the shaft, I provide a gage or caliper for the work, here shown in the form of calipering arms 27, 28. One of these arms at least is desirably pivoted, in order that it may rock to form the contact by which I close an electric circuit. I have preferred to pivot both of the arms as at 29 and 30 and to support both pivots upon a lazy tongs construction comprising strips 31, 32, 33, 34 whose upper and lower junctures support the two pivots. One end juncture 35 is fixed upon the standard 36 and the other 37 travels in a slot 38 and may be tightened by nut 39 to secure it against longitudinal movement in the slot as seen in Fig. 4. The lazy tongs opens and closes about the end pivot at 37 raising the upper pivot and lowering the lower pivot as the two ends approach. Both the upper and lower pivotal points are fixed when the nut 39 is tightened.

In this way the centers about which the arms 27 and 28 turn may readily be made to correspond approximately to the diameter of the shaft which is being ground, securing parallelism as nearly as may be required between the extended edges 40 which are used to perform the immediate calipering function. These edges 40 are intended to be formed of any suitable very hard mineral or other hard substance which can rest upon the surface of the shaft indefinitely without becoming appreciably worn. They are held reliably in contact with the shaft by the spring 41.

The arms 27 and 28 are preferably made of strip material with the flat sides horizontal, in order to supply some resilience when the calipering edges are spread by the shaft more than enough for the adjustable contact pin 42 to touch a lower contact 43. This engagement of the contacts closes an electric circuit through rheostat 44, battery 45, any desired resistance 46 and solenoid 47. The rheostat comprises arm 48, coils 49 and terminals 50, with which the arm makes contact. The solenoid winding is placed upon a non-magnetizable spool 51.

The portions of the arms 27 and 28 to the right of the pivot points in Fig. 1 are preferably longer than the portions to the left thereof, in order to enlarge the extent of movement of the ends carrying pin 42 and contact 43 to increase the delicacy of the mechanism. The pin 42 is insulated from the arm 27 to prevent short-circuiting through the pivots and support.

The solenoid 47 is supported from the nut 22 by an arm 52 so as to act upon and attract a solenoid core 53 upon the depending bar 20, with the purpose and effect of tending to draw this paramagnetic core into the solenoid whenever the electric circuit is closed, *i. e.*, whenever the diameter of the shaft exceeds that for which the calipers have been set and so long as that condition obtains. The pull upon the solenoid core is transmitted to the grinding wheel as soon as it exceeds the counter pull of the spring 16, and may be made as great or subject to as much range and fineness of adjustment as desired. This will depend, of course, upon many things, such as the strength of current available, the character of the solenoid, the size and shape of the core, the extent to which the core enters the solenoid, the range and number of divisions of the rheostat and the strength of the spring. All of these may be predetermined with great nicety.

The position of the calipers or gage may be adjusted transversely of the shaft by screw 54 which moves the standard 36 upon the guides shown at 55.

In operation, the grinding wheel may be used with the forced feed for the rough grinding if desired. The gage is set by spacing the caliper edges 40 or other measuring terminals used to the size of shaft required, so that the electric contacts will just clear when this size is reached. The rheostat may be operated to bring more pull upon the solenoid core when the rougher grinding is being done and to bring but a slight pull upon it when nearly to size, setting the gage twice if desired, the first setting representing the size to which the rough grinding is to be carried and the final setting representing the finished size.

The grinding will continue until the size to which the gage is set has been reached, independently of errors in the setting of the shaft, such as setting it at an angle to the true axis of the machine, and all other errors, inaccuracies and machine troubles which have given trouble in previous machines. The gage must be set accurately and must measure the portion of the shaft at which the wheel is cutting to the smallest diameter. So long as these two requirements are met my invention is substantially fool proof.

In the form shown in Figs. 5 to 8 I have shown my invention applied to a straight internal grinder. The bed 1′ is here provided with longitudinal guides 2, 2, for a carriage 3′. The live head place is here taken by a chuck 56, driven by any suitable pulley, and the place of the dead center is taken by steady rest 57 clamped at 58.

The grinding wheel, gage and contact mechanism are all supported upon the carriage and moved bodily as the wheel and

gage enter the cylinder or other work 59. The transverse feeds of the wheel and gage are separate, in order to permit the wheel to be separately advanced without disturbing the setting of the gage and to provide for initial setting of the same.

The wheel carriage 60 is movable upon undercut guides 15′ and is advanced positively by ear 21′ connected with nut 22′ with which screw 23′ engages. The screw turns in a bracket 24′ which prevents longitudinal movement by the usual collar construction. The base 60 has a little lost movement with respect to the ear, permitting the base to advance a little in a transverse direction ahead of the positive feed, but the lost motion is taken up when the electromagnet is not working by the spring 16. It is shown in Fig. 6 as pulled away by the electromagnet 47′ acting upon armature 61. I have chosen the armature form here to indicate that either the magnet and armature of this form or the solenoid and core may be used, the solenoid being the better because more uniform.

The magnet is supported by an arm 52′ and its armature is connected with the standards for the wheel upon base 60, for the advance of the wheel against the spring 16 and in advance of the positive feed.

Guides 62 receive the base 63 upon which the gage structure is supported through arm 64. The feed for this base is shown in the screw 65, the thrust of whose collared shaft 66 is taken by bracket 67. The arm 64 is provided with bearings 68 and 69 for the arms 70 and 71 which are pressed outwardly at their inner ends by reason of the tension spring 72 between their outer ends. The inner ends of the gage carry points, rather than surfaces here, of suitable hard or hardened material and are set to the required diameter at the time that the adjustable contact 73, supported from one of them by a bracket 74, just touches the other arm. The contact 73 is insulated from the collar at any desired point and the electrical connections from the battery 45, rheostat 44 and electromagnet 47′ are passed through the contact 73 and the arm with which it engages, obtaining the same automatic control of the electric feed of the grinding wheel to hold it to its work until the required diameter has been reached as is obtained with the first form.

In operating the second form the rough grinding may be done before the gage is set if desired. When it is desired to begin automatic control of the grinding the gage is set to the required size, from calipers, another gage or a portion previously ground, for example, making sure that the points of the gage are set for diametrically opposite positions in the work, and the adjustable contact is set to make contact with the contiguous arm until the intended diameter is reached. The operation then parallels the operation of the first form.

I have not considered it necessary to go into the refinements of the various parts of the mechanism shown which would be desirable in practice, such as platinum facings or pins where the current is interrupted, using a relay where the current which the designer desired to use proved in excess of that which he wished to pass through the contact selected, protecting the adjustment of the contacts from accidental movement, special bearings for the gage arms, micrometer adjustment for the contacts and many other features which do not affect the principle of the invention and upon whose desirability in a general way designers might agree quite as fully as they disagreed in regard to the exact form to be adopted. Reasonable space here does not permit more than a conventional showing of these various parts of mechanical and electrical construction which in combination form my invention and the several elements of which are known to those skilled in the art in different forms.

I believe that I am the first to apply a gage to the work being ground and to determine the feed of the grinding wheel to its work automatically as indicated by the gage.

In Fig. 9 I show the clutch, or chuck 56′, bearing, driving pulley and ball race clutched to a ball race grinder. This is characterized by the fact that the parts are mounted upon pivot 75 directly under the center of the arc of the race where the grinding wheel is in operation, requiring that the gage shall be supported upon the parts which oscillate about the pivot during the grinding. They do not, however, revolve with the work. The points are set to the desired diameter and are placed at the centers, respectively, of the longitudinal arcs on opposite sides of the axis of the ball race. I have designated two such points at 76 and 77. In view of the full discussion of the internal grinder in connection with my second form I regard further explanation of the mounting of the gage upon oscillating but not rotating parts of the figure and the application of the current closed to electrical feeding of the grinding wheel as unnecessary.

It will be evident that my invention is equally applicable, with the information given by me, to external surfaces in which the work is oscillated to give concave effects, parallelling the operation of Fig. 9, and to any form in which a master form is used and in which the gage can be rested upon the master form to release when the size has been reached and it is desired to release the grinding operation. It is my purpose to claim broadly all constructions where the

principles of my invention are applied to maintain a follow-up feed during the supersize grinding and release it by reason of the operation of the gage when the predetermined size has been reached.

It will be evident that the follow-up feed need not be electrically produced, to get the benefit of part of my invention, though this is the best mode of practising the invention known to me, but may be produced in other ways and released in any appropriate way by reason of the movement of the gage to its releasing position, permitted by the grinding away of the work.

It will be evident that my invention is related to another invention made by me while making the present invention, namely, the process of grinding disclosed herein with the various sub-processes, by which the grinding operation is not only released by work-operated measuring means but is, in this preferred electrical embodiment, automatically set by this work-operated means.

It will be evident that the character of follow-up feed applied, whether it is separately set initially or set automatically by the work-operated gage, the character of the work-operated release adapted to the feed, etc., will vary greatly, within the spirit and scope of my invention, according to the particular service to be performed, ability, experience and preference of the designer, the character of other machinery made and other factors too numerous to mention.

It will be noted that applicant's "resilient" feed by means of the electromagnet is additional to the positive feed and draws the grinder wheel toward the work in advance of the position which would be required by the positive feed. The two feeds are therefore, "cumulative."

Applicant's invention is safe-guarded by the fact that it is applied by the electric current and maintained so long only as the electric current flows. As distinguished from a feed cut off by the electric current, this arrangement avoids injury to the article ground, in case of failure of the electric current.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:—

1. In a device of the character stated, a grinder having means for holding the work to be ground, a transversely movable grinding wheel, guides for two cumulative transverse feeds of the grinding wheel and separate means for transversely feeding the wheel on one of the guides and giving relative longitudinal feed to the work and wheel, one with respect to the other in combination with a gage in contact with the work, contacts maintained by the gage until the work has been ground to the required size and electromagnetic means for resiliently drawing the wheel transversely upon the other guide in advance of the first named transverse feed and having its circuit closed by said contacts.

2. In a device of the character stated, a grinder having normal longitudinal feed for the work with respect to the grinding wheel, two sets of guides for transverse feed of the wheel and a positive transverse feed for the wheel upon one set of guides, a gage in contact with the work being ground, contacts closed by the operation of the gage until the required size of the work has been reached, an electric circuit closed by the contacts, resilient means for holding the wheel in engagement with the positive feed and electromagnetic means connected with the circuit for pulling the wheel along the second set of guides in advance of the forced feed against said resilient means.

3. In a device of the character stated, a grinder having lost motion between its grinding wheel and the transverse positive feed for the wheel and a resilient device adapted to draw the wheel toward the feed, taking up the lost motion, in combination with a gage resting against the work being ground, a circuit closed by the gage and an electromagnet in the circuit and connections adapted to move the wheel against the work overcoming the pull of the resilient device.

4. In a device of the character stated, a grinder having a positive feed for the grinding wheel, an electromagnetic resilient feed for the wheel adapted to press it against the work in advance, in a transverse direction, of the positive feed and work-operated automatic means for applying the automatic feed.

5. In a device of the character stated, a grinder having a positive feed for the grinding wheel, an electromagnetic resilient feed for the wheel adapted to press it against the work in advance, in a transverse direction, of the positive feed, resilient means for pulling the wheel back from the work, opposing the electromagnetic feed and work-operated automatic means for applying the automatic feed.

6. In a device of the character stated, a grinder having a positive transverse feed for the grinder wheel, an electromagnetic feed for the wheel adapted to press it against the work transversely in advance of the positive feed, an electric circuit for the electromagnet, a work-operated closure for the electric circuit and means for adjusting the pull of the electromagnet.

7. In a device of the character stated, a grinder having a positive transverse feed for the grinding wheel, a spring holding the wheel support in contact with the posi-

tive feed, a relatively fixed electromagnet, paramagnetic material connected with the wheel and within the range of attraction of the electromagnet, an electromagnet circuit, relatively movable contacts in the circuit and a pair of gage arms resting against the work being ground and adapted to make and break the contacts according to the extent of grinding.

8. In a device of the character stated, a grinder having a positive transverse feed and a lost motion feed for the grinder wheel, a spring taking up the lost motion, a solenoid core connected with the wheel, a solenoid surrounding the core and adapted normally to pull the wheel in advance of the positive feed, an electric circuit for the solenoid, a pair of arms gaging the work being ground, and a contact made and broken by the movement of the arms.

9. In a device of the character stated, a grinder having a yielding transverse feed normally holding the grinding wheel against the work in combination with a work-engaging device for releasing the yielding feed when the predetermined diameter of the work has been reached.

10. In a device of the character stated, a bed, work holding and rotating devices, a grinding wheel, means for supporting and rotating the wheel, a positive transverse feed for the wheel and an electromagnet and paramagnetic material attracted by it connected with the bed and wheel support, respectively, to feed the support resiliently in advance of the positive feed.

11. In a device of the character stated, a bed, rotatable supporting means for the shaft being ground, a grinding wheel and support therefor, guides directing longitudinal movement of the shaft with respect to the wheel, a positive feed for the wheel transverse to the shaft, calipers for the shaft engaging it in the section being ground by the wheel and maintained in this relation to the wheel, transverse adjustment for the calipers, a resilient feed for the wheel normally holding it transversely in advance of the positive feed and a release for the resilient feed carried by the calipers.

12. In a grinding machine, work supporting and rotating devices, a grinding wheel and support therefor, resilient means normally pressing the wheel against the work, a release for the feed and work-calipering operating means for the release.

13. In a grinding machine, work supporting and rotating devices, a grinding wheel and support therefor, means for giving the work and wheel relative movement longitudinally of the machine, a work-calipering device and resilient means normally pressing the wheel against the work set and released by reason of movement of the work-calipering device.

14. In a grinding machine, work supporting and rotating devices, a grinding wheel and support therefor, means for giving the work and wheel relative movement longitudinally of the machine, two transverse feeds for the wheel, one of them resilient and work-calipering means for continuously applying the resilient feed and maintaining it while the work is over size.

15. In a grinding machine, a grinding wheel, a support therefor, an electromagnet, paramagentic material attracted thereby, one of the last two elements being directly connected with the wheel support and the other fixed with respect to the frame of the machine against transverse movement so that attraction between them causes resilient pressure of the wheel toward the work, an electric circuit for the electromagnet and work-controlled means for normally maintaining the circuit closed.

16. In a device of the character stated, a grinder having a positive transverse feed and a lost motion feed for the grinder wheel, a spring taking up the lost motion, a solenoid core connected with the wheel, a solenoid surrounding the core and adapted normally to pull the wheel in advance of the positive feed, an electric circuit for the solenoid and work-controlled means for opening said circuit when the work reaches a predetermined size.

17. In a device of the character stated, a grinder having two cumulative transverse feeds, one of them resilient, in combination with an electric circuit maintaining the resilient feed in operation and a work-calipering device closing the circuit when the work is over size and interrupting the circuit when the work reaches size.

18. In a device of the character stated, a grinder having two transverse feeds for the grinding wheel, one of them resilient, in combination with an electromagnet controlling the resilient feed and maintaining resilient pressure of the wheel against the work during the entire time the electromagnet is energized, in combination with a diameter-measuring device engaging the work in close proximity longitudinally to the grinding point, closing the electromagnet circuit when the work is over predetermined size, and opening the electromagnet circuit when the work is ground to the predetermined size at the point of calipering.

CLIFFORD T. RAULE.

Witnesses:
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