C. H. NORTON, J. C. SPENCE & H. N. CUDWORTH.

GRINDING MACHINE.

APPLICATION FILED JAN. 4, 1909.

945,979.

Patented Jan. 11, 1910.

4 SHEETS—SHEET 1.

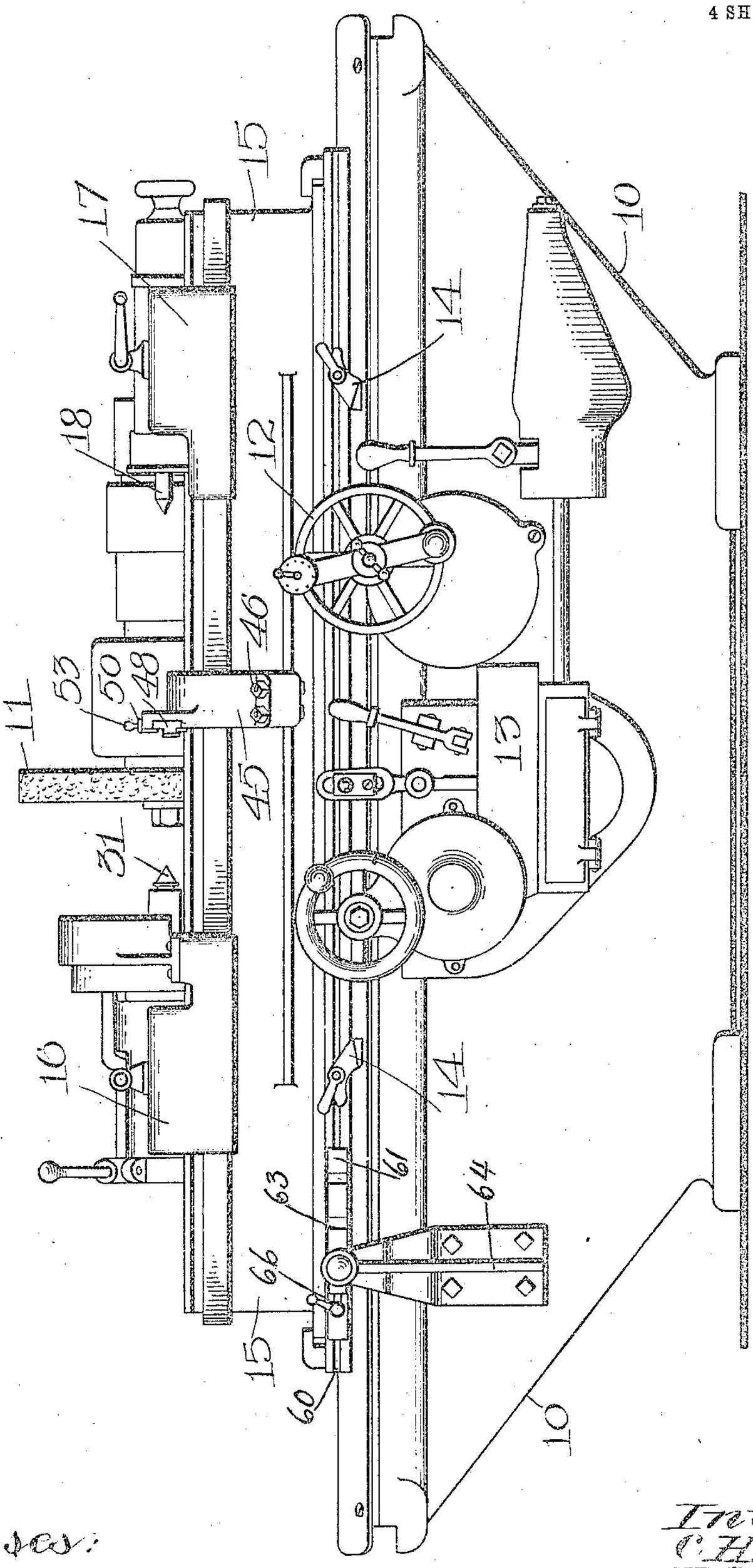

Fig. 1.

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4 SHEETS—SHEET 2.

Fig. 2.

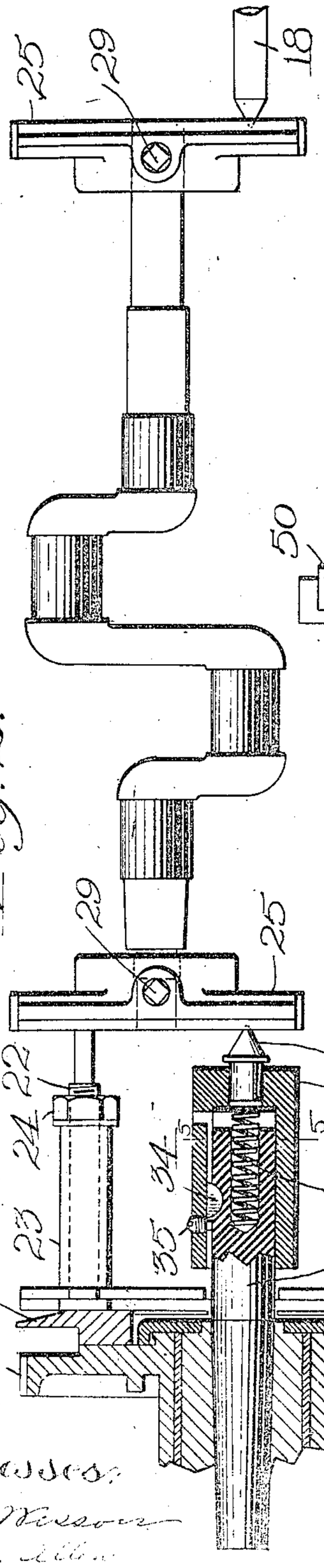


Fig. 4.

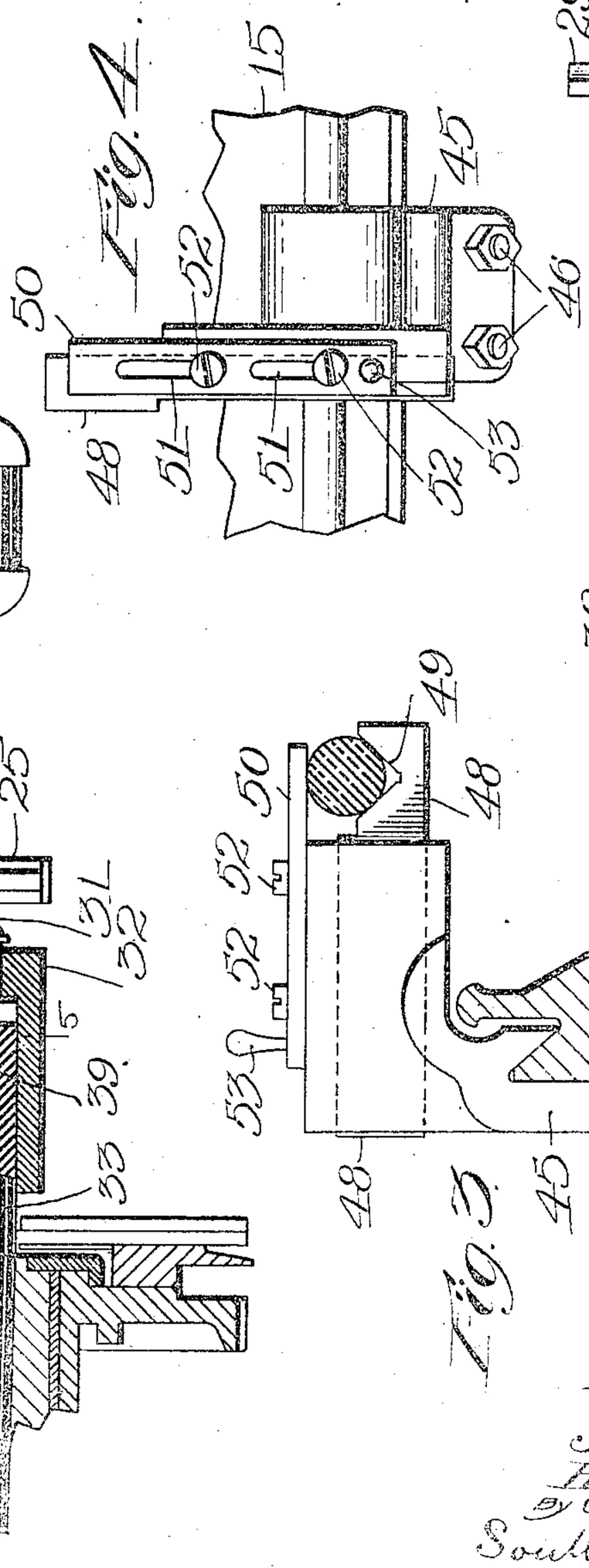


Fig. 4a.

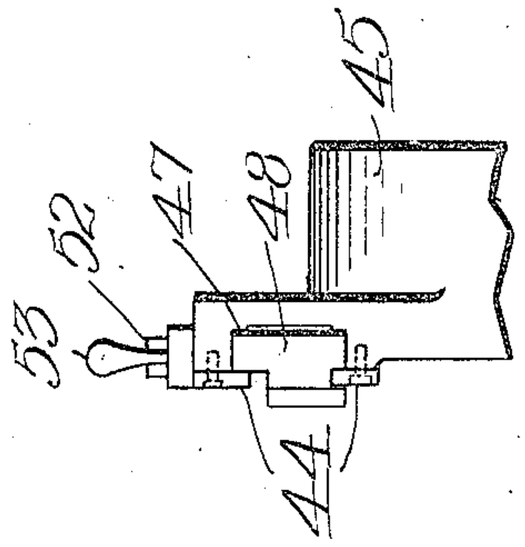


Fig. 6.

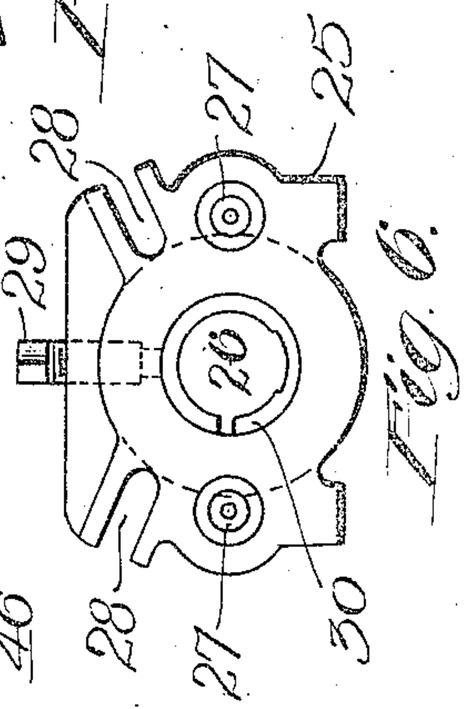
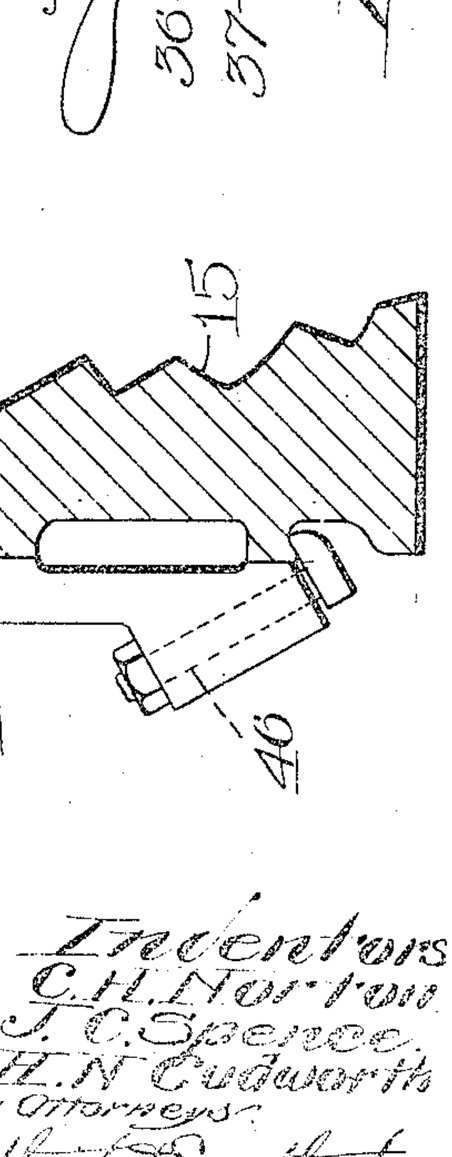


Fig. 5.



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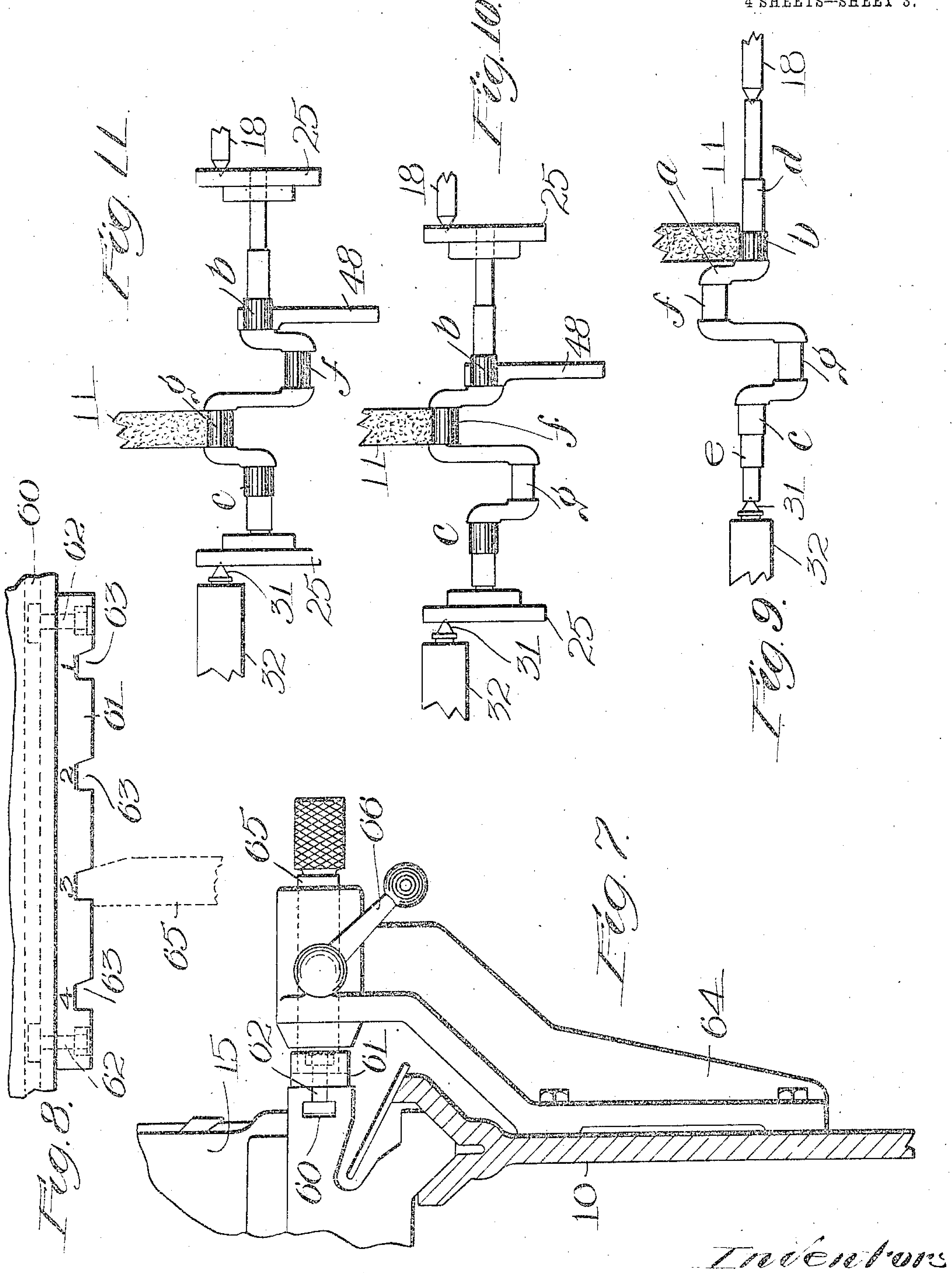
4 SHEETS—SHEET 3.



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4 SHEETS—SHEET 4.

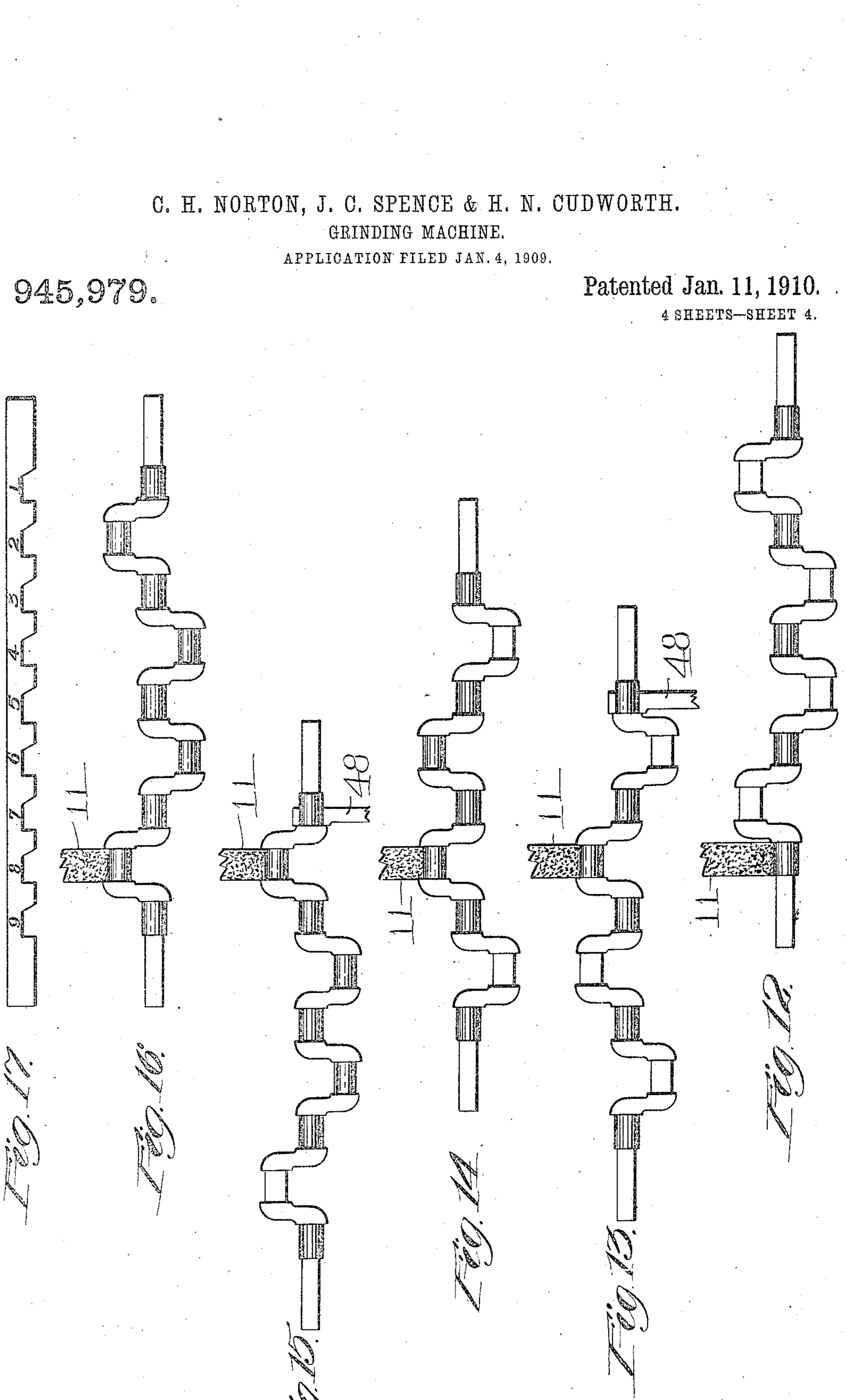

Fig. 12.

Fig. 13.

Fig. 14.

Fig. 15.

Fig. 16.

Fig. 17.

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UNITED STATES PATENT OFFICE.

CHARLES H. NORTON, JOHN C. SPENCE, AND HIRAM N. CUDWORTH, OF WORCESTER, MASSACHUSETTS, ASSIGNORS TO NORTON GRINDING COMPANY, OF WORCESTER, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS.

GRINDING-MACHINE.

945,979. Specification of Letters Patent. Patented Jan. 11, 1910.

Application filed January 4, 1909. Serial No. 470,593.

To all whom it may concern:

Be it known that we, CHARLES H. NORTON, JOHN C. SPENCE, and HIRAM N. CUDWORTH, citizens of the United States, all residing at Worcester, in the county of Worcester and State of Massachusetts, have invented a new and useful Grinding-Machine, of which the following is a specification.

This invention while capable of general use, is particularly adapted for truing and especially grinding, in large quantities, work of such a character that after it is once centered and a part of the surfaces ground, it has to be recentered for the operation on the other parts, an important case of which is the grinding of crank shafts.

This invention is of particular utility when used in connection with a grinding machine having a grinding wheel of a thickness equal to the length of the pins to be ground on the shaft so that there is no relative longitudinal motion between the work and grinding wheel during the grinding operation.

The principal objects of the invention are to provide a simple and practicable construction whereby the work can be gaged up to the grinding wheel so that any desired number of shafts of the same dimensions can be ground successively without necessitating any special care to prepare all the centers alike, and to provide a table-locating device which will locate the table in proper position with respect to the grinding wheel for grinding uniformly the several pins and bearings; also to provide improvements in features of construction as will appear hereinafter.

Some features illustrated herein are claimed broadly in our companion applications filed Dec. 28, 1908, Serial Nos. 469,547 and 469,548.

Reference is to be had to the accompanying drawings in which—

Figure 1 is a side view of a grinding machine having a practicable form of the present invention applied thereto. Fig. 2 is a plan of a portion of the same partly in section on enlarged scale showing a crank shaft held therein and in position for grinding. Fig. 3 is a side elevation of the gage and support showing the carriage or table in section. Fig. 4 is a plan of the same. Fig. 4ª is an end view of the same. Fig. 5 is a sectional view on the line 5—5 of Fig. 2 showing another feature. Fig. 6 is a front view of a center block employed. Fig. 7 is a sectional view through a portion of the bed showing a table locating device. Fig. 8 is a plan of the same, Figs. 9, 10 and 11 are diagrammatic views showing the steps taken in grinding a crank shaft such as is shown in Fig. 2, and Figs. 12 to 17 are similar views of another shaft.

The invention is illustrated as applied to a grinding machine having a bed 10 and provided with a grinding wheel 11 adapted to be adjusted to and from the work by an adjusting device 12. The machine also is shown as having a reversing device 13 and reversing dogs 14 as the invention is ordinarily applied to a machine having reversing devices but when employed in the way hereinafter described for grinding the crank shaft pins, these reversing devices are not in use.

A reciprocating table 15 is provided with a head-stock 16 and foot-stock 17 for holding the work. The foot-stock is shown as of a well known type having a foot-stock center 18. The head-stock is shown as provided with a rotating gear 20 on which is mounted a face plate 21 for driving the work. From this face plate projects a bolt 22 having a sleeve 23 thereon adapted to be tightened by a nut 24 so that the bolt rotates with the face plate. The crank shaft to be ground preferably is driven by means of eccentric center blocks 25 each having an opening 26 therein for receiving the end of the shaft. These blocks are provided with hardened eccentric centers 27 set at a distance from the center of the block equal to the off-set of the center of the pins of the crank-shaft from the axis of the bearings. It is provided with slots 28 for receiving the bolt 22 and with a screw 29 for fastening a split ring 30 on the end of the shaft to securely hold the eccentric center block thereon.

The head stock center 31 is shown as mounted on a head 32 which is reciprocable on a stud 33 mounted in a head-stock, this stud being provided with a key 34 and the head with a key-way in which the key fits loosely. A stop screw 35 is also shown. In the head 32 is mounted a pin 36 capable of

a slight longitudinal motion and having a notch 37 cut out to receive the stud. This pin is screw-threaded at the top and provided with a binder 38 so that the pin can be moved up or down to tighten the head on the stud. Within an opening in the end of the stud is a spring 39 for normally forcing the head and head-stock center outwardly.

It will be understood, of course, that the gear 20 is operated in any desired or usual way for the purpose of turning the center block and the work. In order to register the work with the grinding wheel so that the latter will grind up to a proper shoulder on the crank shaft, a gage is employed which is capable of receiving the pins or bearings of the crank shaft and is adapted to abut against one of the shoulders thereon so as to bring the work up to proper position, the head center 31 yielding to permit this to be done. For this purpose, the table 15 is shown as provided with a gage supporting bracket 45 mounted on ways thereon and adapted to slide back and forth and to be clamped in adjusted position by a bolt 46 or the like. This bracket is enlarged at the top and has a passage 47 therethrough in which is a slide 48 held in position by gibs 44 constituting a gage member, and provided with means at its outer end for receiving the pins or bearings. This means, in the form shown in the drawings, consists of a V-shaped depression 49 in the top of the gage member. It will be observed that this gage member can be moved back and forth so that it can receive the cylindrical parts of the crank shaft at points between the centers 18 and 31 or at the sides of a line connecting said centers. The gage is completed by a plate 50 mounted on top of the bracket and having longitudinal slots 51 through which project screws 52 or the like so that the plate can be adjusted back and forth by the handle 53 thereon. It will be seen, therefore, that the gage can be moved out and in to receive the bearings of the crank shaft when it is eccentrically centered and that if the gage supporting bracket is located in fixed position on the table, successive crank-shafts positioned by it can have their pins located in the same position with respect to the grinding wheel 11 so that they will be uniformly ground.

Upon grinding the crank shaft in the manner set forth herein, it will be seen that although it is desirable to adjust the table back and forth after a pin or bearing has been finished to bring the work into position for grinding the next one, the points at which the table will be fixed for grinding the different pins and bearings are invariable for a job of crank shafts of the same dimensions. In order to take advantage of this fact, the table preferably is provided with a T-shaped slot 60 on the side, by which is held a table locating bar 61 by means of head bolts 62. This bar is provided with devices which can be engaged by means held on the bed to locate the table in proper positions for grinding the several parts of the crank shaft or other work.

In the present form the locating bar is shown as provided with a series of notches 63 marked 1, 2, 3 and 4 in Fig. 8 and the bed as having a bracket 64 thereon on which is located a reciprocatory locking pin 65. This pin is adapted to enter any desired one of the notches 63 and is then fixed in position by a binder 66 so that it will hold the bed while a certain grinding operation is performed. Then the binder 66 can be loosened and the table moved along until the pin 65 can enter another one of the notches. The table is then fixed in position as before, it being understood of course, that the bolts 62 normally hold the locating bar on the table during all this time.

One of the several ways in which a crank shaft such as shown in Fig. 2 can be ground by this machine is illustrated diagrammatically in Figs. 9, 10 and 11. The rough forging is first provided with the usual countersunk centers at its ends and with an ordinary lathe dog and is then placed in the machine. The table is adjusted back and forth until the grinding wheel just clears the web *a* on the shaft at the left of the right-hand bearing *b* as indicated in Fig. 9. The locating bar 61 is then adjusted along the table until the locating pin 65 comes into notch #1 therein, then the locating bar is tightened up on the table. The machine is then operated as is well understood to grind the bearing *b*. Then the pin 65 is withdrawn and the table moved along until the pin enters the notch #4 which will bring the crank shaft in proper position for the wheel to grind the bearing *c* at the other end, bringing the two shoulders of these bearings at a proper distance apart. If the crank shaft has additional bearings as is indicated in the last sheet of drawings these are also ground in a similar way, for instance by placing the pin successively in the notches, 1, 3, 5, 7 and 9.

Referring again to Figs. 9, 10, and 11, the next step is to true up the parts *d*, *e* etc. at the ends of the bearings. This can be done in the same machine, or if desired, the shafts can be taken to another machine and either ground or turned up at these points. These operations can be performed if desired in the manner set forth in our co-pending application on a reversing device filed on even date herewith, Serial No. 469,548. When these parts are trued up the eccentric blocks 25 are applied to the ends. It will be understood that all the shafts forming part of a single job, being of the same dimensions, are prepared in this way and supplied with

the eccentric center blocks, and they are then taken one by one into the machine for the performance of the rest of the operations upon them.

Referring now to Fig. 10, a shaft is placed in the machine and centered on one pair of the eccentric centers for the purpose of grinding one of the pins *f*. As has been stated in the first part of this specification one of the objects of the invention is to do away with the necessity of machining the centers of the several eccentric blocks with perfect accuracy and uniformity. If these centers are not machined exactly uniformly, it will be obvious that the centers are now lost, as the expression is, and consequently the shaft has to be gaged up again. For this purpose the binder 38 is loosened and the gage 48 may be brought up to the grinding wheel 11 and adjusted until its left hand edge is flush with the left side of the stone. Then the shaft may be adjusted back and forth, the head center moving with it, until the gage when applied to the bearing *b* which has been ground will engage the left shoulder thereof. This being accomplished the binder 38 is tightened up. It will be seen now that any difference between the original centers and the centers on which the shaft is now mounted will be compensated for exactly by the adjustment of the shaft which has been made, and that the gage can now be drawn back and the pin 65 withdrawn from notch #1 so as to allow the table to move along until the pin enters notch #2. The parts will then be in the position shown in Fig. 10, except that the gage will not be in position.

Another way in which this result can be accomplished is as follows: After the shaft is centered in the eccentric center blocks the pin 65 can be placed in the notch #2 of the locating bar. The required distance from the left-hand shoulder of the bearing *b* to the grinding wheel can be measured in any ordinary way in accordance with the dimensions which the shaft is to have, the shaft being moved slightly with the center 31 to bring it into proper position. Then the binder 38 is tightened and the parts are in the position shown in Fig. 10. The gage is then set and withdrawn so that it can be used for the subsequent shafts. It will be understood, of course, that this is the only operation performed with the parts in exactly the position shown in Fig. 10, but if a shaft like that shown on the last sheet is being ground, two of the pins will be located in this way because for example in Figs. 14 and 15, two center pins are ground without changing the adjustment by moving the table to the points at which the pin 65 enters the notches 4 and 6 respectively.

Now in order to grind the pins the gage bracket of course remains in fixed position and the gage is drawn back away from the shaft. The shaft is then turned over so that the other eccentric block centers are employed and as has been explained above, this disarranges the adjustment because these centers are not carefully made to the same depth as the other centers, nor are they necessarily the same on the several eccentric center blocks. The gage is brought on the bearing *b* and the pin 65 is brought into notch #3, the center 31 having been loosened and adjusted in accordance with the measurement between the gage 48 and the grinding wheel. Then the pin *g* of this shaft is ground and those on subsequent shafts are located in the same way.

The way in which the several pairs of pins on the last sheet of drawings are ground will be understood readily from what has been said above, it being clear that the table locating bar will have a number of notches equal to the total number of pins and bearings. It will be seen of course that when each shaft is ground and replaced by another the proper shoulder on the new shaft has to be brought up to the gage, the center moving with the shaft, and that that is all that is necessary in order to gage each new shaft, the rest of the adjustments above described being employed only for the first shaft.

While we have illustrated and described a preferred embodiment of the invention, we are aware that many modifications may be made therein by any person skilled in the art without departing from the scope of the invention as expressed in the claims. Therefore we do not wish to be limited to all the details of construction shown, but

What we do claim is:—

1. In a machine for grinding crank-shafts and the like, the combination of a grinding wheel, head and foot centers, and a gage having means for receiving the bearings or pins of the crank shaft and registering a shoulder thereof by contact with the grinding wheel.

2. In a machine of the class described, the combination of a grinding wheel, a support or bracket, and a gage mounted on said support and adjustable transversely thereon, said gage comprising a member having a depression in the top thereof for receiving a bearing or pin of the crank shaft, and a plate above said member movable parallel with it for engaging the top of the bearing or pin.

3. In a machine of the character described, the combination of a support or bracket, a transversely reciprocable gage member carried thereby having a V-shaped depression in its upper surface for receiving a cylindrical part of the work to be operated upon, and a plate above said member movable in the same direction as the gage for engaging the top of the work.

4. In a device of the character described, the combination of a grinding wheel, a foot center, a gage for positioning the work with respect to the grinding wheel, a head-stock, a yielding center mounted on the head-stock, a center block adapted to be fixed to the work and to be centered on said center, and means for rotating said center block.

5. In a machine for grinding crank shafts, the combination of head and foot centers, with a gage movable toward and from a line connecting said centers and adapted to receive the bearings and pins of a crank shaft when located on said line or offset therefrom, and a yielding head stock center.

6. In a machine of the character described, the combination of a head stock, a rotary face plate thereon, a taper mounted on the head-stock and having a key, a hub slidably mounted on said taper and having a way for said key, a head center mounted on said hub, and a spring for yieldingly forcing the hub and head center forward.

7. In a machine of the character described, the combination of a head stock, a taper mounted on the head-stock and having a key, a hub slidably mounted on said taper and having a way for said key, a head center mounted on said hub, a spring for yieldingly forcing the hub and head center forward, and means on said hub for fixing the hub with respect to the taper.

8. In a machine of the character described, the combination of the head-stock, a taper mounted thereon, a hub slidably mounted on the taper a head center on the hub, and means on said hub for fixing the hub with respect to the taper to prevent longitudinal motion of the head center.

9. In a machine of the character described, the combination of a head-stock, a taper thereon, a hub slidably mounted on the taper, a head center on the hub, a slotted pin passing through the hub and adapted to engage the taper, and means for moving said pin to engage the taper and hold the hub for clamping the pin in fixed position.

10. In a grinding machine, the combination of a bed, a work-supporting table adjustable thereon, a pin mounted on the bed and movable toward and from the table, and means carried by the table for receiving said pin, whereby the table will be fixed in a definite position on the bed.

11. In a grinding machine, the combination of a bed, a table adjustable along the bed, a pin supported by the bed and movable toward and from the table, and an adjustable bar on the table having notches therein for receiving the end of the pin, whereby the table may be fixed in an adjusted position on the bed.

12. In a machine of the character described, the combination of a bed, a table movable along the bed and having a T-shaped slot in the side thereof, a plate adjustable along said slot and removable from the table and having notches therein at predetermined distances apart, and means supported by said bed for engaging in said notches to fix the table in a definite position on the bed.

13. In a machine of the character described, the combination of a bed, a table movable along the bed and having a T-shaped slot in the side thereof, a plate adjustable along said slot and removable from the table and having devices thereon at predetermined distances apart, and means supported by said bed for engaging said devices to fix the table in a definite position on the bed.

14. In a machine of the character described, the combination of a bed, a table movable along the bed, a plate adjsutable along said table and having devices thereon at predetermined distances apart, and means supported by said bed for engaging said devices to fix the table in a definite position on the bed.

15. In a machine of the character described, the combination of a grinding wheel, a bed, a table movable along said bed, means for locating said table in a plurality of operative positions with relation to said bed and a gage carried by the table for positioning the work with reference to the grinding wheel.

In testimony whereof we have hereunto set our hands, in the presence of two subscribing witnesses.

CHARLES H. NORTON.
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HIRAM N. CUDWORTH.

Witnesses:
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