[Third Edition.]

A.D. 1856 . . . . . N° 2896.

Machinery for Cutting Nuts, Screws, and Toothed Wheels.

LETTERS PATENT to Christian Schiele, of Oldham, in the County of Lancaster, Engineer, for the Invention of "**Certain Improvements in Machinery or Apparatus for Cutting Nuts, Screws or Bolts, and Toothed Wheels.**"

Sealed the 5th June 1857, and dated the 6th December 1856.

PROVISIONAL SPECIFICATION left by the said Christian Schiele at the Office of the Commissioners of Patents, with his Petition, on the 6th December 1856.

I, Christian Schiele, of Oldham, in the County of Lancaster, Engineer, do hereby declare the nature of my said Invention for "**Certain Improvements in Machinery or Apparatus for Cutting Nuts, Screws or Bolts, and Toothed Wheels,**" to be as follows:—

These improvements are designed to obviate to a great extent the reciprocating or periodical action of cutting nuts, bolts or screws, and the teeth of wheels by the following arrangements:—

First, as to cutting nuts.—I take a tap of such a length in the thread as will ensure the strength of its long stem or uncut portion (of a size that will slip easily through the nuts) to be sufficient for tapping. I allow the nuts to accumulate on this lengthened portion or stem, and their accumulation disconnecting the catch turning the tap, thereby gives notice when the nuts are

finished and have to be removed, so as to allow of the accumulation of another lot. The tap being supposed to revolve, I feed the nuts on its smaller end at such periods that the one is almost tapped before another is put on. To keep them (the nuts) from turning round I apply a capsule or pipe (similar to a lengthened socket key without a bottom), wherein the nuts slip longitudinally, but are prevented to turn round; a tube serving to give pressure and shewing the end of the cut; this may also be done by a catch holding each nut, sliding along guide bars, and returning to the starting to the starting point after the cutting of each nut. To hold the tap central I apply or make use of a long square and long catch hole for turning; I also apply one or more springs in this hole, which prevents the tap from being easily drawn out, on only when there is a stronger strain, like that occasioned by a nut or its guide getting fast, or by the accumulation of nuts. I also enclose the whole in such a way that the tap may run immersed in oil, soap water, or other suitable lubricant, so as to allow a comparatively high speed to be applied without danger of softening the taps by heat. In order to allow of a large number of nuts to remain in this fluid without obstructing the process, I raise a central boss (wherever the turning spindle is upright), allowing of a greater space around this boss for the above purpose. In withdrawing the tap, I employ a lever attached to the nut guide, for removing the nuts that *may remain* lodged on the top of the boss or spindle. The square hole or catch for the tap is widened on the top, so as to guide and receive the tap again the more easily when let down to it.

Secondly, as to cutting screws or bolts. I take two dies, which in cutting represent the well-known mechanism of worm and wheel, the cylindrical portion on which the screw has to be cut representing the worm, and the dies the double wheel. The action of the dies is partly cutting the threads, and thereby allowing the bolt or other cylindrical portion to enter, and partly turning on their axis, giving way to a too great resistance. By obstructing the free turning of the dies (increasing their friction on the faces which guide them), the bite or speed of cutting may be regulated. Of course this may also be done by pressure on the bolt, &c., which again may be so regularly applied by gearing, that a most uniform cutting action may be obtained. The bolt or other portion to be screwed is guided in a similar manner to the nuts (as described above), and the immersion in oil or other lubricant is also similar; when the screw is cut sufficiently long, draws it back, the dies turning round will allow of the free removal of the screw; in this manner wood screws may be cut by this method most readily. In some cases it will be of advantage to have the dies connected by gearing, so as to insure their completely uniform action.

Thirdly, as to cutting toothed wheels.—I reverse the above action (for cutting screws) by causing the worm to cut the wheel, connecting the motion of the worm with the motion of the wheel in such a way that the teeth may be shaped differently from what a wheel generally represents when gearing with worm. For instance, when moving the wheel in the line of its axis the teeth will be perpendicular, as in a common plain wheel; when the cutter or wheel is efficiently guided, a mitre wheel, a bevil wheel, an oblique, or almost any other description of wheel, may be cut in this manner, the same cutter serving for almost any size of wheels of the same pitch.

SPECIFICATION in pursuance of the conditions of the Letters Patent, filed by the said Christian Schiele in the Great Seal Patent Office on the 6th June 1857.

TO ALL TO WHOM THESE PRESENTS SHALL COME, I, CHRISTIAN SCHIELE, of Oldham, in the County of Lancaster, Engineer, send greeting.

WHEREAS Her most Excellent Majesty *Queen Victoria*, by Her Letters Patent, bearing date the Sixth day of December, in the year of our Lord One thousand eight hundred and fifty-six, in the twentieth year of Her reign, did, for Herself, Her heirs and successors, give and grant unto me, the said Christian Schiele, Her especial licence, that I, the said Christian Schiele, my executors, administrators, and assigns, or such others as I, the said Christian Schiele, my executors, administrators, and assigns, should at any time agree with, and no others, from time to time and at all times thereafter during the term therein expressed, should and lawfully might make, use, exercise, and vend, within the United Kingdom of Great Britain and Ireland, the Channel Islands, and Isle of Man, an Invention for "**CERTAIN IMPROVEMENTS IN MACHINERY OR APPARATUS FOR CUTTING NUTS, SCREWS OR BOLTS, AND TOOTHED WHEELS,**" upon the condition, amongst others, that I, the said Christian Schiele, by an instrument in writing under my hand and seal, should particularly describe and ascertain the nature of the said Invention, and in what manner the same was to be performed, and cause the same to be filed in the Great Seal Patent Office within six calendar months next and immediately after the date of the said Letters Patent.

NOW KNOW YE, that I, the said Christian Schiele, do hereby declare the nature of my said Invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement and accompanying Drawings (that is to say):—

Schiele's Improvements in Machinery for Cutting Nuts, Screws, or Bolts, &c.

These improvements are designed to obviate to a great extent the reciprocating or periodical action in cutting or tapping nuts, in cutting bolts or screws, and in cutting or trimming the teeth of wheels, by the following arrangements:—

First, as to tapping nuts.—I take a tap of such a length in the thread as will ensure the strength of its long stem or uncut portion (of a size that will slip easily through the nuts) to be sufficient for tapping. I allow the nuts to accumulate on this lengthened portion or stem, and their accumulation disconnecting the catch turning the tap, thereby gives notice when the nuts are finished and have to be removed, so as to allow of the accumulation of another lot. The tap being supposed to revolve, I feed the nuts on its smaller end at such periods that the one is almost tapped before another is put on. To keep the nut from turning I apply a capsule or pipe (similar to a lengthened socket key without a bottom), wherein the nuts slip longitudinally, but are prevented from turning round, a tube serving to give pressure and shewing the end of the cut; this may also be effected by a catch holding each nut, sliding along guide bars, and returning to the starting point after the cutting of each nut. To hold the tap central I apply or make use of a long square and a long catch hole for turning. I also apply one or more springs in this hole, which prevents the tap from being easily drawn out, or only when there is a stronger strain, like that occasioned by a nut or its guide getting fast, or by the accumulation of nuts. I also enclose the whole in such a way that the tap may run immersed in oil, soap water, or other lubricant, so as to allow a comparatively high speed to be applied without softening the tap by heat. In order to allow of a large number of nuts to remain in this fluid without obstructing the process, I raise a central boss (wherever the turning spindle is upright), allowing of a greater space around this boss for the above purpose. In withdrawing the tap I employ a lever attached to the nut guide, for removing the nuts that may remain lodged on the top of the boss or spindle. The square hole or catch for the tap is widened on the top, so as to guide and receive the tap again the more easily when let down to it.

Secondly, as to cutting screws or bolts.—I take two dies, which in cutting represent the well-known mechanism of worm and wheel, the cylindrical portion on which the screw has to be cut representing the worm, and the dies the double wheel. The action of the dies is partly cutting the threads, and thereby allowing the bolt or other cylindrical portion to enter, and partly turning on their axis, so as to give way to a too great resistance. By obstructing the free turning of the dies (increasing their friction on the faces which guide them), the bite or speed of cutting may be regulated. This may also be done by pressure on the bolt, &c., which again may be so regularly applied by gearing,

that a most uniform cutting action may be obtained. The bolt or other portion to be screwed is guided in a similar manner to the nuts (as described above), the immersion in oil or other lubricant being also similar; when the screw is cut sufficiently long draw it back, the dies turning round will allow of the free removal of the screw: in this manner wood screws may be cut by this method most readily. In some instances it will be of advantage to have the dies connected by gearing, so as to ensure the uniformity of their action.

Thirdly, as to cutting toothed wheels.—I reverse the above-named action (for cutting screws) by causing the worm to cut the wheel, connecting the motion of the worm with the motion of the wheel, in such a way that the teeth may be shaped differently to those which a wheel generally represents when gearing with a worm. For instance, when moving the wheel in the line of its axis, the teeth will be perpendicular, as in a common plain wheel: when the cutter or wheel is efficiently guided, a mitre wheel or a bevil wheel, an oblique or almost any other description of wheel may be cut in this manner; the same cutters serving for almost any size of wheels of the same pitch.

In order that my Invention may be more readily understood and explained in detail, I have hereunto attached two Sheets of Drawings illustrative of the same, and having similar letters of reference marked upon corresponding parts of the apparatus.

In Sheet 1, Fig. 1 is a front elevation of my improved nut cutting or tapping machine, in which *a* is the tap, seen partly in dotted lines; *b* is its lengthy stem, for allowing of a comparatively great number of nuts to accumulate on it after they are tapped. By a long square (see Fig. 5) its perpendicular position, and by its pointed end, the necessary central position and easy introduction of nuts are secured, allowing its stem to be of great length. *c* is a short pipe, similar to a lengthened socket key (see Fig. 2, plan), loosely fitting the nuts. At proper intervals (the previous one being just cut) the nuts to be cut are introduced on the top, slipping along the pipe by the tap screwing into them. Being tapped, they accumulate upon the stem *b* until it is filled, when the tap screws itself forward, and out of its square socket, therefore out of gear: a cylindrical portion on its lower end preventing its swaying away or vibrating from its central position. It is then lifted up sufficient for the removal of the nuts (which fall down a perforated inclined plane or shoot into a receptacle). The tap is then brought into gear again, and a new operation is commenced, and so on. For preventing the detrimental twist of the long stem, the tap is made longer than usual, calculated to cut but little at a time, making up by speed what is lost in the power of the cut: it is also tapered to the end in its thread. The lubricating fluid is forced on to the tap (to cool,

clear, and lubricate it) by means of the small pump *g*, pumping out of a flat reservoir, to which the bottom plate is arranged, where all overflowing fluid is collected, its heat being reduced by the surface offered to the action of the air on it during working. There is a sieve or grating on the suction pipe or opening, preventing the entrance of cuttings into the pump. The small tube conveying the fluid to the top has a joint or junction at *h*, so that different tubes to suit different heights may be introduced. The hollow spindle *i*, better seen in the sectional part of the bolt machine in Fig. 3, here driven by bevil gear) is formed at the top and bearing portions to the "antifriction curve," as at $i^{1\times}, 2^{1\times}$, and lengthened out on the upper end, in order to apply there a kind of friction coupling. Two plates *z*, *z*, are screwed together, bearing on curved surfaces, and may be so regulated by their tightness that they will transmit the requisite power to the tap, but no more, so that on the tap getting fast it may not be damaged. Fig. 5 represents this coupling in section. It also shews how the tap is arranged with a spring, to hold it fast until the nuts have so far accumulated as to force it upwards. The plate *y*, *y*, or the carrier, is secured to the friction coupling by projections entering through corresponding slots, and turning partly round when set therein, are taken along by projections on the coupling. The cross top piece *l*, *l*, Figs. 1 and 2, has a large square hole to receive the different sizes of cornered tubes. Its height is easily adjusted by pinions on a shaft *n*, and racks on the rods or bars *m*, *m*. A hand wheel on the cross shaft *n* gives the necessary facility: and on the rods *m*, *m*, there are two collars *x*, *x*, with set screws resting against the bar guides, to secure the proper position of the crosshead *l*, *l*. In some cases it might be of advantage to have the perpendicular position of the tap inverted, hanging like a drill on an upright drill spindle, and screwing the nuts upwards; or the spindle may be made the nut guide, the tap being fixed in a central position, perpendicular or otherwise.

Having now described this part of the Invention relating to the cutting or tapping of nuts, I would remark, that I claim the perpendicular position of the tap, in order to attain great length of stem, the stationary nut guides, nut guides revolving, and the tap stationary, so as to allow of the tap being formed of greater length, if required, and also the general construction and arrangement of the mechanism or apparatus, & the safety coupling, as before described.

Secondly, in Sheet 1, Fig. 3 represents a side view of the machine for cutting screws or screwing bolts, shewn partly in section as applied to screw cutting or the screwing of bolts, &c. Instead of the capsules in the top frame, there is a kind of clamp, so arranged that it may hold the head of a bolt, or its

cylindrical portion, firm and central. It consists in a steel, or partly steel capsule, cut open by several slots, reaching to within a short distance from its upper end (see Fig. 4). There is a screw thread round this upper portion, with a nut as a hand wheel, by which it is held up and tightened, its lower collar laying angular against corresponding faces in the crosshead *l*, *l*, presses inwards and holds the bolt. The collars *x*, *x*, on the upright bars *m*, *m*, (Fig. 1), are so adjusted that each bolt is tapped to the proper length, when it is withdrawn by turning the pinion hand wheel to lift the crosshead. By this hand wheel the speed of cutting may also be regulated. There is a kind of reservoir round the body of the spindle, high enough to keep the dies immersed in lubricating fluid, even when running at high speeds, at which the cuttings are washed off by the circulation of the fluid drawn out by centrifugal force; the dies are also thereby kept cool and lubricated. The spindle *i* is closed by a slide on its lower end, to prevent the lubricating fluid escaping. Over the top of the dies there are loose wings, to guide the fluid from its revolving motion towards the bolt again, see dotted lines, Fig. 7. The pump *g* supplies or renews the fluid. The cutting dies *r*, *r*, *r*, *r*, are circular, four of them being mounted on spindles *v*, *v*, *v*, *v*, (see Fig. 7), in a frame of two plates, and form a set for each size of screw bolts. These frames are fixed on to the friction coupling of the spindle, as described before with reference to the nut-cutting machine.

Fig. 6 represents a section, and Fig. 7 a plan view of a set drawn to an enlarged scale. *r*, *r*, *r*, *r*, are the dies, having small bevil gearing cut into them to gear one into the other, so that they must turn and open out towards the entering bolt at an equal uniform rate. When the bolt is cut it is drawn out there being no need for stopping the machine as the dies are revolving according to requirements. The cuttings being comparatively fine, and the cooling and lubricating being well provided for, as also there being a great number of continually renewed cutting edges, the speed of the main spindle is rapid and suited to the washing out of the cuttings, to prevent their accumulating. To cut these dies, they are put together equally soft, when turned of equal diameters, as marked by the dotted lines on the outer edges (Fig. 7); then the machine is set and the tap is let down into them, care being taken by means of the hand wheel to allow it but gradually to enter. It will also be necessary in cutting the dies to employ, in starting, a tap of less diameter, and of a pitch so much larger than the proper pitch as the outside of the plain dies is larger than the centre or pitch line of the threads when cut, so that the correct division may be ensured. For finishing the cutting, a tap of the proper pitch, as above, must be used, which will readily follow the cutting of the former tap. When the dies are cut and the last tap has entered to its full

size, remove the dies, and turn grooves and cutting edges on, as shewn in the Drawing, Fig. 6 and Fig. 7. The object in forming the cutting edges should be equal in opposite ones, and the division of the cutting edges, so as to offer them at different points, say, two in the middle of the dies, two others slightly sideways, and two others again further towards the sides. There ought to be sufficient body of thread left to secure the bolt being properly guided during cutting. The dies are then hardened and tempered in the usual way, and put together again to marks to exactly the same place as before; any obstruction or forcible cutting that might occasion breakage causes the friction coupling to slip, preventing damage. In some cases less or more dies than four might be found of advantage. The diameters of the dies should be at least twice that of the bolts.

In this part of the Invention I claim principally the general arrangement of the machinery, together with the circular revolving dies representing a wheel cutting the worm, also the method of gearing the dies, the safety coupling, and the method of washing out the cuttings, thereby securing the cooling and lubricating.

The third portion of this Invention, relating to the cutting or trimming teeth of wheels, is shewn in Sheet 2.

Having shown how to cut screws, comparing the process to worms being cut by wheels, I will proceed now to shew how to cut wheels by worm-like cutters, excepting the known way of cutting worm wheels.

I employ a revolving block with projecting cutters arranged in a screw thread, and shaped to fit, for instance, into the teeth of a spur wheel, or a template representing a segment or portion to the rim of a spur wheel, and being placed with its axis at right angles to the axis of the cutter. The revolutions of the cutter are in a certain porportion set by change wheels to the motion of the wheel to be cut; the cutter of the wheel being gradually advanced in the line of the axis of the wheel to be cut, thereby shaping or forming the teeth to be cut. If oblique teeth are wanted, the advance must be in an oblique direction.

In Sheet 2 of the Drawings, Fig. 8 and 9 represent a machine for cutting small wheels; Fig. 10 and 11 represent a machine for cutting or trimming the teeth of larger wheels: similar letters of reference being marked upon corresponding parts.

In the elevation Figs. 8, and, in the plan view, Fig. 9, *a* is the cutter; *b*, the wheel partly cut; *c*, the face plate upon which the wheel is fixed; *d* is a spindle, which rises during the cutting by means of the internal screw and wheels underneath the cutter. *a* is placed correct, and fixed by means of the

portion of a worm wheel *e*, by its worm and a hand wheel *f*, and by tightening the large bearings. The change wheels at *g* transmit motion to the worm *h*, which gears into the worm wheel *i*, securely mounted on a hollow axis *k*, with curved bearings. The cutter is made of one hollowed piece of steel slipped on a spindle when small, or of discs or rings keyed with one key on the spindle when of a larger description, or as shewn in Fig. 12, when a still larger cutter is required. It is best formed on the screw cutting lathe, fitted to a template, as described above. The cutting spindle receives its motion by means of a speed pully turning on a stationary spindle and a pair of spur wheels. There is a cover provided to prevent the division worm wheel being injured by the cuttings falling in, and an oil reservoir underneath for the purposes of lubrication. It is better that the "skin" of cast-iron wheels is turned off on one side the wheel before commencing to cut, and sufficient metal provided where teeth have merely to be trimmed to allow the cutters to enter under the skin of the metal. In Fig. 8 there are some dotted lines marking the position of the cutter and its frame when used for cutting bevil wheels. Different cutters, *according to* the varying pitch in the teeth of the bevil wheel are set in and caused to enter and cut to the required depth by lowering the frame gradually until the bottom of the cutter touches the top of the teeth. The joining of the different cuts have to be made by filing to even surfaces. The cutter frame is mounted on a slide bed, which can be adjusted to the different dimensions required.

In the elevation, Fig. 10, and in the plan view, Fig. 11, *b* is a large description of wheel, to be cut. *a*, the cutter: *i*, the worm wheel fixed to the spindle of the large wheel: *h*, the worm to drive it: *g*, the change wheels.

The axis of such heavy wheels does not advance lengthways, but the cutter advances on a slide, which is mounted in a frame, which also allows of a slight adjustment forwards and backwards. The cutters are set and adjusted by the wooden template *q*, shown in dotted lines, fixed to the side of the wheel to be cut. The first motion is transmitted by a pinion fixed to a pulley by means of pins going through them, which are purposely made so weak that they will give way before any other portion of the machinery. The adjustment of different sizes is effected by shifting the bearings of the large wheel and the worm underneath, which slides on its spindles, and is held by adjustable bearings.

And, lastly, I wish it to be understood that I do not claim the cutting of worm wheels, as hitherto practiced, but I claim the method of obtaining a more continuous and correct cutting of other wheels by using a division or regulating wheel in connection with a worm cutter, so shaped and so guided in its action

as to produce the required forms of teeth independent of its tendency to act as a propelling screw or worm on the wheel: also the method of fixing and adjusting the larger kind of cutters, and also the general construction and arrangement of such cutters, and of the machinery or apparatus to be employed for cutting or trimming the teeth of spur, oblique, and other toothed wheels, as herein-before described, fully set forth, and exhibited in the Drawing attached.

In witness whereof, I, the said Christian Schiele, have hereunto set my hand and seal, this Fourth day of June, in the year of our Lord One thousand eight hundred and fifty-seven.

CHRISTIAN SCHIELE. (L.S.)

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.
[Wt. 42—50/9/1911.]

A.D. 1856. Dec. 6. N° 2896.

SCHIELE'S SPECIFICATION.

(3rd Edition)

(2 SHEETS: SHEET 1.

FIG. 2.

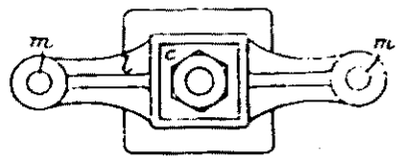


FIG. 1.

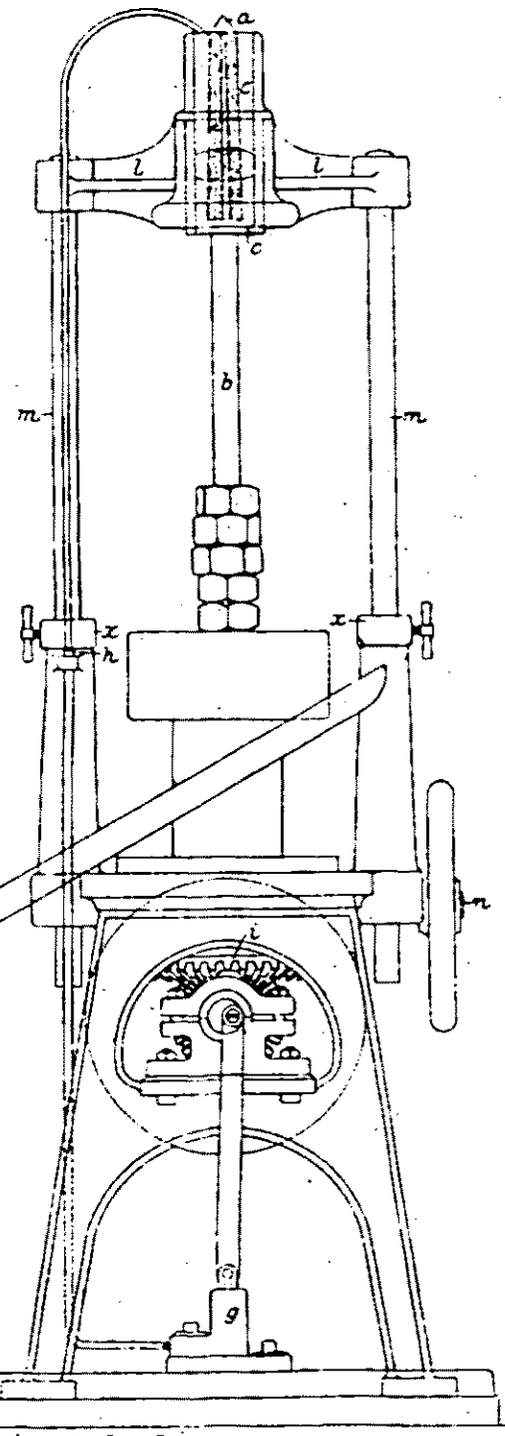


FIG. 4.

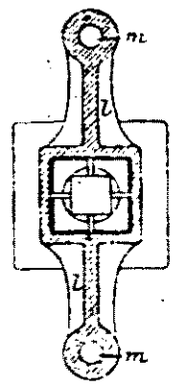


FIG. 3.

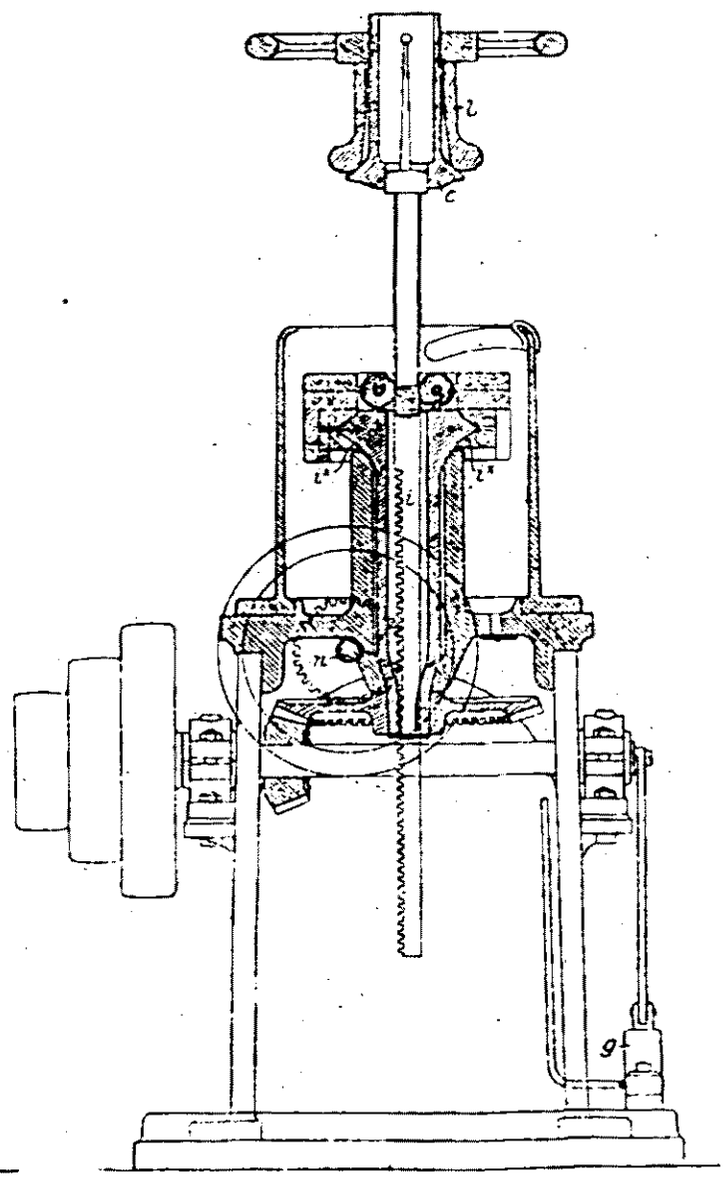


FIG. 5.

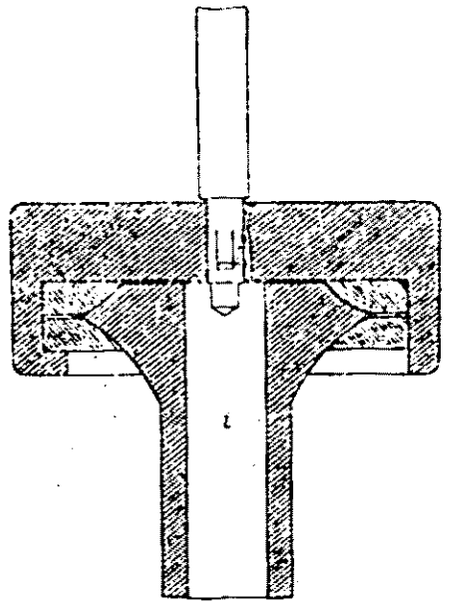


FIG. 6.

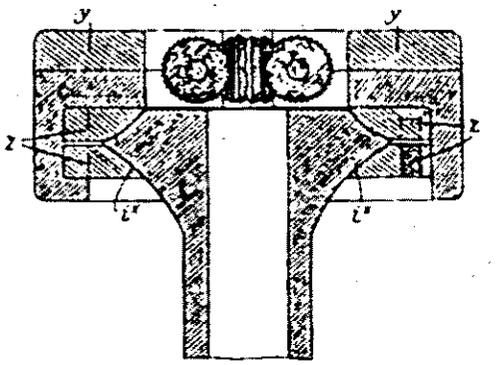
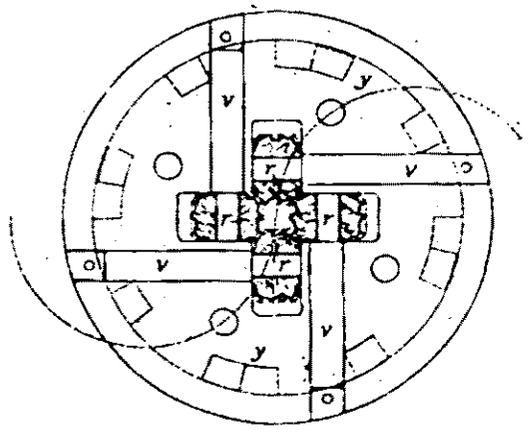


FIG. 7.



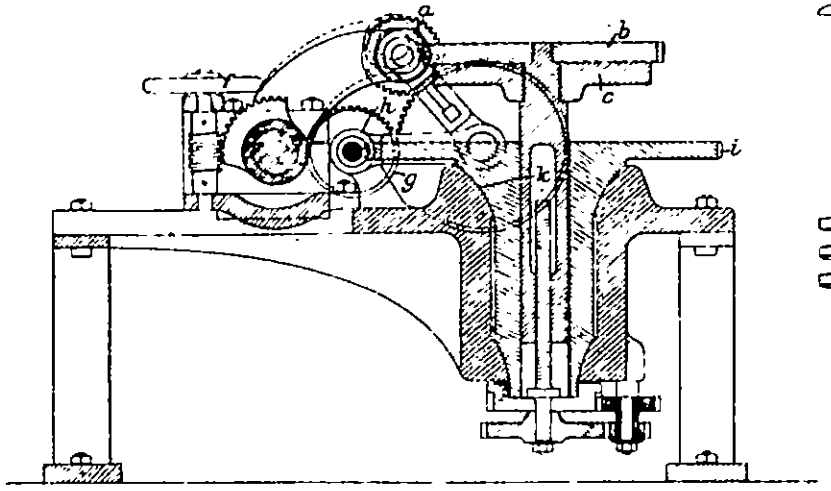
The filed drawing is not colored.

Malby & Sons, Photo-Litho

A.D. 1856. Dec. 6. Nº 2896.
SCHIELE'S Specification.
(3rd Edition)

(2 SHEETS)
SHEET 2.

FIG. 8.



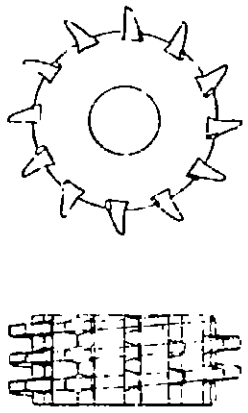


FIG. 10.

FIG. 9.

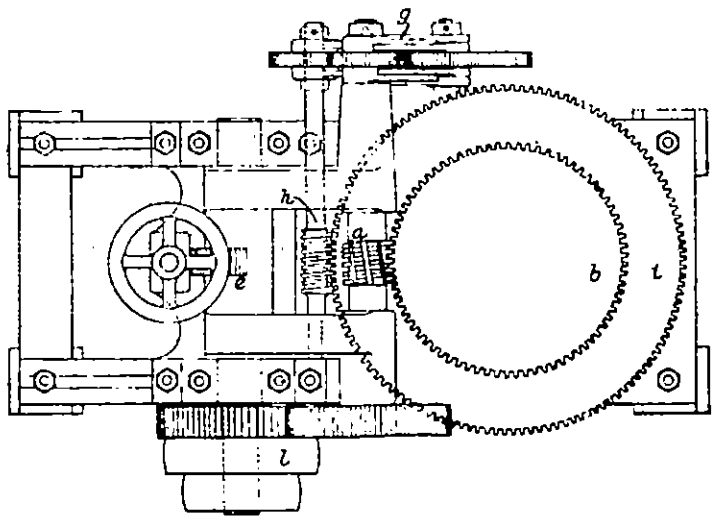
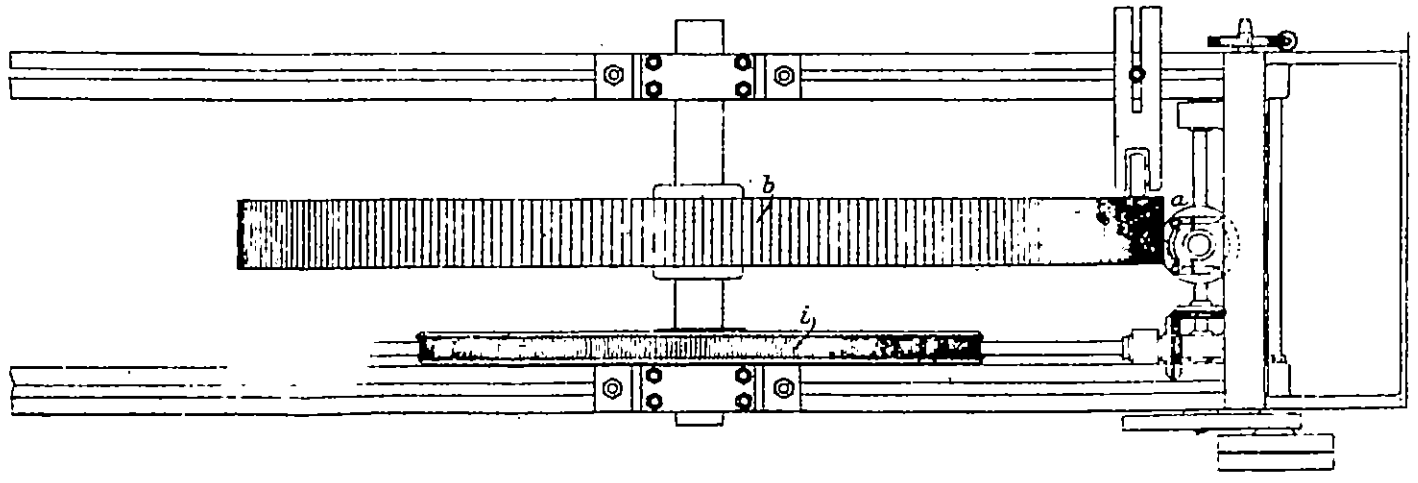


FIG. 11.



The filed drawing is not colored

Malby & Sons, Photo-Litho