June 18, 1935. H. H. ASBRIDGE 2,005,332

INTERNAL GRINDING MACHINE

Filed Dec. 14, 1934 2 Sheets-Sheet 1

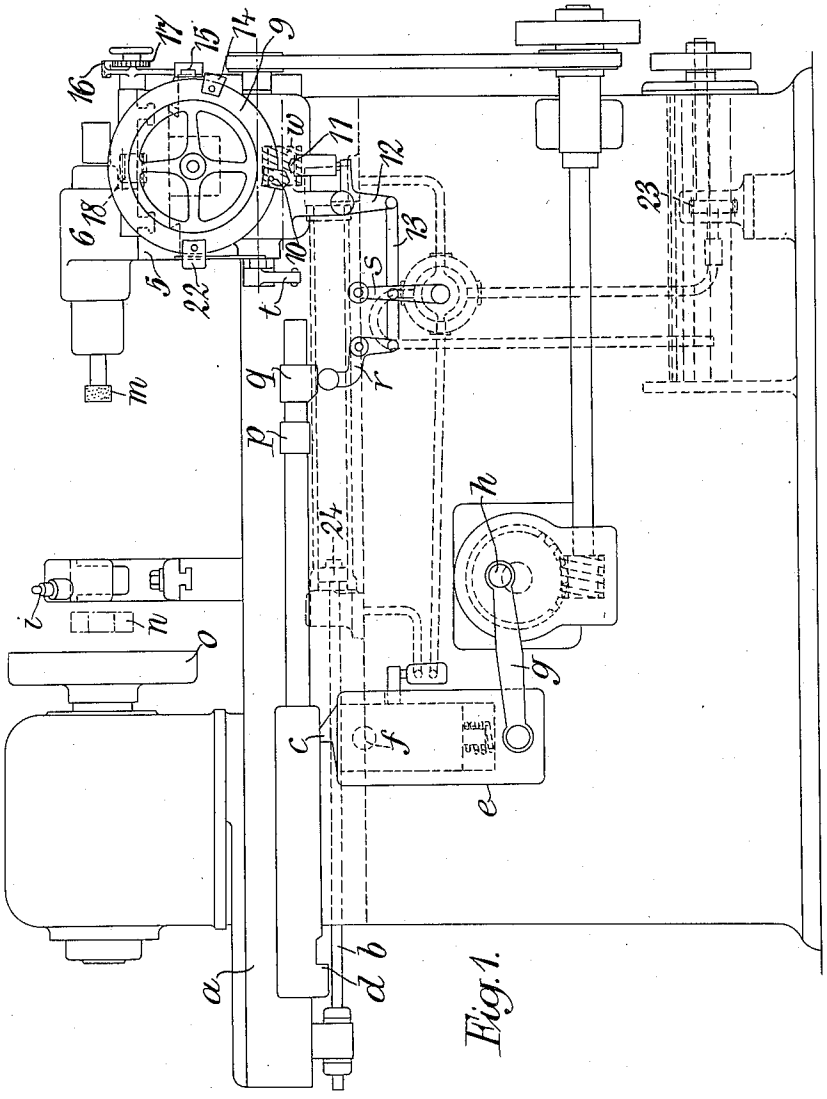



Fig. 1.

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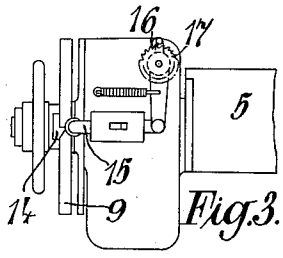


Fig.3.

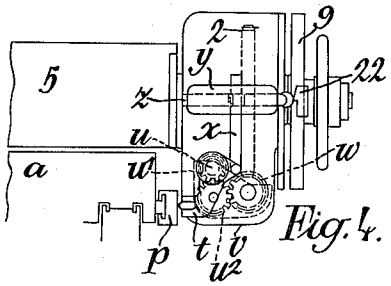


Fig.4.

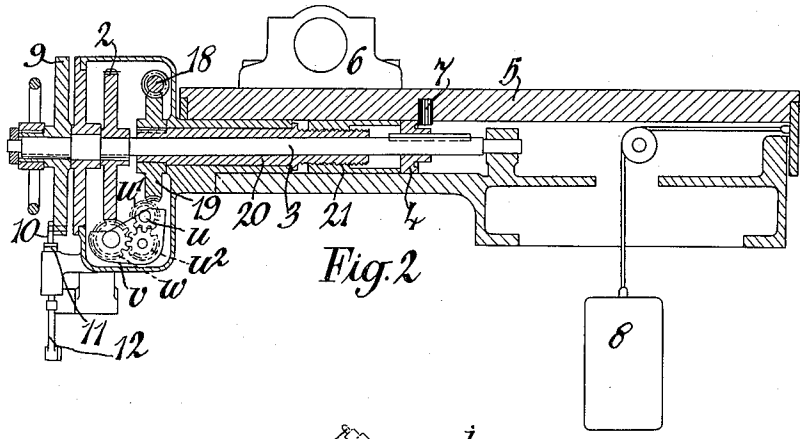


Fig.2

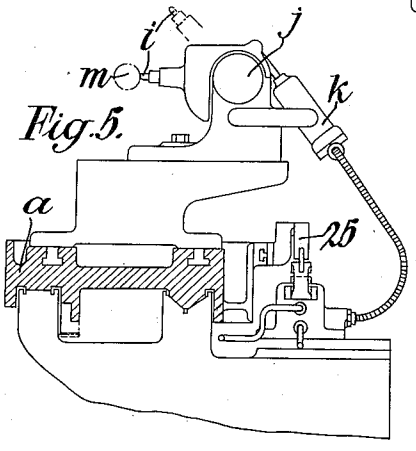


Fig.5.

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Patented June 18, 1935 2,005,332

# UNITED STATES PATENT OFFICE

2,005,332

## INTERNAL GRINDING MACHINE

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Application December 14, 1934, Serial No. 757,572
In Great Britain July 19, 1933

2 Claims. (Cl. 51—95)

This invention relates to internal grinding machines and has for its object to provide means for so controlling and regulating the operation of such machines as to increase the rate of production of the machines and to adapt the latter for the economical and efficient internal grinding of workpieces in an automatic manner.

The invention comprises the arrangement wherein the worktable when moving into its grinding position puts into engagement a driving mechanism operating a mechanically timed cycle which when started is independent of table movement until the cycle is completed, the said cycle comprising means to control the feeding of the grinding wheel into and away from the work, and a tappet wheel which makes one revolution for each cycle and controls the feed compensation for wheel wear, the reversal of the worktable and the disconnection of the drive to the mechanically timed cycle.

Referring to the accompanying sheets of explanatory drawings:—

Figure 1 is a front view of an internal grinding machine constructed and arranged in one convenient form in accordance with this invention.

Figure 2 is a sectional view through the cross slide.

Figure 3 is a side view (looking from right to left of Figure 1) of the portion of the grinding head having thereon the means for controlling the motion for adjustment of wheel wear.

Figure 4 is a side view (looking from left to right of Figure 1) of the means upon the grinding head for automatically stopping the cycle of operations.

Figure 5 is a cross sectional view showing the diamond truing device for the grinding wheel.

The work carrying table *a* is traversed by the hydraulic ram or plunger *b* until the stop *c* engages the abutment *d* when the table is given short reciprocations by the oscillation of the frame *e* (pivoted at *f*) by the connecting rod *g* and crank pin *h*. This arrangement of oscillating stop is described and claimed in my prior application for patent No. 733,676/34. When the table has moved a short distance from its initial position a switch is operated to cause the face plate *o* to be turned. Such switch is again operated to stop the rotation of the face plate when the worktable is being returned to its initial position.

The diamond truing tool is shown at *i* and is carried upon the table *a*. It is mounted in a frame for movement about an axis *j* by means of a hydraulic plunger in a cylinder *k*. The service position of the diamond is shown in full lines in Figure 5 in contact with the grinding wheel *m* and the out-of-service position in dotted lines.

The work-piece, the internal surface of which is to be ground, is indicated in dotted lines at *n* in Figure 1. It is suitably supported upon the head or face plate *o* which is rotated in any convenient manner.

Upon the table *a* are two dogs *p* and *q*, the latter being adapted to engage a lever *r* which puts the hydraulic control handle *s* into a mid or neutral position to bring the machine to rest when the table *a* has reached its extreme left hand position. The dog *p* engages a lever *t* (see Figure 4) upon a spindle *u* to which are secured arms *v* carrying a drop worm *w*. The drive from *u* to *w* is by the gear wheels $u^1$, $u^2$ to the worm shaft. The lever *t* had a rod *x* pivoted thereto which passes through a fixed member *y* with a locking slide *z* thereon. There is a recessed part upon the rod *x* which is engaged by the slide *z* when the latter is in its right hand position, Figure 4, so that the slide holds up the rod *x* and thereby maintains the lever *t* in a position in which the worm *w* engages the worm wheel **2**. The latter is keyed upon a spindle **3** which has a face cam **4** splined thereon, the cross slide **5** carrying the grinding head **6** having a pin **7** thereon which bears against the cam **4** under the pressure of the weight **8**. A wheel **9** with dogs or tappets thereon is also secured upon the spindle **3**. One tappet **10** upon the wheel **9** is adapted to engage a plunger **11** for the purpose of turning a lever **12** coupled by the rod **13** to the starting handle *s* and to the lever *r*, the turning of the lever **12** putting the handle into its left hand position (it is shown in its mid or neutral position) to reverse the direction of movement of the table *a*, as hereinafter described. A second tappet **14** upon the wheel **9** (see Figure 3) engages a sliding rod **15** which by means of a pawl **16** and ratchet wheel **17** turns a worm **18** (see Figure 2) and through it a worm wheel **19** upon a bearing sleeve **20** free around the spindle **3** but having a screw threaded end to engage a nut like part **21** capable of axial and not rotary movements and forming a supporting member for the cam **4** which determines the feed of the cross slide **5**. The amount of movement imparted to the nut **21** is proportioned to advance the grinding wheel an amount corresponding to the reduction in its radius due to wear and after each

truing operation, whilst the contour of the face cam 4 determines the feed imparted to the grinding wheel at each operation. The cam causes both the out and in movements of the grinding wheel. A third tappet 22 upon the wheel 9 serves to release the sliding rod *z* from engagement with the rod *x* so as to free the lever *t* and allow the drop worm *w* to move out of engagement with its worm wheel 2.

The handle *s* controls the supply of hydraulic fluid from the pump 23 to the respective ends of the cylinder containing the piston 24 by which the table *a* is traversed.

The operation of the machine is as follows:—

The operator secures his work-piece as *n* upon the face plate *o* and then moves the handle *s* to the right from its mid position as shown. This results in hydraulic fluid being supplied to the left hand side of the piston 24 and the table *a* is thereby traversed towards the right. As the table approaches its right hand position, a tappet 25 thereon causes pressure fluid to be supplied to the cylinder *k* so that the truing diamond *i* is brought into operative position and traversed over the grinding wheel *m*. Thereafter the pressure fluid is released from the cylinder *k* and the diamond tool returned to its out-of-service position. The dog *p* now engages the lever *t* and causes the worm *w* to be raised into engagement with the worm wheel 2.

The table *a* is now arrested by the stop *c*. The worm wheel 2 turns the spindle 3 and so the feed cam 4 to control the feed to the grinding wheel. The wheel 9 upon the spindle 3 is also being turned and in succession it causes (1) by the tappet 14 and the nut 21 to have a small axial movement to give an additional feed movement to the grinding wheel as before described, (2) by the tappet 10 the starting handle *s* to be moved to the left to reverse the table *a*, and (3) by the tappet 22 the rod *x* to be released to disconnect the worm drive *w*, 2. The dog *q* returns the handle *s* to its mid position. The machine is now at rest with the work head in its original position for the removal of the work-piece and the substitution of a fresh work-piece.

It will be noted that once the operator has started the machine by the handle *s*, the operations proceed in a mechanically timed cycle until the machine is at its original starting point.

What I claim is:—

1. In an internal grinding machine, in combination, a bed, a worktable traversible upon the bed, a handle controlling the traverse of the table and having forward, reverse and neutral positions, a cross slide upon said bed, a grinding head upon said cross slide, a cam controlling the feed movements of said slide, a shaft turning said cam, means acting on said cam for progressively increasing the limit of feed movement imparted by said cam in order to compensate for grinding wheel wear, a dog upon the table, an arm operatively connected to said handle and adapted to be engaged by said dog to bring the worktable to rest, a second dog upon the table, driving means for the said shaft, means whereby said second dog couples up said driving means to said shaft, a tappet wheel upon said shaft, tappets upon said wheel, one tappet actuating the means aforesaid for progressively increasing the limit of the feed movement of the cross slide, a second tappet actuating the handle to put it in its reverse position, and a third tappet disengaging the drive to said shaft when the tappet wheel has made one turn.

2. In an internal grinding machine, in combination, a bed, a worktable traversible upon the bed, a hydraulic cylinder upon the bed, a piston in said cylinder connected to said worktable, a hand valve controlling the flow of hydraulic fluid to the opposite ends of said cylinder, a cross slide, a grinding head upon said cross slide, a cam controlling the feed movement of said slide, a weight holding the slide against the cam, a shaft turning said cam, a tappet wheel upon said shaft, means for progressively increasing the limit of the feed movement of the slide to compensate for wheel wear, a dog upon said worktable, an arm operatively connected to the hydraulic fluid control valve adapted to be engaged by said dog to bring the worktable to rest, a second dog upon said worktable, a driving means for said shaft, means whereby said second dog makes said driving means operative, tappets upon said tappet wheel, one tappet actuating the means aforesaid for progressively increasing the limit of the feed movement of the slide, a lever operatively connected to said hydraulic fluid control valve and adapted to be engaged by a second tappet to reverse the said valve, means maintaining the drive to the shaft after it has been established, and a third tappet upon said tappet wheel for releasing and disconnecting said drive when the tappet wheel has made one turn.

HARRY HALES ASBRIDGE.