March 17, 1799.

PATENT FOR FIVE YEARS,

For various horological machines,

By sieur Frederic Japy, of Beaucourt, Haut-Rhine.

[Note: This is not literal translation ofthe original text; it has been altered to suit the format of this translation. All notes in italics and in brackets are my comments. Richard Watkins]

The following machines produce the principal parts of a watch, with rapidity and precision, by employing only not very skilful workmen, and can even be operated by children.

The first is a machine to cut rolled brass sheets into parallel strips of arbitrary widths; from them one makes the plates, balances and wheels of watches. It consists of a thin cutter on a revolving axle mounted between two points, as on a lathe. This cuts the sheet of brass, which is placed between guides and maintained flat on a shelf mounted on rollers, which a weight constantly pulls against the cutter receiving a fast rotational movement from a large wheel. See figures 1 and 2.

The second is a type of facing lathe whose arbor is bored; it is used to turn plates, fusees, barrels, cocks, slides and racks of watches. Each one of these parts, placed on special chucks whose tail enters and is held in the arbor of the lathe by a lock screw, receives the form which it must have by only the action of the graver, whose movement is regulated by screws and levers. See figures 3 and 4.

The third is a machine for cutting the teeth of wheels. For this purpose, one places a certain number of wheels, of the same diameter and to have the same number of teeth, on an chuck where they are held tightly by a screw. This chuck is then placed on a horizontal arbor, carrying a divider, which is turned by an endless screw with a crank handle. A pointer, in the shape of spring, stops the divider at the required point of division, while all this equipment, being moved on well formed slides, makes the pile of wheels pass a cutter which divides all at the same time. See figures 5, 6 and 7.

The purpose of the fourth machine is to make round or square pillars at will. The brass wire used to make these pillars goes through a bored lathe arbor, in the center of which it is maintained by screws. A cutter, of a suitably turned profile, rounds or squares according to whether one turns the brass wire continuously or one stops it while the cutter acts, at the four rectangular divisions of a divider placed on the arbor of the lathe. The end of the pillar is held by a support. As the cutter is attached to a mobile frame, one can bring it more or less close according to need. See figures 8 and 9.

The fifth is a screw press to cut out balances with only one blow. See figure 10.

The sixth is a piston press, which acts by percussion; it is used to cut out gear wheels. See figures 11 and 12.

The seventh is a small drilling machine driven by a bow; it is put in a vice. One presses the drill against the part which one wants to bore, in the direction of its axis, by means of a cylindrical runner sliding friction tight in a sleeve. The piece to be bored is held perpendicular to the direction of the drill between two jaws, of which one is part of the base of the lathe, and the other is a sliding jaw pressed onto it by a lock nut. See figure 13.

The eighth is intended to rivet the pillars of watches frames onto the plate where they must be fixed. The watch frame is placed on a platform made for this purpose, whose two columns rise vertically and support, at the height of approximately 18 lines, a plate bored with round holes corresponding to the four pillars that are to be riveted. See figures 14 and 15. Another plate with the same holes, slides parallel to the first along the two columns which are used to guide it, and can press on the watch frame where it is held by a screw which acts on its center. In the holes of these plates, corresponding to the pillars, one places cannons, which go down onto on the watch plate and are used as guides for a steel stake with which one rivets all the pillars using a hammer.

The ninth slits heads of the screws. A certain number of screws of same kind are held tightly in a clamp, with the heads being on the same straight line, and all are slit at same time by a tool fixed in a frame which is driven between rollers. See figures 16 and 17.

Lastly, the tenth machine is a draw bench, with a winch and a chain, by means of which one makes the slide of the potence and all other objects which can be drawn through a draw-plate. See figures 18 and 19.

Figures 1 and 2: Plan and elevation of a machine to cut sheets of brass in parallel strips of arbitrary widths.

a, Driving wheel of the machine.

b, Shelf of wood, furnished with rollers underneath and on its sides, in order to facilitate its movement. It is on this shelf that one fixes the sheet of brass that one wants to cut.

c, Iron strip which, by means of two bolts, holds the sheet on the shelf *b*.

d, Stop with slide, used to regulate the width of the brass bands to be cut out.

e, Weight which moves the shelf from right to left, when one withdraws pin *f*.

g, Headstock made of iron, bent in a half-circle at the top, and the foot of which is strongly fixed to the frame of the machine. It carries an axis, turning on two points on the ends of screws, and furnished with a small, thin cutter and a pulley corresponding to the driving wheel.

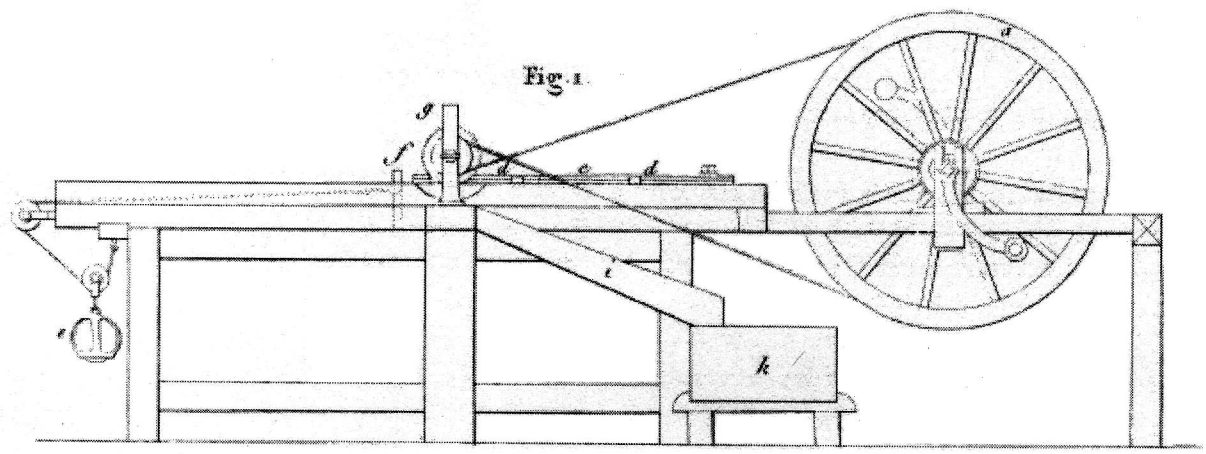
h, Sheet of brass to be cut, fixed on the shelf *b*.

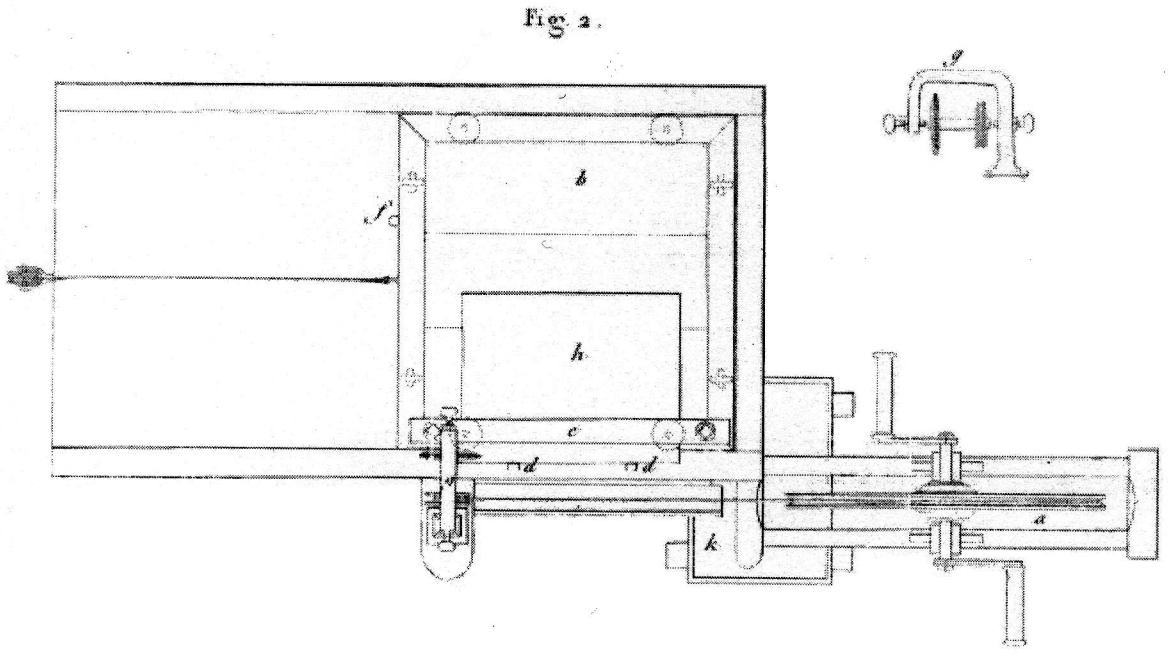
i, Wood channel, slightly inclined, into which fall the pieces of brass that the cutter produces.

k, Container to receive these brass pieces. *[i and k should be on the left end of the table.]*

The operation of this machine does not offer any difficulty: the brass plate is placed on the shelf *b*, and pin *f* withdrawn, then one has only to turn the wheel in the right direction, until the cutting is completed.

[This is a very early circular saw. Rees "Cyclopaedia" states that the earliest circular saws were those used at the time of Hooke to cut the teeth of wheels, but when the method was next used is not specified An internet site says that "in 1777, Samuel Miller invented the circular saw in England.]





Figures 3, and 4: Elevation, plan and details of the lathe used to turn plates; like the turns with a bow, it is fixed in a vice or on a bench as required.

A, Piece of iron, well dressed and sized, on which the lathe is mounted.

B, Arbor of the lathe carrying a pulley with several angular throats, which is put into motion by a large wheel.

C, Support which is fixed to the iron base *A* by a screw; it carries two slides *D*, which guide the graver.

E, The graver placed between its guides, to recess the large plate. *[pratiquer la rayure]*

E', Circular graver turning in a horizontal plane around its pivot, to make the external contour of plates and to bring them size.

F, Lever with hinge, to push forward and withdraw the graver *E*. One sees in figure 4 how one regulates the length of the rod *F'* so that the lever is always approximately perpendicular to the direction of the graver. The rod *F'* screws into the head of the horizontal headstock *G*, where it is stopped by a piston and a nut with lever *H*, when it is suitably placed.

I, Screws which hold the guides of the graver *E* on the support *G*.

J, Screw by which one determines the position of the circular graver *E'*, so that plates have the required size.

K, Screw to lock the support *C* on the bar of lathe *A*.

M, Chuck with tail to turn plates. The plates are held there by four small pins, which enter the pillar holes.

N, Large and small plates, bored to receive the pillars.

O, Another chuck with tail, which is also placed in the hollow of the arbor *B* of the lathe, which is used for turning the small parts *P*.

Q, View of the circular graver and its mount, detached from the machine.

R, View of another headstock, whose point supports the center of a small plate while it is turned.

S, Headstock which one can put on the lathe in place of the support *C*, and which carries a chuck *T* armed with small gravers *X*, suitably placed to turn the small parts *P*.

T', Separate view of this chuck.

[The chucks must be wax chucks. It appears that Japy's verge movement design required only one recess, in the center of the pillar plate. The lathe, as described, cannot turn anything off-centre.]

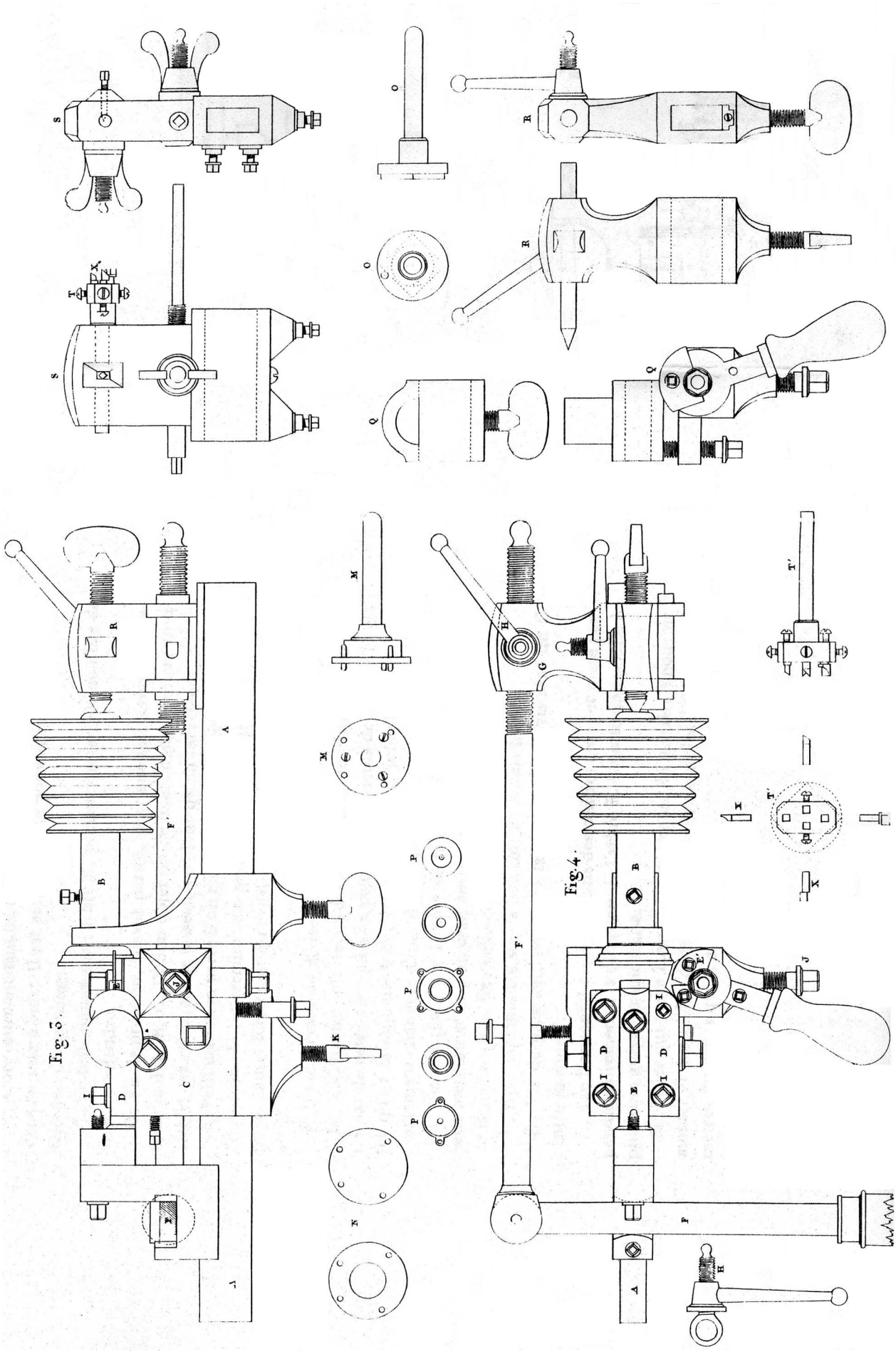


Fig. 3.
Fig. 4.

Figures 5, 6 and 7: Elevation and plan of a machine to cut the teeth of watch wheels.

A, Iron plate, carrying two parallel edges on its sides, which are used as guides for all the equipment *B*, *C*, *D*, mobile on this plate in the direction its length.

B, Rotating shaft supported in a collet and on a screw point, as in a bidet *[furniture?]* lathe. It is bored, in order to be able to put in different chucks.

C, Chuck assembled on the arbor *B*, carrying a number of wheels to be split.

D, Locking screw forming, with its nut, part of the mobile system *B*, *C*, *D*. Its purpose is to fix the wheels on the chuck immovably while they are divided.

E, Small bored sleeve with a hole of the same diameter as the arbor of the chuck. It is finished with a point, against which the sliding nut of the screw *D* presses as strongly as is necessary.

F, Wheel used as the divider, mounted on the arbor *B*.

G, Endless screw, placed below and in the plane as the wheel *F*. The pitch of this screw, which engages in the teeth of the wheel *F*, is such that by turning it, the wheels that one divides are moved exactly one tooth.

H, Spring placed on the side of the machine, which, using a small catch and a corresponding notch in the head of the endless screw, fixes the endless screw at the point of division.

I, Crank handle assembled on the head of the endless screw *G*.

K, Screw used to support the endless screw *G* against the wheel *F*.

L, Horizontal axle turning in centers in screws, and placed perpendicular to the direction of the arbor *B* It carries a pulley with several throats and a cutter.

M, Iron hoop which carries the axle *L*. It is made so that it can move up and go down within the limits required by the various diameters of the wheels that one has to split.

N, Screws which are used to fix *M* at a suitable height.

O, Cutter for brass.

P, Cutter for iron and steel.

Q, Separate view of the dividing wheel *F* and the endless screw *G*.

R, Chucks for the various sizes of wheels.

S, Sleeve, finished with a point, used to press the wheels against the chuck.

[The accuracy of division depends on the accuracy and rigidity of the spring stop H. The use of an endless screw may enable arbitrary divisions, by turning the handle an appropriate amount, but it is an error-prone and potentially very inaccurate system compared with using a traditional dividing plate. There is also the problem that, unless held very tightly, there is nothing to prevent a wheel rotating relative to the others in the stack and so being incorrectly divided.]

Figures 8 and 9: Machine to make round or square pillars.

a, Well sized iron rod, on which all the machine is assembled.

b, Arbor of the lathe, furnished with a pulley having several throats; it is bored right through and its head carries a chuck with four screws. At its opposite end is a disc, whose edge is divided into four equal parts. The head of a spring, of which one sees the outline in figure 8, enters the notches of this disc and is used as the pointer for this divider.

c, Headstock, in the holes of which the arbor *B* turns.

d, Support of the lathe, which one fixes on the rod *a* with lock screws.

e, Screw to fix this support.

f, Another support for the cutter carrier; it is also fixed by screws to the rod *a*, so as to be able to move to all the necessary positions for the work, either horizontally or vertically.

g, Cutter carrier.

h, vertical headstock, fixed on the support *f*. The middle is open and has a bolt *i*, whose head is used as a center with the screws *k* of the cutter carrier *g*.

l, Screw which is used to regulate the height of the cutter carrier, according to need.

m, Milling spindle axle; it turns between two screw points *n*, which the cutter carrier *g* carries.

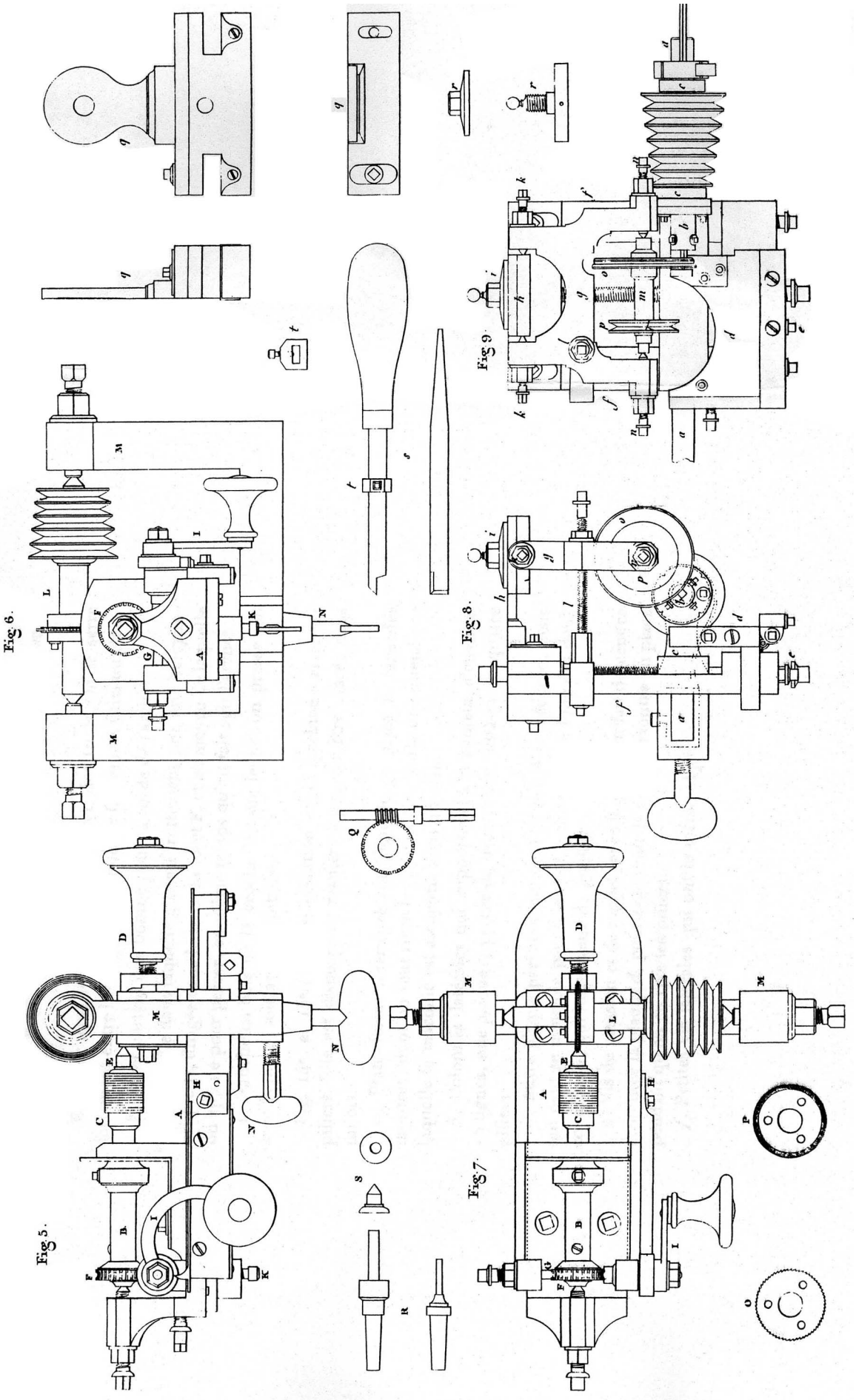


Fig. 5.
Fig. 6.
Fig. 7.
Fig. 8.
Fig. 9.

o, Mill whose profile is cut suitably to make the forms of round or square pillars.

p, Pulley used to impart movement to the cutter *o*, using a large driving wheel.

q, View of the headstock *h*, detached from the machine.

r, View of bolt *i* and its nut.

s, Tool to turn brass.

t, Sliding ring with lock screw, which one puts on the stem of a tool, to regulate projection and to use it as a support.

The machine thus laid out, one puts a brass wire of suitable size in the arbor of the lathe; one fixes it at the center with the four screws of the chuck, having care to let the length necessary to make a pillar protrude on the side of the nose,. Then, if it is to make a square pillar, one stops the arbor of the lathe in one of divisions, using the spring head, and then one makes the cutter act which, being propped up by the screw *l*, forms the first face. The same is done for the other three faces and there is a perfectly regular square pillar.

One sees that to make a round pillar, it is necessary to impart a rotational movement to the arbor of the lathe while the cutter or the tool works. In either case, it is necessary to support the end of the pillar.

[An extremely complex solution to a relatively simple task! Squares are cut incorrectly in that the sides are cupped by the cutter.]

Figure 10: Screw press to cut out watch balances with only one blow.

A, Frame for the press or hollow punch; it is made of wrought iron.

B, Brass nut, mounted in the upper cross-piece of the frame.

C, Iron screw and with square-cut threads; it is operated by the lever *D*, which has a wooden handle *E*.

F, Screw used to regulate the sliding rods of the machine in the event of play.

G, Die and counter-die placed in the machine. The first is fixed by a pin on the end of the piston, and the other is held in place by the screws *H*.

I, Plan and elevation of the die.

K, Plan of the counter-die.

Figure 11: Drop press with piston.

A, Frame of the press, which can be put on a block or in a vice as required.

B, Piston or cylindrical runner, whose lower end receives the die.

C, Packing strip which enters in a groove in the piston, to prevent it from turning.

D, Die and counter-die installation.

E, Lock screws to adjust and fix the counter-die in the machine.

F, Plan of the counter-die.

G, *G'*, Plan and elevation of the die shown separately.

H, Band of steel used as gauge, to initially cut out the wheels such as one sees them in *I*.

K, Punches, used first to cut out the discs *I*. These pass through a press a second time with it furnished with the dies *F*, *G*, and then they take the form *G'*.

L, Calibre gauge furnished with points to mark the various holes to be made in the plates.

[As the holes are drilled by hand (see figure 13) they must be marked on the plates somehow. As Japy does not punch out the plates, how this gauge is used is unclear.]

Figure 12: Arrangement of the drop hammer, by which drives the press represented in the preceding figure. It is shown on a smaller scale. Inspection of the figure is enough to understand how it works.

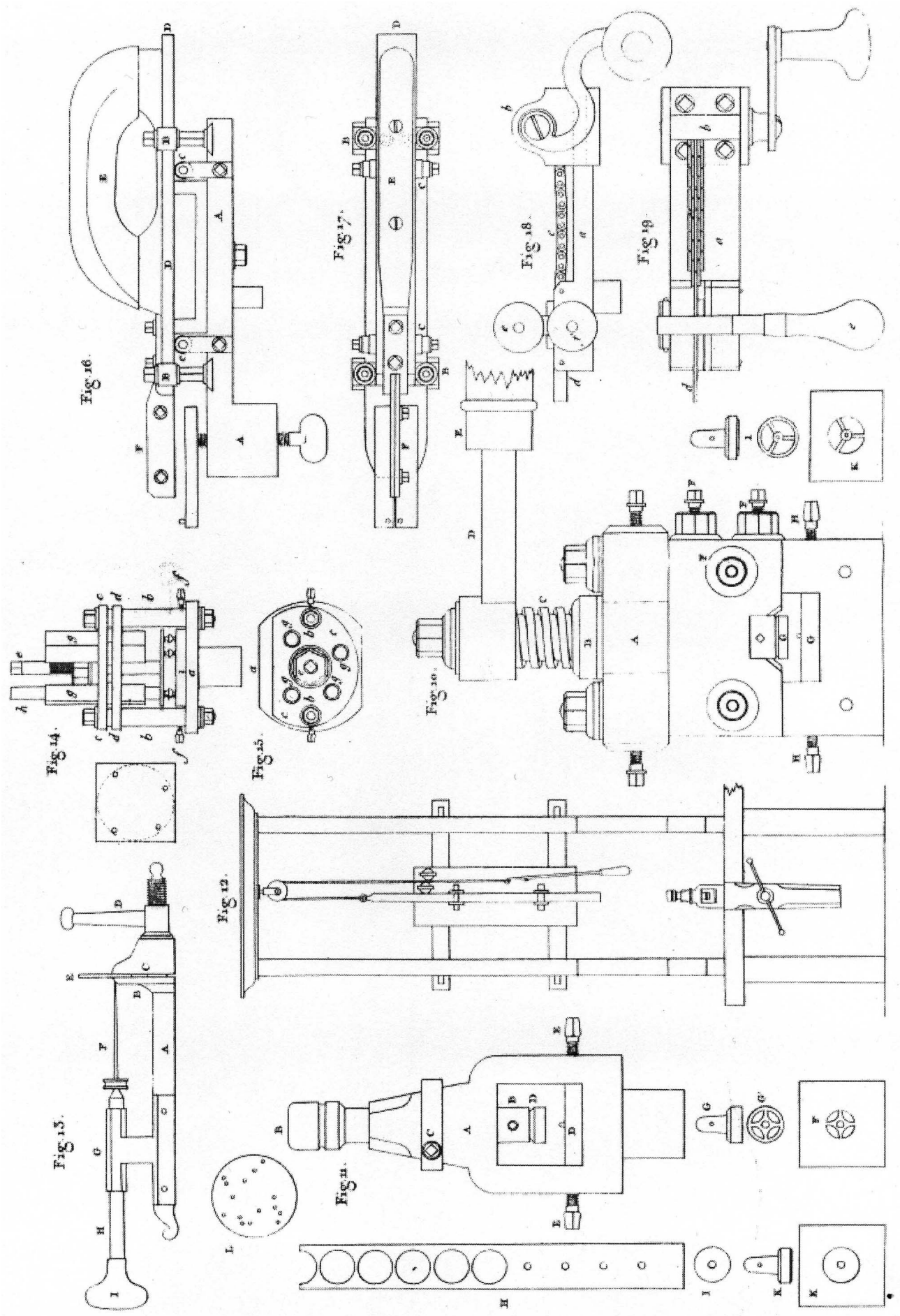


Fig. 16.
Fig. 17.
Fig. 18.
Fig. 19.
Fig. 14.
Fig. 15.
Fig. 10.
Fig. 12.
Fig. 13.
Fig. 11.

Figure 13: Small upright drilling machine with bow. It is placed in a vice.

A, Iron rod, the left end of which is designed to be held in a vice,.

B, Shoulder, whose face is perpendicular to the rod *A* and which is part of the rod.

C, Headstock sliding along the rod *A*, one face of which can rest exactly against the shoulder B.

D, Nut with lever, with which one presses the headstock *C* against the shoulder *B*.

E, Object in which one wants to bore holes. It is tightened firmly between the shoulder *B* and the headstock *C*, as in a vice.

F, Drill carrying a pulley for the cord of the bow.

G, Sleeve in which a cylindrical runner *H* slides with friction in the same direction as the drill *F*, and by means of which one supports the drill to bore at the same time as one operates the bow.

I, Wooden knob of the sleeve *H*, on which one presses either with the hand or with the chest.

[There is no way to accurately center the plate being drilled so that the correct spot is opposite the drill bit. Setting up this drill would be a nightmare compared to the conventional method of drilling free-hand and it is unlikely to be any better.]

Figures 14 and 15: Plan and elevation of a machine for riveting pillars. It is arranged so that it can be placed in a vice.

a, Lower platform on which one places the watch frame in which one wants to rivet the pillars. It has a tail by which the machine is held in a vice.

b, Side columns which support, at a height of approximately 18 lines, a plate *c* bored with round holes opposite the four pillars.

d, Another plate exactly the same as the preceding one, but which can be moved parallel along the two columns *b*, which are used as guides.

e, Screw by which one makes the plate *d* descend onto the watch frame, to hold it in place while one rivets the pillars.

f, Small side screws which have the same object.

g, Cannons placed in the plates *c*, *d*, and which go down onto the watch frame opposite the pillars.

h, Steel stake which one successively introduces into the cannons, by which one rivets each pillar using a hammer.

i, square and mobile plate, with four holes corresponding to those of the pillars. This plate is put on the platform *a*, where it is held by the screws *f*.

[I presume the ends of the pillars which are to be pinned, and which protrude through the top plate, enter the holes in i. Thus i aligns the frame correctly in the tool.]

Figures 16 and 17: Machine to split screw heads, seen in elevation and plan.

A, Frame arranged to be placed in a vice.

B, Rollers, or friction wheels, having for axles the four vertical pillars mounted on the frame A.

C, Rollers, whose axles are horizontal and at the same height, mounted on arms fixed to the sides of the frame.

D, Iron piece, well sized, which sits on the horizontal rollers, and which exactly fills the space between the vertical rollers *B*; it must be able to move left and right.

E, Wooden handle, resembling that of a plane, which one holds to operate the machine.

F, Screw clamp in which one fixes a slitting file; this part is fixed on the front of and driven by *D*.

G, Support for the clamp which holds the screws while one slits the heads. It is arranged so as to be able to adjust the clamp into a suitable position for the heads of screw relative to the slitting file. All being thus laid out, the operation of this machine does not present any difficulty. It is not absolutely necessary to move the part *D*, *E*, *F* back and forth to its limit and a certain number of times. All the screws are slit at the same time, being held in the same vertical plane, passing by the slitting file, and having their heads at the same height.

Figures 18 and 19: Draw bench with a winch and a chain; it can placed in a vice. It is used to equalize the hole in the potence.

a, Plan and elevation in the body of the bench.

b, Cable winch handle.

c, Iron chain which is rolled onto the winch and which draws the file *d*.

e, Levers to tighten more or less the file *d* at the entry of the potence.

f, Screw to tighten the potence.

[This is obscure. Japy describes it as forming the hole in the potence for the slide, in which case a file would be necessary. But then he writes about using a draw plate to make the slide and other components. The latter is much more likely, in which case the file and other features don't make sense! The drawing appears to be a miniature rolling mill where the pressure on the top roller is applied manually; a method that is unlikely to produce uniform results.]
