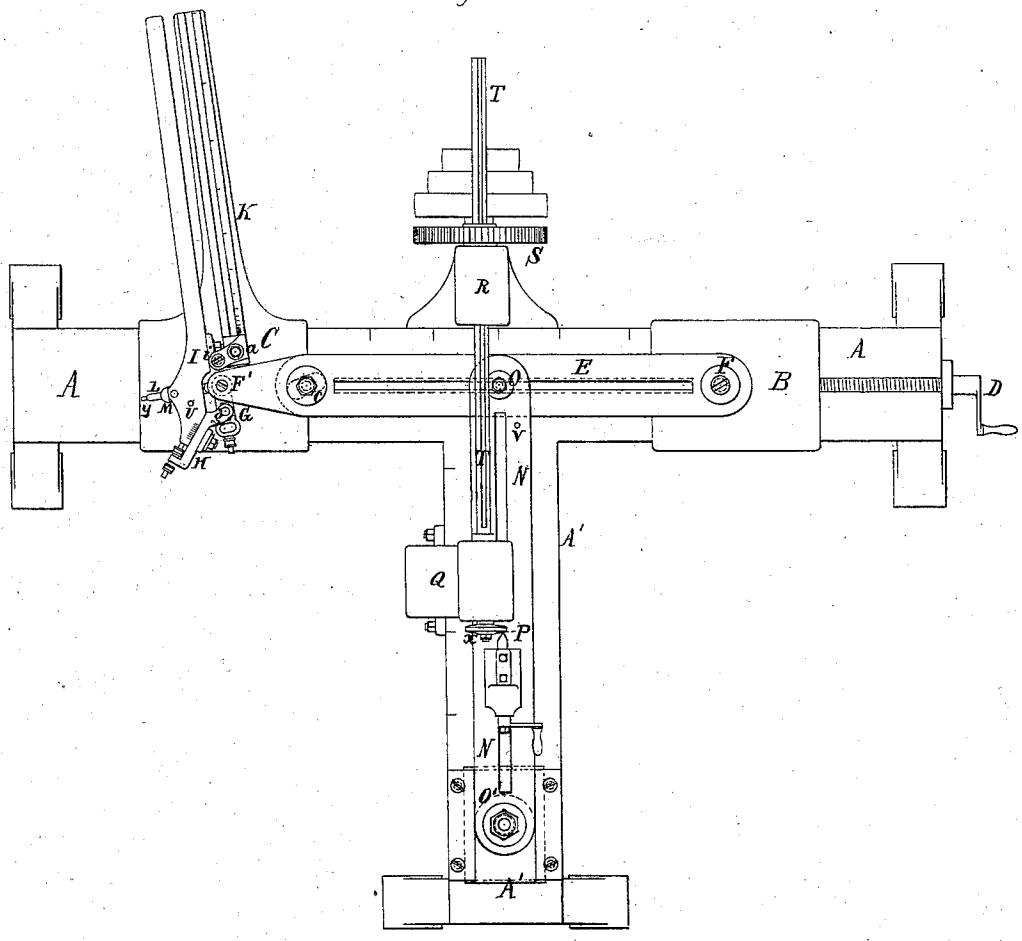
2 Sheets--Sheet 1.

W. SELLERS.

Machines for Forming Cutters for Cutting the Teeth of Wheels.

No. 136,101. Patented Feb. 18, 1873.

—Fig. 1.—



Witnesses:

Wm. E. Morgan.

Wm. S. Lynn.

Signed:

Wm Sellers

2 Sheets--Sheet 2.

W. SELLERS.

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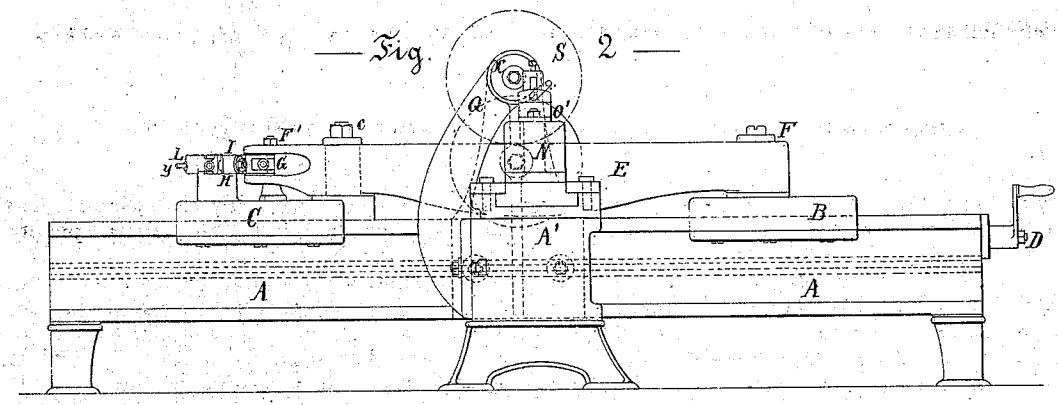
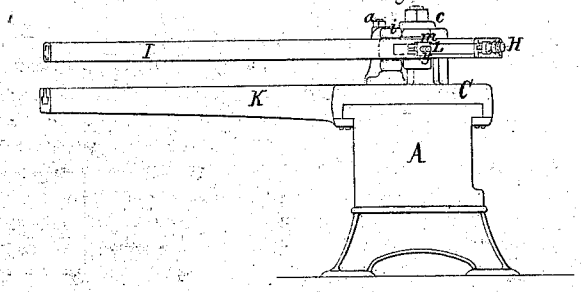
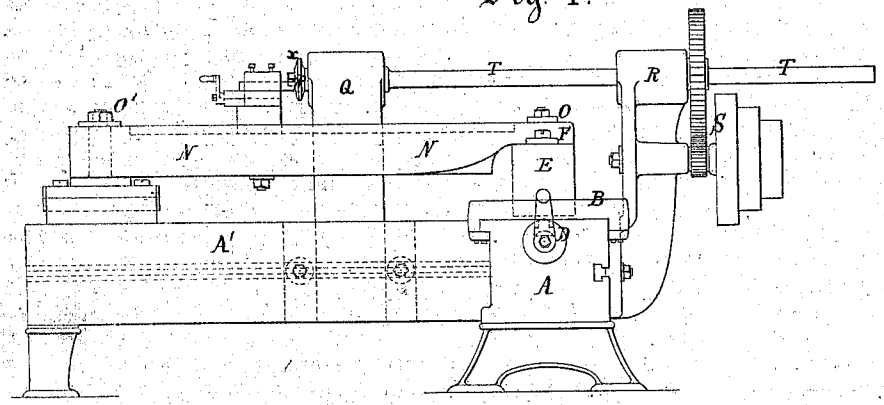
—Fig. 2—



—Fig. 3—



—Fig. 4.—



Wm. E. Morgan.
Wm. S. Lynn.
} Witnesses

Signed
Wm. Sellers

UNITED STATES PATENT OFFICE.

WILLIAM SELLERS, OF PHILADELPHIA, PENNSYLVANIA.

IMPROVEMENT IN MACHINES FOR FORMING CUTTERS FOR CUTTING THE TEETH OF WHEELS.

Specification forming part of Letters Patent No. **136,101**, dated February 18, 1873.

To all whom it may concern:

Be it known that I, WILLIAM SELLERS, of the city and county of Philadelphia, in the State of Pennsylvania, have invented certain new and useful Improvements in the Art of Automatically Forming the Teeth of Wheel-Work, or of forming cutters for such teeth, of which improvements the following is a specification:

It is the object of my invention to form, by means of automatic mechanism, a cutter that shall be the counterpart of the spaces between the teeth to be cut; or, by the same mechanism, to so guide a simple planing and shaping tool as, when the mechanism is once adjusted, it will produce the desired work with a degree of accuracy not attainable by hand, and not heretofore attained by mechanism; the range of these capabilities in the improved mechanism by which my invention is carried out extending from the largest to the smallest diameters of wheels, and being equally available in the coarsest or the finest metals used for such work. Beyond this my improved mechanism aforesaid will not only produce the form of a tooth, or of the spaces between the teeth, (according to the shape or kind of the cutting-tools employed,) in the maximum size, with mathematically-exact uniformity, but will with the same accuracy, by simple adjustments, reproduce or form teeth or spaces of lesser sizes in exact circumferential or diametrical proportion to the given maximum, the given form or the given contour in the maximum, in the minimum and in the intermediate sizes, being produced by the cutting-tools without the use of templets or patterns; and, moreover, a system of shapes or contour for the teeth or the spaces being adopted, (say, for example, teeth formed with two arcs,) the desired work may be produced by my mechanism, as above set forth, in symmetrical extension, so that, starting with a minimum number of teeth of a given pitch for the smallest of a series of wheels, each larger wheel of the series, up to a rack of the given pitch, will interchangeably mesh or gear properly with all the others. Such a system of gear-wheels, and the method of determining the proper radiuses and the positions of radial centers for tops and flanks of teeth, will be found fully described in the well-known Treatise on the Teeth of Wheels, by R. Willis, M. A., of the University of Cambridge, England. The subject-matter claimed by me will be specifically designated hereinafter.

The accompanying drawing, which forms part of this specification, represents my improvements as embodied in a machine for forming cutters, the original outline of which is first adjusted and described at the point F′, and thence imparted in symmetrical reduction to the movement of the cutting-tool.

Figure 1 represents a plan or top view; Fig. 2, a front elevation; Fig. 3, an elevation of the center and left of Figs. 1 and 2; and Fig. 4, an elevation of the center and right of Figs. 1 and 2.

The bed-plate A, shown in each of the figures, supports two sliding saddles, B, Figs. 1, 2, 4, and C, Figs. 1, 2, 3. The saddle B is moved to and fro on the bed-plate by means of a winch-screw, D. The saddle C is moved with the saddle B to and fro on the bed-plate, as hereinafter described, and when in position is clamped fast by means of set-screws. The saddle C has an extension, K, Figs. 1 and 3, projecting at an angle, to be determined as hereinafter explained, to which projection K a radius-bar, I, is attached by a bolt, *a*, and vibrates about an adjustable center, *i*, its movement upon this center being limited in one direction by a stop, *m*, Fig. 1. An adjustable piece, H, Figs. 1, 2, 3, is attached to one end of the radius-bar I, and jointed to a short adjustable radius-bar, G, Figs. 1, 2, on which there is a pin, F′, Figs. 1, 2. A slotted radius-bar, E, Figs. 1, 2, 4, extends across the bed-plate from saddle B to saddle C, and has one of its ends centered on the pin F, while its other end is centered on the pin F′ on the adjustable radius-bar G, Figs. 1 and 2. A broad-headed pin, *c*, on the saddle C passes through an elongated hole in the radius-bar E, thus holding it down to its work while allowing it to play freely horizontally. A rod, L, Figs. 1, 2, and 3, in the radius-bar I, is surrounded with a spiral spring, which tends to press the end of this radius-bar away from the radius-bar E; and to limit this movement of the bar I the end of the rod L is provided with a stop, *y*, Figs. 1, 2, 3. The angle at which the extension K projects from the saddle C is to be regulated with reference to the minimum number of teeth in the series to be cut, as de-

scribed by Professor Willis in the construction of his odontograph or instrument for drawing the shape of the teeth for gear-wheels. (See his treatise already referred to.) I contemplate such a connection between the saddle C and the extension-piece K as will admit of any requisite adjustment of the angle of its projection, though I have not so shown it in the drawing, deeming it unnecessary to describe so obvious a device as will be sufficient for such variations in the position of the projection-piece K. This arm K should be graduated for the inside radiuses, suited to wheels of various numbers of teeth, from the smallest number admissible to a rack, say, from twelve teeth up to the rack —as, for example, rack 300, 150, 100, 75, 60, 50, 43, 38, 34, 30, 27, 25, 23, 21, 20, 19, 18, 17, 16, 15, 14, 13, 12—thus giving the proper adjustment to form that part of the cutter which shapes the tooth inside of the pitch-line. On the other hand, the adjustable radius-bar G and the adjustable piece H are respectively graduated for the proper adjustments to form that part of the cutter which shapes the tooth outside of the pitch-line. Upon a suitable projection, A′, of the bed-plate A I arrange a slotted radius-bar, N, one end of which has a pin adjustment, O, in the slotted radius-bar E, while the other end has a pin adjustment, O′, which permits it to vibrate about the pin O and slide freely in the plate A′. If the mechanism be so adjusted that the point O shall be midway between the points F and F′, then the pin O will have half the lateral movement caused by the curvilinear movement of the pin F′, while it will have all the longitudinal movement of the pin F; and if the point of the cutting-tool P be so adjusted as to be midway between O and O′ it will obviously have all the curvilinear movement of the pin O, while it will have half the longitudinal movement of the pin O; and by these concurrent conditions the movements of the point of the cutting-tool P will be, in all directions, reduced to just half the movements of the point F′. For example, in the positions prescribed, if the radius-bars G and I be adjusted to the proper length to describe a tooth of two inches pitch, the point of the cutting-tool P will describe a tooth of one inch pitch. A head, Q, adjustable back and forth on the bed A′, supports that end of the shaft T which carries the blank *x*, which is to be formed into a cutter. This shaft is further supported by a fixed stand, R, which carries the gear-wheel S with the pinion and pulleys, through which the gear is driven. The shaft T, which is revolved by means of the gear-wheel S, slides endwise through the gear-wheel to accommodate the adjustments of the head Q. To adjust the machine pins are inserted in dowel-holes *u* and *v* in the bars I and N corresponding with holes in the saddle C and plate A′, respectively, the radius-bar I being thus fixed in a position coinciding with a pitch-line which is common to all wheels, and the radius-bar N being fixed in a position perpendicular to the radius-bar E. The curves described by the point F′ will be determined by the positions of the centers *i* and *g* in the radius-bars I and G, and the relation of these curves to each other will be determined by the adjustment of the position of the adjustable piece H on the bar I. All of these positions must be fixed by an adjustment of the parts correspondently with the pitch and diameter of the wheel to be cut.

To adjust the pin O the saddle C must be loosened so as to slide freely on the plate A, and the pin O must be loose in the bar E. The saddles B and C and the bar E must then be moved so as to bring the pin O into the proper position correspondingly with the adjustments previously made, and in this position the pin O and the saddle C must be secured. The point of the cutting-tool P must then be brought to and fixed at a point in the bar N at which its position relative to the points O and O′ will correspond with the position of the point O relative to the points F and F′, and the sliding head Q with the blank *x* must then be brought up to and secured in a position at which the blank can be operated upon by the cutting-tool. All of the parts being thus duly adjusted, the dowel-pins are removed from the holes *u* and *v*, the blank is set in motion, and the saddle B moved to and fro by means of the winch D so as to bring the blank under the action of the cutting-tool.

When it is desired simply to produce and transfer the outline of the tooth without reduction I contemplate placing the point F′ in a slide mounted upon a secondary slide, the movements of the two slides being at right angles to each other, and placing the cutting-tool upon the slide to which the center F′ is attached, so that the outline of the tooth described by the point F′ will be transferred directly to the cutting-tool without being reduced, as is the case when the point F′ is placed at the end of a radius-bar, as herein described. This modification, however, involving nothing more than the adaptation to the substance of my invention of devices which I do not claim, but which are well known and understood by those skilled in the art, and such adaptations being obvious, I need not describe them in detail.

The essential features of this mechanism are the adjustable radius-bars through which the outline of a tooth is described at the point F′, and the transfer of this outline thus described, either immediately and in its original proportions, or intermediately and in symmetrical reduction, as may be desired, from the point F′ to the point of the cutting-tool acting either on a cutter or on a tooth of a wheel, the essence of my invention being contained rather in the attainment of these broadly new results than in the specific devices by which I have wrought them out; but these specific devices are also new, and constitute a part of the subject-matter herein claimed.

Having thus described the nature and objects of my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. As an improvement in the art of forming teeth for wheel-work, or of forming cutters which are the counterpart of the spaces between the teeth to be cut, describing the outline or contour of the tooth to be cut, and imparting to the cutting-tool a movement conformable to such outline or contour by adjustable automatic mechanism, substantially such as hereinbefore set forth, and without requiring the use of templets or patterns.

2. As an improvement in the aforesaid art, describing the outline or contour by adjustable automatic mechanism, substantially such as herein set forth, and imparting to the cutting-tool a movement describing the same outline or contour in symmetrically-reduced proportions, substantially as set forth.

3. The combination, with the adjustable radius-bars G and I, of their respective stops *m* and *y*, for the purposes described.

4. The combination, with the adjustable radius-bars G and I, of the adjustable piece H, for the purposes set forth.

5. The combination, with the saddle C or its equivalent, of the graduated extension K or its equivalent, for the purposes described.

6. The combination of the radius-bar E and the adjustable sliding saddles B and C, for the purposes described.

7. The combination, with the adjustable radius-bars E and G, of the center-pin F′, for the purposes described.

8. The combination of the extension-piece K, the radius-bars I and G, the stops *m* and *y*, and the adjustable piece H, for the purposes set forth.

WM. SELLERS.

Witnesses:
WM. E. MORGAN,
WM. S. LYNN.