AN IMPROVED METHOD FOR REGULATING THE THICKNESS OF MICROTOME SECTIONS.

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In some of the Minot forms of microtomes several springs and other parts are arranged in such a manner as to cause the specimen in the machine to be set out the desired distance for sectioning. The above mentioned arrangement is usually very complicated, and apparently unnecessarily so, in many machines of this type. This adds greatly to the expense, liability to get out of order, and makes the apparatus unduly large and heavy. A microtome, as most other types of machines, should not be made heavy simply to remain in one position, but should only be heavy or substantial enough to prevent springing or getting out of allignment when in use. Of course this is a point that merits due consideration in a microtome when such very thin sections are to be cut, but still the present weight of most such machines of the microtome type can be greatly reduced without detriment. A simple table clamp is all that is necessary to obviate most of the difficulty of shifting of the position of the machine. The chief weight is, of course, in the framework of the machine especially in the wheel base, slide pillar and uprights of the microtome I used. This is true of most machines of this type. The weight of these parts could be reduced to one-third or even one-half of what it is without sacrificing any necessary rigidity. The weight of the wheel and frame running on the slide pillar could be much reduced especially by the proper adjustment of the balancing of the weight of the two since they are connected to the same shaft. This same balancing of weight is seen in the adjustment of the pitman rod on the crank of engines and other much more delicate machinery. The difference in weights and balancing here referred to in the case of microtomes is so considerable as often to cause considerable inconvenience and unsteadiness in operating the machine. Part of this adjustment, as the machine I used as now arranged, could be partly arranged for by a different length in the threading of the main shaft so as to throw the heavy parts of the machine, concerned in the motion, more nearly in balance when the microtome is in operation. A machine which is arranged for cutting sections in the ways here described, should be so arranged and adjusted as to turn or start with equal ease in any position. Its construction should also be such that it could be stopped instantly and at any point without having to turn a special device at the top of the slide pillar. That a microtome is not a machine that is expected to be moved about much, has no bearing on the question for whether it is moved much or little an unnecessary amount of material and weight is often present in many of its parts which could from the standpoint of cost and convenience often be eliminated. The question of setting the block for cutting thin sections is arranged in a very accurate and better way on the Jung Sliding Microtome by means of an incline plane and a spiral thread of definite value for each adjustment. Even in this machine the weight far exceeds what is necessary. The arrangements of springs on the microtome used by me were, as is generally the case sooner or later, a source of annoyance and often

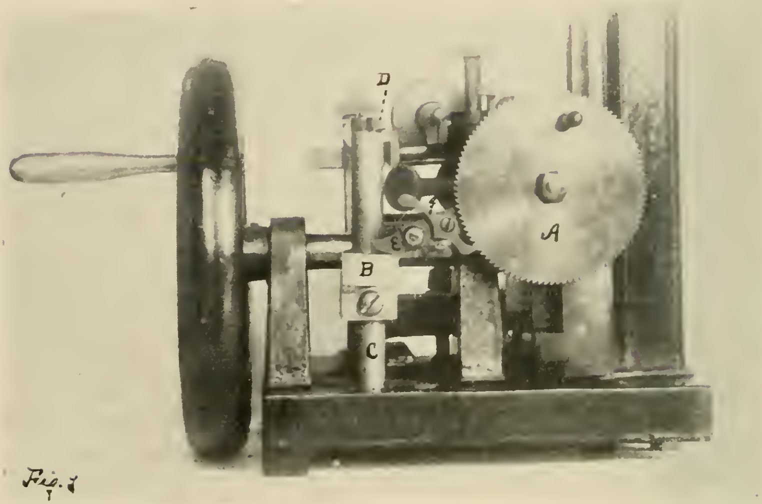

Fig. 1.

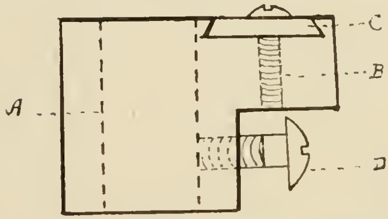

Fig. 2. Median longitudinal sectional view of the brass block. Natural size.

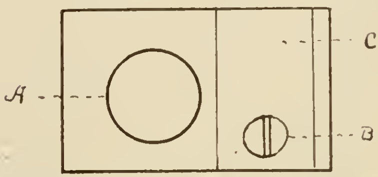

Fig. 3. Top view of brass block, natural size.

caused inaccuracies in the thickness of the sections that were cut. This latter was caused by weakness in the springs, one of which controlled the ratchet of the cogwheel, and frequently on account of this the cogwheel was not turned the specified distance. Sometimes the sections were cut too thin or the block was not set out for cutting at all. At other times a notch in the cogwheel was skipped causing the section to be cut too thick.

The above mentioned imperfections of the system of springs for adjusting the thickness of the sections was overcome by the use of a simple contrivance which at the same time insured accuracy and uniformity. The microtome I used is provided with a brass cogwheel 7.5 cm. in diameter, a circumference of 235.6200 mm. and having on its periphery 100 cogs (A Fig. 1). This cogwheel is attached to a threaded shaft which moves the paraffin block out carrying the specimen to the sectioning knife. The threaded shaft's diameter is 5 mm. and its circumference 15.7080 mm. The circumference of the wheel is therefore 15 times that of the shaft. Since there are 100 notches in the circumference of the wheel the shaft turns .15 mm. per notch or 150 u. The shaft is threaded with 20 threads to 1 cm. and therefore one thread or revolution or the 100 notches equals .5 mm. or 500 u that the section is moved out. Therefore when the large cogwheel is turned one notch the paraffin block carrying the specimen is moved out so that a section 5 u. thick will be cut. The above mentioned points make it clear that a faulty spring system for a machine cutting such thin sections would be serious for even rather thick sections and especially so for very thin ones.

My improvement is the use of a brass block (B Fig. 1) attached to post C. This post was originally in the machine and carries at the top a metal arm D so arranged as to arrest the movement upward of a lever E attached to the brass cogwheel A above referred to. The metal arm E projects 3.5 cm. beyond the circumference of the brass cogwheel A and carries a ratchet G. which turns A as the specimen is raised above the sectioning knife. The brass block B attached to C, for regulating the thickness of the microtome sections, is made of solid brass. It is 35 mm. long and 21 mm. wide on the upper side, Fig. 2. In Fig. 2 A is the path of the post C through B; B is the insert plate, B the set screw and D the set screw for the brass block B. The block B is 25 mm. high, 23 mm. long and 21 mm. wide at the shoulder where the set screw D. is placed Fig. 2. The part projecting above the set screw D which tightens the block B on the post C is 11 mm. thick, Fig. 2. This part which is just above the set screw I have cut out so as to allow an insert plate C. Figs. 2 & 3, to be used. This I made from a steel plate which covers the bobbins of a sewing machine and cut the brass block as illustrated so that its sides had the same angles as the steel plate and allowed the latter to slide true in the channel cut Fig. 2 c. This steel insert plate is in cross section 14.5 mm. at the base, 13 mm. at the top and 21 mm. long, C. Fig. 2 & 3. The illustrations C Fig. 2 & 3 represent the exact size. The block has a hole 12.5 mm. in diameter bored vertically through it at one end of the insert plate, A, Fig. 2 & 3. so that the post C, Fig. 1, can be passed through it and on which it can be moved up or down to the desired position. In case of wear on the brass lever E a new brass tip can be used. In fact it can be grooved and short new insert plates used there as at C. Fig. 2 & 3 on the lower side of E at the striking point. I made use here of the principle that hard and soft metal surfaces where wear is present should be brought together so that any wear will take place on the soft metal which can be replaced. This principle is used generally in machinery. Since the metal arm E strikes the insert plate with a sort of shearing stroke in descending it has a tendency to push the insert out of place. This I have remedied by putting a set screw B, Figs. 2 & 3, through the insert plate C and into the brass block B, Fig. 2. This is not shown in the photograph but is shown in the drawings of the brass block, Fig. 2. Figure 2 is a drawing of the brass block above mentioned which I constructed for this purpose. It carries on its upper side, where the lever strikes, the insert plate above described. Many of the later types of microtomes of the kind here illustrated are even much more complicated. In addition to a complicated and cumbersome system of expensive adjustments these parts are often housed in by a metal enclosure. All this adds, as above stated, unnecessarily to the weight and size of the machine and especially to the cost. The metal housing, just referred to, only partly protects the mechanism from dust or other injury. This would be as well or better affected by a cardboard cylinder or even by a properly made cloth hood such as is used to cover microscopes when not in use and which are left temporarily on a table in the laboratory. A light glass box can easily be made of plates of single strength glass held together at the angles and corners by strong adhesive tape. One of these I have made and used for years with entire satisfaction and whose cost of making was trivial.

I marked a graduated scale on the post C to control the number of notches on the wheel A and consequently the arc through which it would be turned and therefore the thickness of the sections that would be cut. For example when the top of the brass block B was placed 52 mm. from the base of the post C the wheel A was turned one notch and a section 5 u was cut. Raising the block B 3.5 mm. more allows a section 2 notches or 10 u thick to be cut. When the block B is raised 4.5 mm. above the second mark on C, just mentioned, a section 3 notches or 15 u is cut. Raising the block B 3 mm. above the third mark just mentioned a section 4 notches or 20 u is cut and so on. As the lever E goes up and down it moves not in a small curve, as might be expected, but in a straight line. When, however, the lever E strikes the arm D on the brass block B, Fig. 1 the lever E is turned the amount desired. This really is equivalent, in principle, to a small arc being formed when the cogwheel O is turned as a result of the small divisions for adjustment on the post C. Each one of the small arcs is very small at the periphery of the cogwheel A, especially when the brass block B is placed 52 mm. from the base of the post C which allows, as stated, a section only 5 u thick to be cut. Due to wear and especially to lost motion, the calculated positions and distances from each other that the adjustment marks on the post C should be placed for cutting the sections of different thicknesses did not quite correspond with those positions found by experiment. The variation, however, was not great and if all lost motion could be eliminated the calculated and experimental data would of course exactly coincide. The marks and figures on the post C are conveniently made with an etching tool or by covering the surface of the post C, with paraffin or better with beeswax and then applying concentrated HNO_3.

Back of the cogwheel A, Fig. 1, were originally placed two lugs or projections cast in or built in with other parts of the microtome here shown, Fig. 1. These are so placed as to limit the sections, as they could originally be cut, to a total thickness of 50 u. This is a much greater thickness than the majority of microtome sections are ordinarily cut. Occasionally, however, it is desired to cut sections thicker than this and the arrangement just referred to above of thickness limitation of the sections is a decided inconvenience. This difficulty may be solved by removing the lugs or projections above mentioned. This would then allow a sweep of the arm E through a much greater arc and would allow sections of very much greater thickness to be cut. A corresponding long graduated arc can then be attached by a shouldered center to the post C which would control by means of a movable arm the movements of the metal arm E to any desired degree or extent and therefore still cut very thin or very thick sections.