N. Millington,
Graduating Rules.

No. 74,239. Patented Feb. 11. 1868.

Fig. 3.

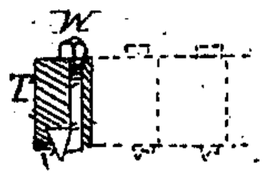


Fig. 1.

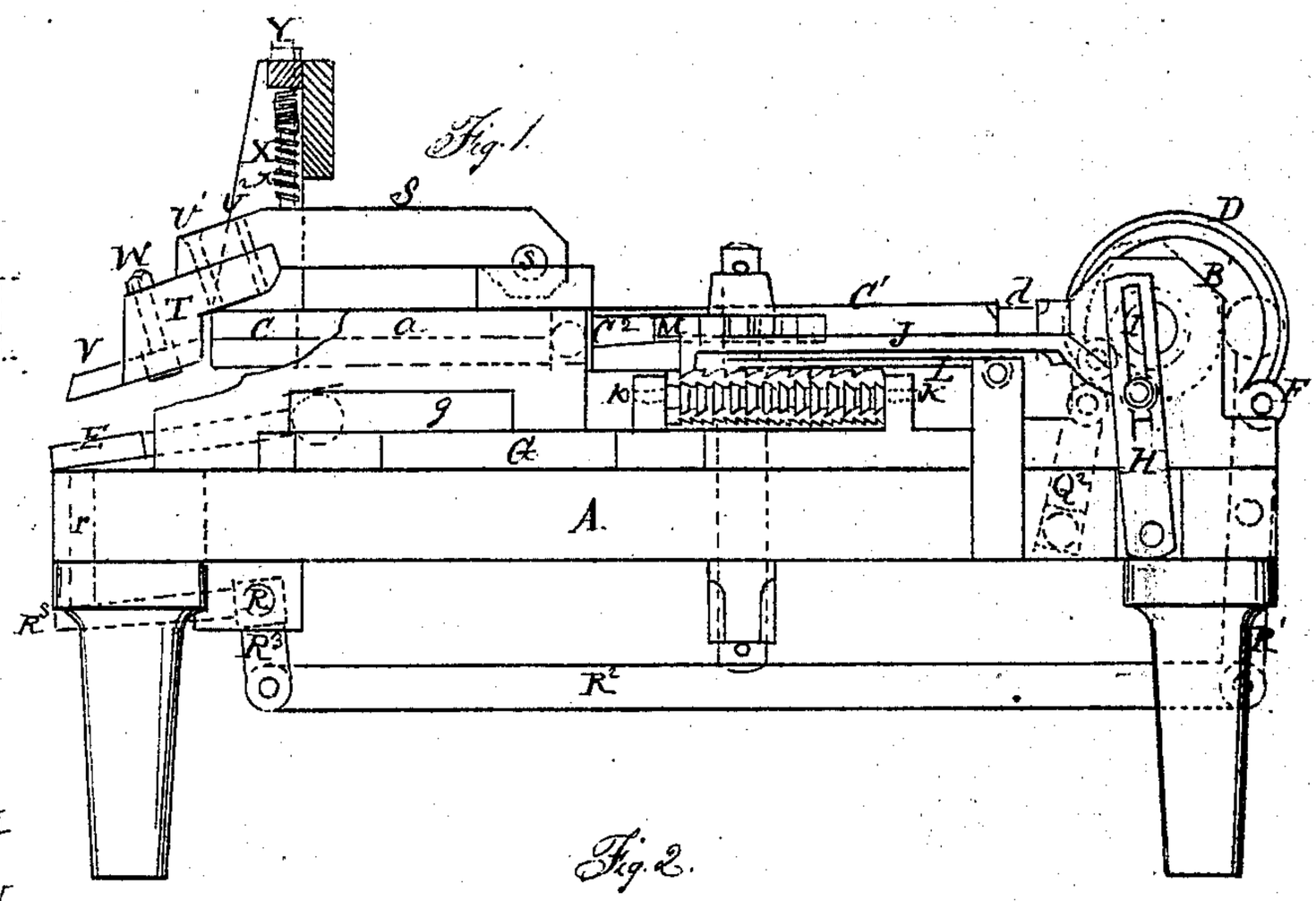


Fig. 4.

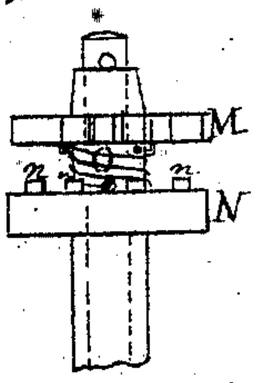
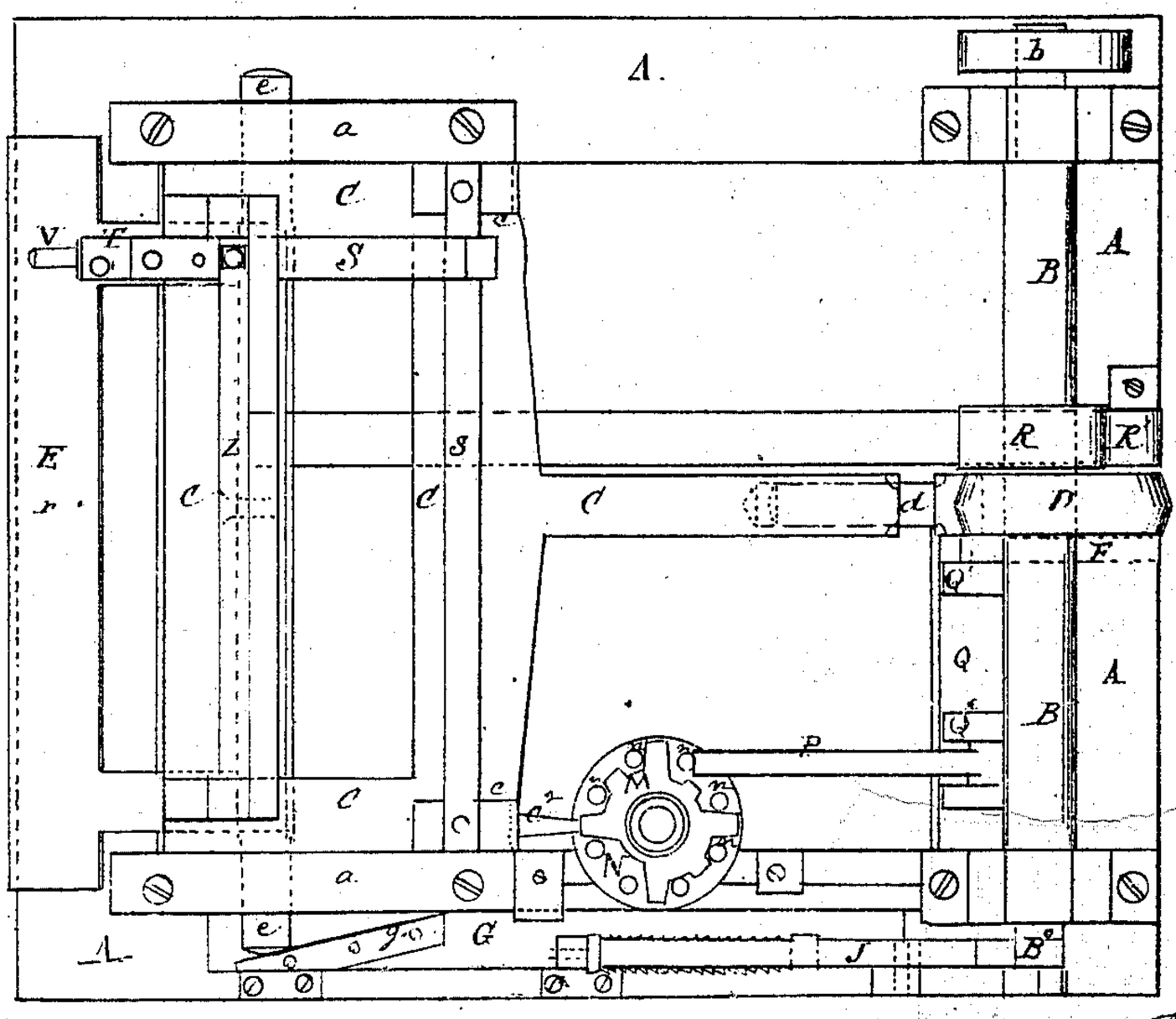


Fig. 2.



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NORMAN MILLINGTON, OF SHAFTSBURY, VERMONT.

Letters Patent No. 74,239, *dated February* 11, 1868.

IMPROVEMENT IN MACHINES FOR GRADUATING RULES.

The Schedule referred to in these Letters Patent and making part of the same.

TO ALL WHOM IT MAY CONCERN:

Be it known that I, NORMAN MILLINGTON, of Shaftsbury, in the county of Bennington, in the State of Vermont, have invented certain new and useful Improvements in Machines for Graduating Rules and other measures; and I do hereby declare that the following is a full and exact description thereof

My invention is based on the machine patented by myself and D. J. George, dated August 8, 1854, and embraces important improvements in several portions of the mechanism. My improved machine is capable of being changed to graduate different rules with greater facility, and it performs the work with greater accuracy, and the lines are produced with more uniformity.

I will first describe what I consider the best means of carrying out my invention, and will aftewards designate the points which I believe to be new therein. The accompanying drawings form a part of this specification.

Figure 1 is a side elevation, and

Figure 2 is a plan view of the machine.

Figure 3 is a cross-section through a graver and tool-holder, of which it is to be understood there is a series, side by side, as indicated in red outlines, and

Figure 4 is a side elevation of some of the details, represented as broken off and detached from the other parts.

Similar letters of reference indicate like parts in all the figures where they occur.

Tints are employed merely to aid in distinguishing parts. The drawings represent the novel parts, with so much of the other parts as is necessary to indicate their relations thereto.

A is the fixed framing, and B is the shaft, by the continuous rotation of which all the mechanism is operated. The shaft may be driven by a belt, not represented, operating on the pulley indicated by *b*. C is a carriage, sliding in ways, *a*, and receiving a forward motion at each revolution of the shaft B, through the medium of the eccentric, B^1, the eccentric-strap D, the pin *d*, and the hinged arm C^1. This arm is mounted on the carriage C by means of the bearings *c*, and it allows for the up-and-down motion due to the revolution of the eccentric, B^1. The pin *d* is adapted to slide freely in the hinged arm C^1, so that the carriage C and its connections need not necessarily move backward to the extent required by the rotation of the eccentric, B^1. A spring, not represented, draws the carriage C and its connections backward with a nearly constant force. The revolution of the eccentric, B^1, compels the carriage to move forward to a certain point at each revolution. It may move back to the full extent of the motion of the eccentric B^1, or to a less extent, according as it is controlled by other portions of the mechanism. The carriage C carries a series of gravers, which are adapted to cut a large number of lines on the rule at each forward movement.

It will be understood that my improved machine, like the machine described in the previous patent referred to, cuts a number of marks or graduations simultaneously on the rule, but all of the same kind; that is to say, when the half-inch marks are cut, all the gravers cut the lines adapted to the half-inch graduations. When the next graduation is marked, supposing it to be the five-eighths or nine-sixteenths mark, the marks are again all of the same kind, but should all be shorter. The means whereby I effect the variation in the length of the several kinds of marks allows the machine to be very rapidly changed and adapted for graduating different kinds of rules. Thus, I can readily change from graduating eighths to sixteenths, or to tenths or twelfths, or any other desired fraction. E is a support, on which the rule is firmly held by means of the ordinary spring-clamps, not represented. The rule, square, or other article thus held, is raised or depressed to a slight extent at each movement, by the working of the support E on the shaft *e*. G is a slide, carrying an inclined piece, *g*, which is adapted to act against the end of the shaft *e*, and to thrust it endwise, thus carrying the rule forward as the work progresses according as the slide G *g* is thrust forward. This slide is moved forward after each cut by means of the crank B^2 on the end of the shaft B, which operates the lever H, and thus, by means of the pin I and pawl J, acts on the ratchet K, which is mounted on the slide G *g*, before described. L is a detent attached to the fixed framing A by means of the pin *l*. At each revolution of the shaft B, the pawl J takes hold of a new notch in the ratchet K, and moves forward the said ratchet and the connected slide G *g*, thus moving the rule. The detent L prevents the return of the slide. The piece K, on which the ratchet is formed, is capable of being revolved on the screws *k k*, and of presenting several differently-formed ratchets, according

as either face is turned upward. Thus, the face now represented as uppermost will produce eight subdivisions; but if the piece K is turned one quarter of a revolution, it will present a differently-cut ratchet, and will produce twelve subdivisions in the inch or other unit on the rule. I have represented the piece K as having four ratchets thus produced. There may be a greater or less number. In order to change the ratchet it is only necessary to slacken one or both of the screws *k k*, and after turning the piece K to the required extent, again to tighten the screws to hold it in that position. Instead of screws, these may be conically-pointed pins or cylindrical journals, forming a part of the piece K, and a spring-catch or other suitable mechanism may be employed to hold the piece K in the required position. M is a gauge-wheel, which is partially turned at each revolution of the shaft B, and is adapted to prevent the return of the carriage C and its connections to the full extent, when the short lines are to be cut. This wheel is formed with a series of bearings, represented in the figure as projections. These projections are evenly spaced, and correspond in number with the number of graduations in the inch. These bearings may, in practice, be conveniently made in separate pieces, and they may be fitted as required by inserting the pieces in holes drilled or otherwise produced in the periphery of a plain wheel. They are presented in succession to check the back motion of the carriage C and its connections. C^2 is a rigid arm, projecting from the back side of the carriage C, and adapted to strike against these several projections or bearing-pieces, in succession, as the work proceeds. N is a controlling or count-wheel, mounted below the gauge-wheel M, and provided with pins or teeth on its upper surface, as indicated by *n*. There is a connection between the count-wheel N and the gauge-wheel M, by means of a coiled spring, O, (see fig. 4.) This spring has sufficient rigidity to hold the gauge-wheel with certainty in the position corresponding to the count-wheel N, in the absence of any considerable disturbing force. In changing the position of the gauge-wheel the count-wheel N is liable to commence its rotation before the arm C^2 on the carriage C leaves the gauge-wheel M. In such case the spring O allows the gauge-wheel to remain stationary until the pressure from the carriage is removed. It then revolves by the action of the spring O, compensating for the lost motion, and thenceforward turns with the count-wheel N until its proper position is attained, where it is allowed to rest until the next movement. The movement of the count-wheel, and consequently of the gauge-wheel M, is effected by means of the pawl P, hung on the arm Q^2 of the rock-shaft Q. This shaft is operated by means of the arm Q^1, which receives motion from the eccentric-strap D, through the connecting-rod or link F. At each rotation of the shaft B, and consequently of the eccentric, B^1, the shaft Q is rocked, and the pawl P turns the wheel N, and consequently the gauge-wheel M, a certain fraction of a revolution. This fraction should correspond with the number of graduations required in the inch or other unit in the rule, and, consequently, should correspond with the number of teeth in that face of the revolving ratchet K which is then uppermost and in use. The teeth *n* in the count-wheel N may be changed at pleasure by inserting a different number in the different series of holes in the wheel.

It will now be seen how the changing of the position of the revolving ratchet K, and the corresponding changes in the number and length of the projections in the gauge-wheel M and its connections, govern the number of graduations on the rule, and how these important elements in the machine can be very readily changed as required. I may further remark that, by changing the inclination of the plane *g* on the slide G, the magnitude of the unit of measurement, or the entire range of motion of the support E, may be varied within wide limits, while the motion of the slide G and all the other portions of the mechanism remains without change. Thus, for example, to change my machine from graduating the ordinary inch-rule divided into sixteenths, so as to graduate the French rule with centimetres divided into tenths, I have, after changing the spaces between the several gravers, simply to give a correspondingly increased inclination to the piece *g*, so that the rule will be moved only a centimetre instead of an inch in performing a complete revolution of the gauge-wheel, and then turn the ratchet K, and change the gauge-wheel and the count-wheel so as to graduate tenths instead of sixteenths.

I will now explain the portion of the mechanism by which the rule and the gravers are held and operated.

The forward edge of the support E is lifted at the proper intervals by means of a stout rock-shaft, R^4, and arms R^5 R^3 operated by a connection, R^2, through the lever R^1, which latter is operated by the cam R on the shaft B. It is necessary that all these parts, as also the pin *r*, which communicates the motion of the arm R^5 to the support E, be very rigid, so that they shall not spring and vary the extent to which the rule is lifted. In the machine described in our former patent, a long lever extended from the shaft to the rule, and it was objectionable on account of the difficulty of giving a sufficient rigidity. The shortness of the arms R^5 R^3 on my rock-shaft R^4, allows the motion to be transmitted with very little elasticity, and the strain on the connection R^2, being longitudinal instead of transverse, there is little difficulty in getting a very rigid and reliable motion from the distant shaft. S is one of a series of levers adapted to turn independently to a moderate extent on the cylindrical bar *s*, which is rigidly fixed on the carriage C. T are tool-holders, bolted to the forward ends of the levers S by means of the bolts U^1 U^2. The tool-holders T are adjustable relatively to the levers S by turning to a slight extent on the bolt U as a pivot. They are held in the desired position by tightening the bolt U^2. It will not usually be necessary to slot the parts in order to allow for all the adjustment which is required in practice, it being only necessary to adjust sufficiently to compensate for any irregularity in the forging or in the grinding of the gravers. V are the gravers. They are made of triangular section, as represented, and each is very firmly held in its corresponding tool-holder, T, by means of a screw-bolt, W, having a wedge-shaped head, as indicated in fig. 3. Slackening a nut, *w*, and lowering the corresponding bolt W, liberates the graver, and the reverse proceeding tightens it. Each lever, S, and its connections, are held down to the work independently by means of a coiled spring, X. Y is a hollow screw attached to the balance-lever Z, and adapted to adjust the tension of each of the springs X independently of its neighbors. There is a pin, *x*, coming up from each lever S, in the interior of its spiral spring X, to support and steady the same. This pin is received in the interior of the hollow screw Y. The spring X may, by preference, act on a shoulder or enlargement near

lower end of the pin *x*, and the pin may rest in a concave socket in the top of the lever S, instead of being fastened therein. The function of the balance-lever Z is the same as in other machines of this character, to equalize the pressure and adapt the machine to engrave or graduate tapered squares as well as those of even thickness. The main portion of the pieces S and T may be of less width than an inch, but the forward ends should be exactly an inch wide in graduating ordinary rules. The back ends of these levers, where they take hold on the cylindrical part *s*, are also to be of the same thickness, so that the whole series will mutually support each other. The holding of each by the cylindrical rod *s* at the back end, and allowing each to yield independently by the means which I have invented, avoids most of the difficulties due to the lost motion and the uncertainty of the action in the previous machines. My wedge-headed bolt W, operating as represented, confines the gravers very firmly, and allows them to be released and exchanged, and also draws them into a uniform position, while the adjustable connection of the tool-holder T to the lever S allows for as much lateral adjustment as is ever required with this mechanism.

Having now fully described my invention, what I claim as new in machines for graduating substantially as specified, and desire to secure by Letters Patent, is as follows:

1. I claim the changeable ratchet K, arranged and operating substantially as and for the purpose herein set forth.

2. I claim the gauge-wheel M, arranged and operating relatively to the carriage C and its connections, substantially as and for the purpose herein specified.

3. I claim the count-wheel N, having changeable pins, combined and arranged to operate relatively to the gauge-wheel M, the graver-carriage C, and to the operating-pawl P, all substantially as and for the purpose herein specified.

4. I claim the spring O, arranged and operating relatively to the count-wheel N, the gauge-wheel M, and to the carriage C, or equivalent part, and the motion of which is controlled by the gauge-wheel, all substantially as and for the purpose herein specified.

5. I claim the pin *d* on the eccentric-strap D, sliding in the hinged arm C^1 of the graver-carriage C, in combination with the gauging means M, or its equivalent, adapted to allow the carriage to retreat different distances, all substantially as herein set forth.

6. I claim the levers S, mounted and arranged as represented, adapted to support each other by direct contact both at the front and rear, and allowing the tool-holders T to be adjusted laterally thereon, substantially as herein specified.

7. I claim the spring X, pin *x*, and hollow adjusting-screw Y, or its equivalent, arranged and operating relatively to the lever S, and its connections turning on the cylindrical rod *s*, substantially in the manner and for the purpose herein set forth.

8. I claim lifting and holding the rule in the path of the gravers by means of the short-armed rock-shaft R^3 R^4 R^5, and its connections, constructed, arranged, and operating as and for the purpose herein set forth.

9. I claim the wedge-headed bolt W, operating as represented, relatively to the triangular graver V, and with the tool-holder T, and its connections, mounted and arranged in the machine, substantially as and for the purpose herein specified.

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