only here describe a form of polishing lathe not there given, referring the reader to that work for all information on the subject.

647. To polish the cylinder lips mechanically.—The polishing of the lips of a cylinder is one of the most delicate operations that can be undertaken by a watchmaker; we have, therefore, endeavoured to devise an instrument by which this can be done mechanically, and which should at the same time be so simple and so easily made that any watchmaker should be able to construct it for himself. An examination of the cylinders ordinarily met with shows clearly that machines are used in factories; but not having seen any of these, we cannot say how far they resemble or differ from the one here described, and shown in fig. 1, plate XI.

648. It consists of two distinct parts which take their place in an ordinary pair of finishing turns. (1.) The plate P, supported on a rod T, to take the place of the T-rest; (2.) the frame E, whose axis replaces one of the runners. This much being clearly understood from the figure, there will be but little difficulty in understanding the following details.

On the plate P is mounted a bracket, *b b* b^1, held by a screw and washer. It has a slot cut lengthwise, so that on loosening the screw it can be made to slide towards the right or left. The vertical portion b^1 supports a fork-shaped piece, *d c*, a front view of which is given in fig. 2, pivoted on a collet-screw, *f*, and this may be fixed by a pin passing through its end like a bolt. The upper end of the fork-piece is provided with teeth for a purpose that will be presently apparent.

The long spindle, *g h*, turns between the two supports, *k*, *l*, fixed to the plate P, under the action of the handle M. This axis carries two excentric cams, *q* and R. When it rotates, the excentric R causes the fork *d c* to rise and fall, thus occasioning an oscillating movement of the rack *d*. At

the same time the other excentric *q* presses against the back of the slide *i n*, which moves freely in the guide *s*, and is always held against the cam by a helical spring *j*; the slide thus has an oscillating motion in the direction of its length.

All the details in regard to the slide and its guide will be easily gathered from the plan in fig. 1, and the side elevation in fig. 3.

A small iron polisher is adapted to the slide *n i*. Being pivoted on a pin at one extremity, serving as an axis, its end *u* is pressed downwards by the light spring *v* (figs. 1 and 3), which might be replaced by a spiral spring below the polisher if preferred.

649. This being understood, we will pass to the frame E.

The rod that carries it is formed of thick drawn steel pinion wire, the diameter of which is less than that of the hole in the poppet-head of the turns. This spindle is provided with brass collars at *y* and *z* of such an external diameter as to be received in the poppet-head, in which the rod can rotate freely. By adopting this arrangement, not only is the frictional surface diminished without reducing the accuracy of the adjustment, but the apparatus can be easily adapted to any pair of turns.

To the right-hand side of the frame is fixed, by two screws, the cylinder carrier *x*, shown apart at x., fig. 4. It must be removed in order to set the cylinder in position by cementing its balance to the surface; care is necessary to make sure that the back of the cylinder shall be towards the side *e* of the frame when the carrier is again screwed in position. After having thus replaced it, set the rack *d* to engage with the pinion wire at *z*, in such a manner that, when the excentric cam R occupies the position indicated in fig. 2, the small iron polisher rests at the middle point of the cylinder lip. Now finally clamp the screw that fixes the support T.

The mode of action of the machine will be easily understood. If, after charging the polisher with polishing rouge,

the handle M is rotated, the cam R will impart an oscillating angular movement to the frame E through its axis *y z*, and the cam *q* will, at the same time, cause the polisher to move backwards and forwards, always in contact with the surface of the lip during its movement.

650. The work will be performed more rapidly, and the polish will be better if the iron have a slight lateral motion as well as that in the direction of its length. It is, however, more simple to communicate a longitudinal oscillating movement to the cylinder, and this answers the same purpose ; it is only necessary to make two small additions, the spiral spring *o* and the little cock *a*. The latter is fixed to *d* in an inclined position (as indicated at A), and this inclination can be varied by merely turning the left-hand screw. It will be evident that when *d* is ascending the cock will push the spindle *y z* forward; and when *d* descends, this spindle will be brought back to its initial position by the pressure of the spring *o*, which is simply placed over the end of the opposite runner. This longitudinal movement must be but slight, and it can be made as little as desired since it depends solely on the inclination of *a*.

651. *Observations.*—(1) The angular motion of the frame E must be sufficient to enable the polisher to act on the entire surface of the lip. The extent of this movement is determined by the size and the degree of excentricity of the cam R. The greatest motion will occur when the spindle passes through the hole 1 (fig. 2), and it will gradually become less as the holes 2, 3, &c., are used. The cam *q* should also have two or three holes for varying its excentricity. These cams may be made of hard wood, ivory, &c.

(2.) The iron polisher may be replaced by a piece of flexible spring fixed by a screw to the slide ; but its pressure is less uniform.

(3.) The bent arm *w*, figs. 1 and 4, is clamped to the plate P by a screw *d*, and the long arm *b* (fig. 4) bears against the back of the poppet-head, and thus ensures the

steadiness of P. To ensure steadiness by its means, *b* is drawn back in the direction of the arrow, then hooked behind the poppet-head and clamped by the screw *d*. The firmer the support is the better.

(4.) The machine may be arranged so that the two lips can be polished at the same time, but it then becomes more complicated. In the tool here described, as soon as one lip is polished the cylinder carrier is unscrewed, turned round, and screwed against the left arm of the frame E, in which are two screw-holes opposite to those in the right-hand arm. Unscrewing the slide *b b*, the T-rest carrier is moved along the lathe bar until the polisher is over the lip; *b b* having been set in position is clamped, and, after seeing that *w* has a bearing, the second lip may be polished.

(5.) The cylinder carrier shown at X, fig. 4, is used when the balance is in position. For a plain cylinder without its balance another form of carrier is employed that has at the edge of its central hole a small but solid projecting shell to which the cylinder is cemented.

652. *Methods of obtaining continuous motion.*—Rapid work is not possible when a simple handle, as shown at M, is used for working the apparatus; recourse may, however, be had to one of the following methods:—

(1.) Mount a small pinion with a square hole at its centre, and make it engage with a large wheel driven by a handle. This wheel, having a greater number of teeth, will proportionately increase the rate of motion.

(2.) At *h* fix a ferrule that gives a continuous movement in one direction as described in article **320**, and drive it with a long bow.

(3.) Take a powerful clock movement and connect up its centre arbor with the axis *g h*; having wound up the mainspring, allow it to run down as long as it possesses sufficient power to drive the mechanism.

(4.) Fix a ferrule at *h*, and drive it by the aid of a foot-wheel.

screw may, if preferred, pass in the direction *h h*, the rim of the ferrule being perforated so as to admit a screw-driver in that direction.

320. *Ferrule that moves continuously in one direction with a bow.*—Thiout, in a work published in 1741, describes a fusee that is wound up whether the hand rotate to the right or left. The ferrule here described effects the same result somewhat more simply.

A ferrule, N, fig. 14, plate X. hollowed out on the side towards *c*, is mounted so as to run easily on a perforated spindle *a c b*. It is held in its place by the collar *b* on one side, and on the other by the ratchet-wheel *d* fixed to the spindle *c*. As is seen from the arrangement of the click

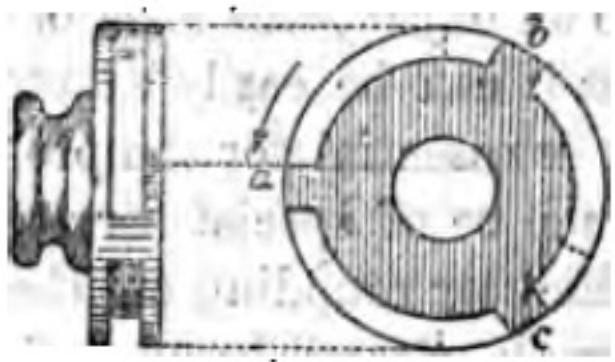


Fig. 12.

work at *y*, when the gut-band descends the spindle will be carried round, but, during its ascent, the click will merely rotate round the ratchet, providing a certain amount of resistance is opposed to the revolution of the spindle.

The ratchet *n* of the ferrule H is also fixed to *a c* and received in a recess in H. The ferrule rotates freely, being held in its place between the ratchet and the collar *s s* which is firmly attached to the spindle. It will thus be seen that the two ratchets, which face each other, will produce a revolution of the spindle in the same direction.

In using this double ferrule, two cords must be attached to one bow, the same distance apart as are H and N. If now an arbor be passed through in the direction *j j* and fixed by the screw at *v*, and if these two cords be passed round the

ferrules so that one, for example that on N, crosses at the front, and that on H crosses at the back, the axis will be found to revolve in a constant direction whether the bow ascends or descends.

The ratchets are shown between the ferrules, but it would be more convenient to place them against the outer faces; their movement can be made very smooth.

If a circular intermittent motion is desired it may be obtained by fixing at *c* a ratchet with which a click engages whose centre of motion is carried on a detached ferrule, and only this one ferrule would be necessary. Assuming cords to be on both the ferrules, they must cross on the same side.

321. *Balance ferrule.*—Figure 12 represents a convenient form of ferrule, especially adapted for holding ordinary balances. It is made of steel, the face being recessed as indicated by the shady portion of the drawing. *a*, *b*, and *c* are three slots cut in the rim that is left, and they are continued round the periphery in a wedge-shaped undercut to the points indicated by the dotted lines. Having placed the balance on the ferrule with its three arms in the slots, it is twisted in the direction of the arrow until firmly gripped. Care must be taken that the extension of the slots is in such a direction that the pressure of the graver in turning tends to tighten the arms, and they should be near the face of the ferrule so as to allow of a little springing; for compensation balances of course only two notches would be required.

GRAVERS AND OTHER HAND-TURNING TOOLS.

322. For details as to the precautions to be adopted in turning with the ordinary graver, the reader is referred to articles **226—8** in Part III., and as regards the sharpening of gravers, see articles **396—8.**

323. Hooked gravers.—It is needless to do more than mention the gravers that every watchmaker is in the habit of

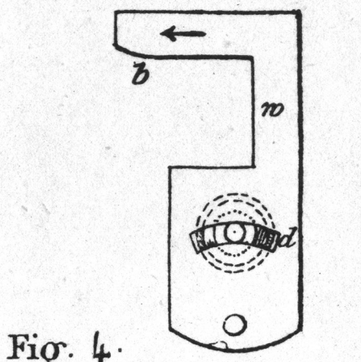
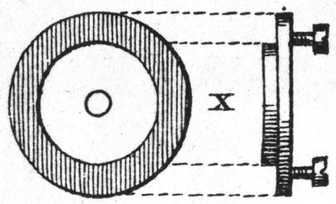


Fig. 4.



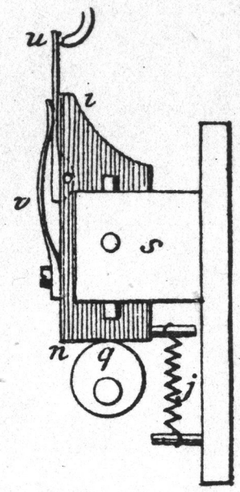


Fig. 3.

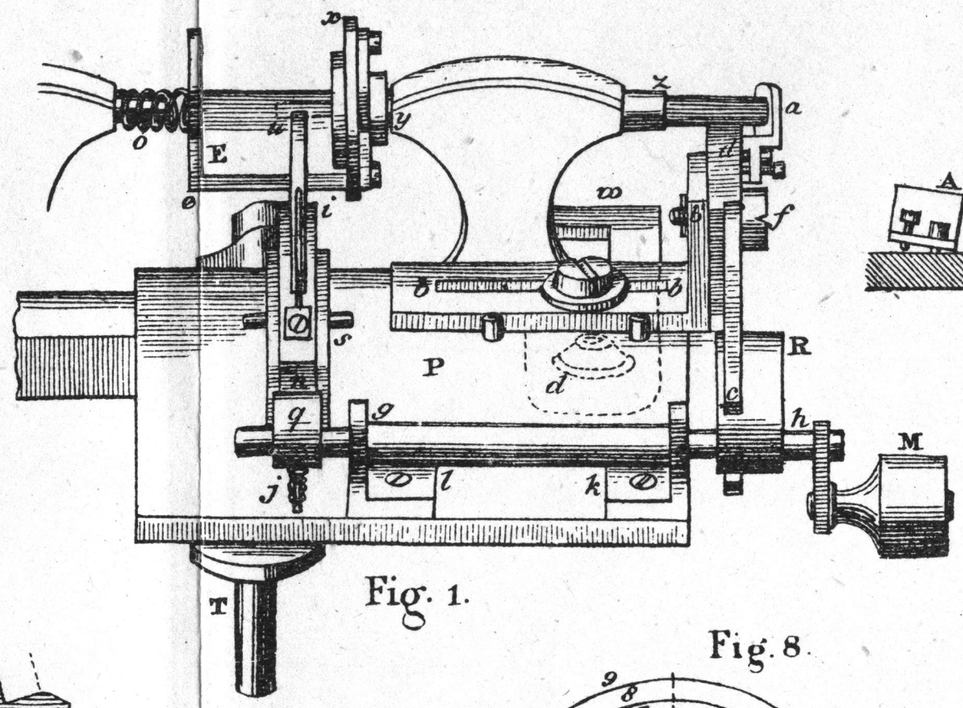


Fig. 1.

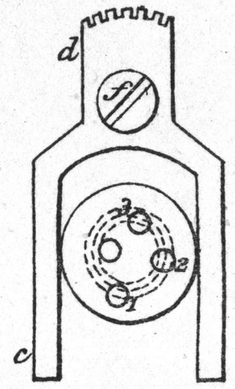


Fig. 2.

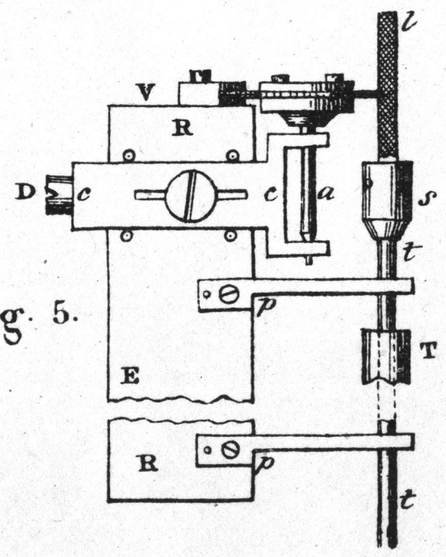


Fig. 5.

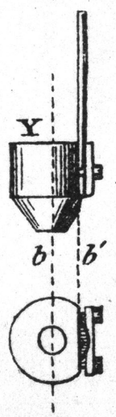
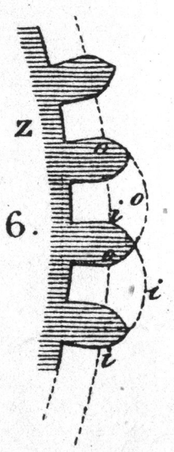


Fig. 6.



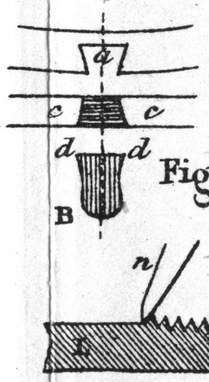
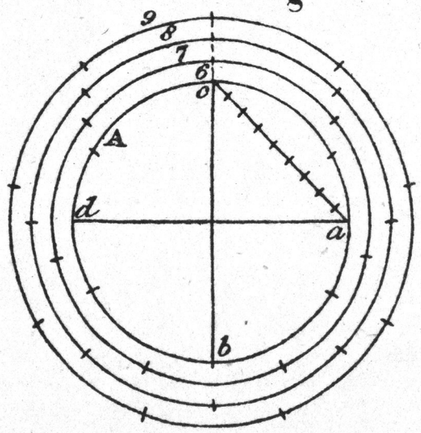


Fig. 7.

Fig. 8.



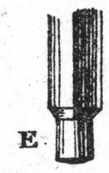
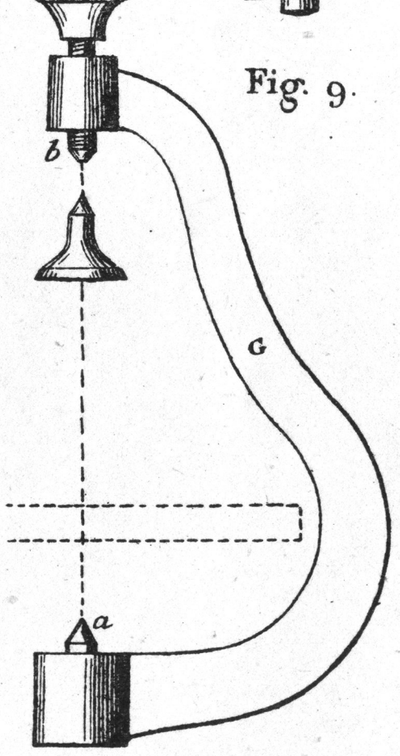


Fig. 9.



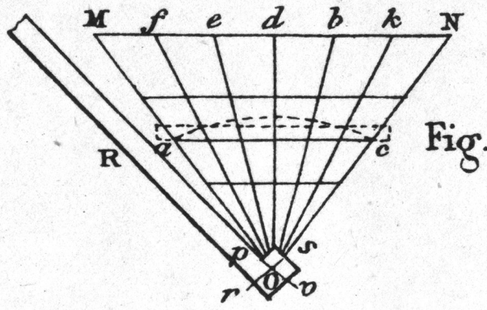
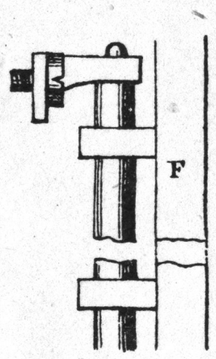


Fig. 10.



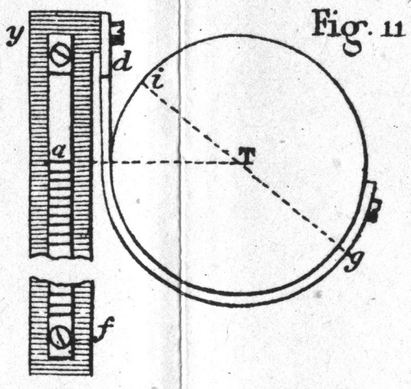


Fig. 11.

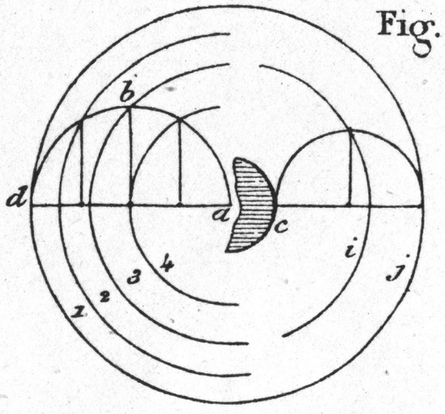


Fig. 12.

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