GRINDING OPERATIONS

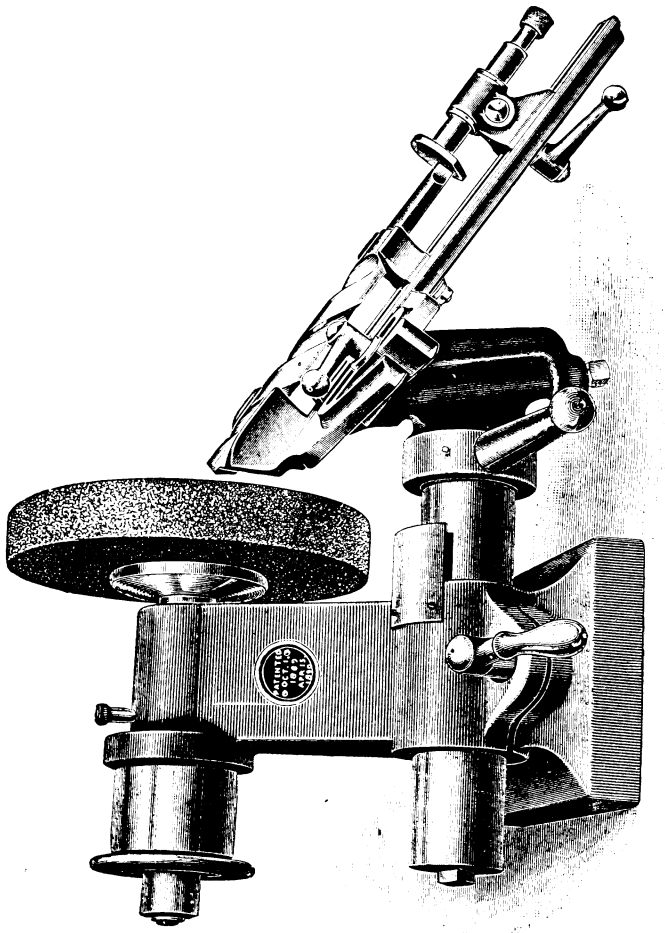

Fig. 237.

GRINDING OPERATIONS.

To grind is to wear down, smooth or sharpen by friction, as by friction of a wheel or revolving stone to give a smooth surface, edge or point to an object.

To abrade is the act of wearing or rubbing off or away by friction or attrition. *An abrasive* is a material used for grinding, such as emery, sand, powdered glass, etc. The

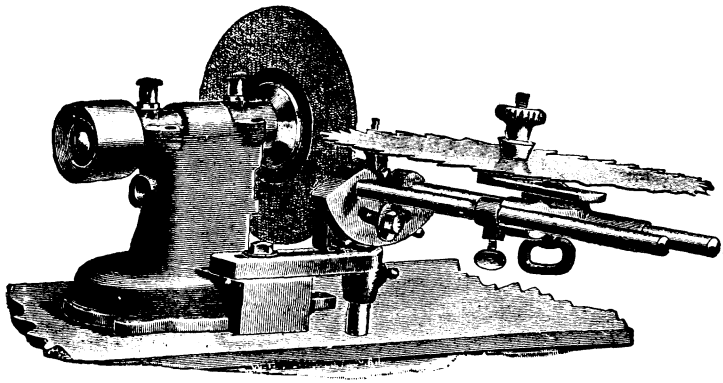

Fig. 238.

operation of grinding is an abrasive process, the material being ground away rather than cut; grinding makes possible the accurate finish of the hardest metals.

In modern machine-shop practice the grinding machine has become recognized as an indispensable tool, and no shop equipment is considered complete without it. The use of hardened spindles in lathes, milling machines, drilling machines, etc., also hardened crank pins and cross-head pins in steam engines, is made possible by its use; with it can be ground milling cutters of all shapes, taps, reamers,

GRINDING OPERATIONS.

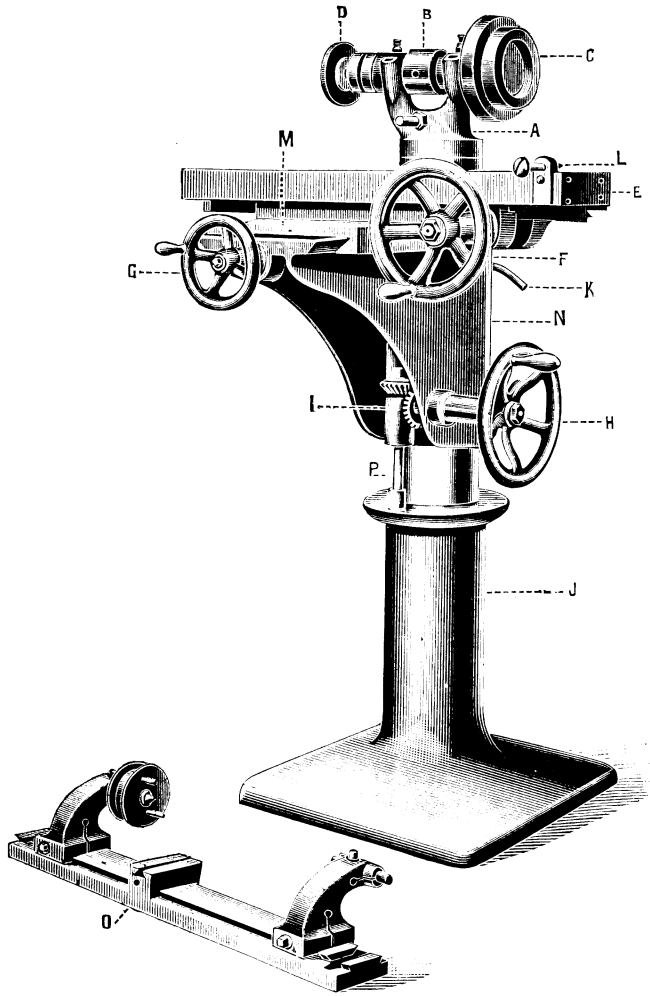

Fig. 239.

arbors, keys, gauges, holes in cutters or other articles, edges, sides and ends of flat, square, hexagon or octagon objects, leaving the ends square with the sides or edges, and also many other kinds of work.

Grinding machines are of various designs, and range from the simple rotating emery or corundum wheel to a perfectly automatic, self-acting universal and surface-grinding machine. One of the former is shown in fig. 236. On page 218, fig. 240, is shown a machine of the latter description.

Fig. 236 shows a simple Wet Tool Grinder; the emery wheel being mounted on a spindle, running in broad bearings, is driven by the pulley; the emery wheel is covered with a shield, to prevent the water splashing; it has no pump; the water trough is raised to the wheel by pressing on the footpedal shown in front of the machine.

Fig. 237 shows an emery grinder sharpening a twist drill; a rest is provided for the shank of the drill, also an adjustable end stop, for any length of drill.

Fig. 238 shows an emery grinder sharpening a circular saw; a self-centering device holds the saw in position; the attachment can be "tilted" to give any desired bevel to the saw.

Fig. 239 is a Grinder, on which a variety of work can be done; the arbor is arranged for two wheels, one on each end; *A* is the "head" of the machine, mounted upon the "standard" *J*; the head contains a spindle driven by the "pulley" *B*, and having emery wheel *D* on left-hand end,

and cup emery wheel *C* on right-hand end; *H* is the hand-wheel which operates the bevel gears *I*, and gives the vertical adjustment to the knee *N*, by the screw *P*; *G* is the hand-wheel fastened to the cross-feed screw, which moves the cross-carriage *M* forward or back; *K* is the binder-screw, which clamps the knee *N* when in the required position; *F* is the hand-wheel fixed on pinion, which operates the long slide *E*; *L* is the adjusting screw, which swivels the pair of centers, *O*, which can be fixed on long slide *E*, when grinding reamers, taps, etc.

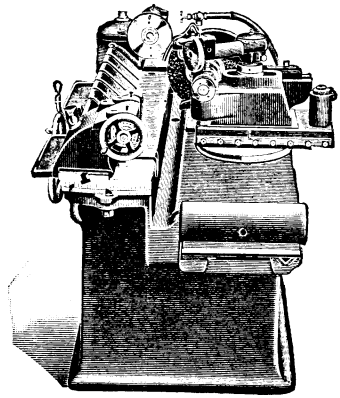

Fig. 240.

Fig. 240 exhibits a front view of a grinding machine, for straight and taper work, that revolves on two dead centers. To obtain the best results, a great variety of table work and wheel speeds are necessary; all speed changes are adaptation of the belt and cone, easily understood by operators.

Provision is made for the amount of power and water demanded by the rapid rate at which the machine is designed to work.

GRINDING OPERATIONS.

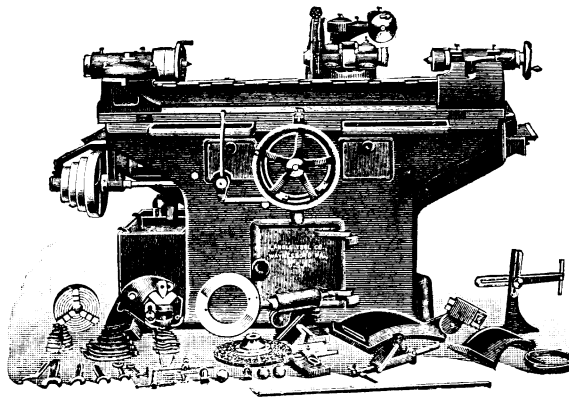

Fig. 241.

Fig. 241 is a front view and fig. 242 is a back view of the machine shown in fig. 240. From these views the arrangement of the machine can be easily understood.

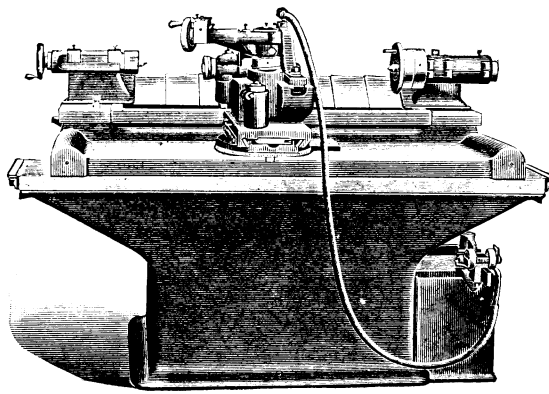

Fig. 242.

GRINDING OPERATIONS.

The following illustrations show several of the many kinds of accurate work, for which the universal grinding machines shown in fig. 178 are adapted.

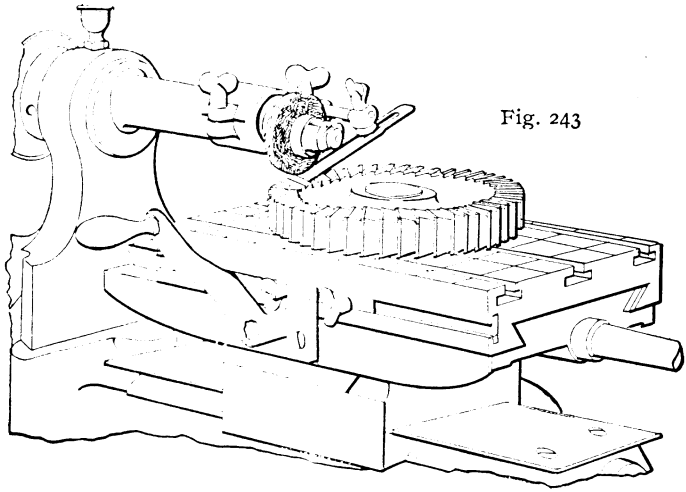

Fig. 243

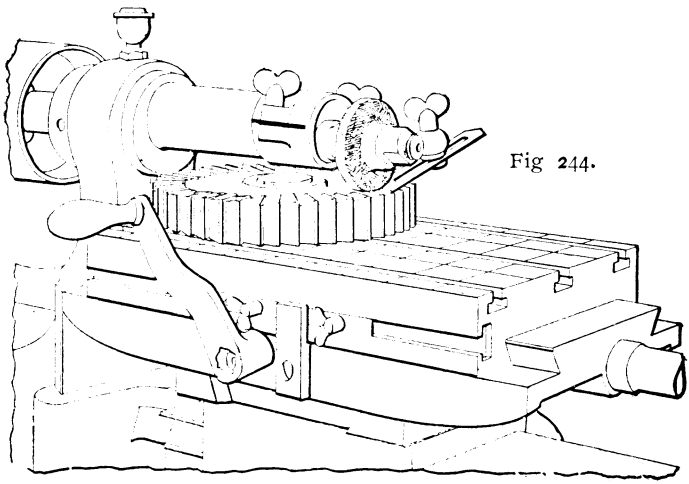

Fig 244.

Fig. 243 and fig. 244 exhibit the method of grinding the sides of a face, or straddle mill, by means of the

GRINDING OPERATIONS.

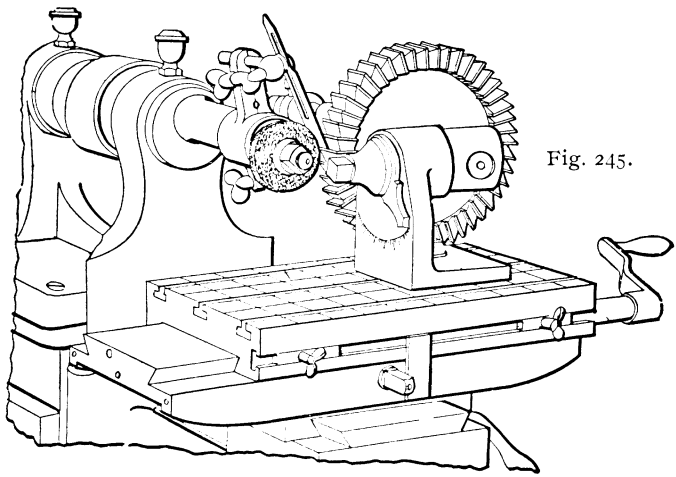

Fig. 245.

emery wheel. The straddle mill is placed upon the table of the grinding machine, and is revolved on a stud, so as to bring each tooth in turn under the action of the revolving emery wheel.

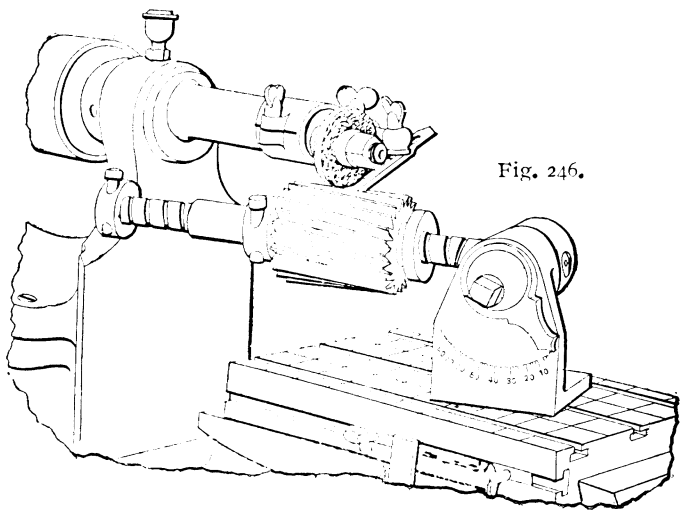

Fig. 246.

Fig. 245 shows the grinding of the same object, the emery wheel acting upon the face of the mill, which is carried on a stud in the universal cutter-head.

Fig. 246 illustrates the grinding of a spiral tooth cutter, carried on a sleeve, sliding on the arbor, between the head and the adjustable collar.

Fig. 247 shows the sharpening of a tap held in reamer centers, which are fitted in the universal cutter-head.

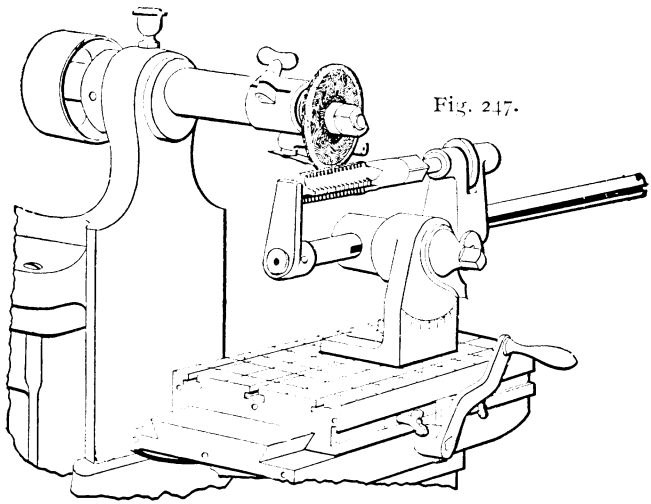

Fig. 247.

"POINTS" RELATING TO GRINDING OPERATIONS.

It is considered good engineering practice to push the work of a grinding machine to the utmost limit, get all that can be got out of it in work and get it out quick. This does not imply wasting the tool; it is intended to save the time of workmen. At the same time, where grinding is to

be done rapidly and well, a machine to do it must be heavy and powerful.

The durability and usefulness of all machines depend largely upon proper care, which if not given will in a short time cause them to become unreliable, even though the machines are well constructed. The grinding machine being a tool upon which great accuracy is required, becomes, therefore, most susceptible to bad results through such lack of care.

The machine should be kept clean and the bearings well lubricated, using the best oil only, to prevent gumming.

In order to produce correct work it is important that the spindle boxes be kept in proper adjustment, so that there may be no lost motion. This is true of the head-stock, foot-stock and emery wheel spindles and also the wheel spindle boxes, which, to do accurate work, should be adjusted closely, even though they warm up slightly.

The adjustment of the emery wheel slide is equally important; it should be close and yet not tight enough to move hard; the slide should be well oiled.

Wheels for internal grinding should be softer than for external, as the surface in contact is greater; therefore the wheel will not let go the dulled particles so readily. It should be very keen cutting and of coarser grade than for external grinding. As the surface speed of the wheel is not as great as that for external grinding, the work cannot therefore be done as rapidly, and more time must be given to remove the stock, and the work must be revolved slower.

Too great a variety of work should not be expected of one grade of wheel, and when the amount of grinding will

warrant it, several grades of wheels can be profitably employed, each carefully selected for its particular purpose.

All machines should be securely fastened to a solid floor or foundation where there is no vibration.

To grind tools without drawing the temper requires a soft grade of wheel, which would not be suitable for rough work; moreover, much depends upon the nature of the material to be ground as to whether a hard or soft, coarse or fine wheel should be used.

A wheel should be kept perfectly true and in balance to obtain the best results, both as regards rapidity and accuracy in grinding. For the sake of economy it is necessary that a dresser be kept constantly at hand to dress up the wheels a little and not allow them to become out of true.

It should be remembered, the contact between an emery wheel and the work is entirely different from that of the lathe or planer tool in operation. In the latter case some extra pressure is always required to counteract spring between work and tool; but in the former condition, some material is removed at the slightest contact.

The speed of work should be in proportion to the amount of stock removed at each revolution, as the wheel must always have sufficient time to do its work; if the

NOTE.—There can be no hard and fast rules for the speed of emery and polishing wheels, since there is so great a variety in the nature of the work to be done, but a peripheral speed of a mile—5,280 feet—a minute for ordinary emery wheels is commonly regarded as good practice. For water tool-grinders the speed is usually about two-thirds that of dry grinders, while on the other hand, polishing wheels are generally run at about one and one-half, and buff wheels at twice the speed of dry grinders. Emery wheels are classed as water grinders and dry grinders; the former run at about one-third less than the dry grinders, that is, about two-thirds of a mile per minute on the surface.

work is revolved too rapidly the wheel is liable to crowd, chatter and waste, and make an unsatisfactory job. There is no fixed rule as to speed, but by a little experience the operator will soon learn what is best.

These numbers represent the grades of emery, and the degree of smoothness of surface may be compared to that left by files as follows:

8	and	10	represent	the	cut	of a wood rasp.
16	"	20	"	"	"	" a coarse rough file.
24	"	30	"	"	"	" an ordinary rough file.
36	"	40	"	"	"	" a bastard file.
46	"	60	"	"	"	" a second-cut file.
70	"	80	"	"	"	" a smooth file.
90	"	100	"	"	"	" a superfine file.
120	F	and FF	"	"	"	" a dead-smooth file.

Nearly all emery wheel makers use a letter to designate the grade of hardness of wheels, grade M being the medium between the hardest and the softest. All letters before M are softer, as L, K, J, I, in the order given; while all letters after M are harder, as N, O, P, in their order.

Wheels are numbered from coarse to fine; that is, a wheel made of No. 60 emery is coarser than one made of No. 100. Within certain limits, and other things being equal, a coarse wheel is less liable to change the temperature of the work and less liable to glaze than a fine wheel. As a rule, the harder the stock the coarser the wheel required to produce a given finish. For example, coarser wheels are required to produce a given surface upon hardened steel than upon soft steel, while finer wheels are required to produce this surface upon brass or copper than upon either hardened or soft steel.

Wheels are graded from soft to hard, and the grade is denoted by the letters of the alphabet, A denoting the softest grade. A wheel is soft or hard chiefly on account of the amount and character of the material combined in its manufacture with emery or corundum. But

other characteristics being equal, a wheel that is composed of fine emery is more compact and harder than one made of coarser emery. For instance, a wheel of No. 100 emery, grade B, will be harder than one of No. 60 emery, same grade.

The softness of a wheel is generally its most important characteristic. A soft wheel is less apt to cause a change of temperature in the work, or to become glazed, than a harder one. It is best for grinding hardened steel, cast-iron, brass, copper and rubber, while a harder or more compact wheel is better for grinding soft steel and wrought iron. As a rule, other things being equal, the harder the stock the softer the wheel required to produce a given finish.

Generally speaking, a wheel should be softer as the surface in contact with the work is increased. For example, a wheel 1/16-inch face should be harder than one ½-inch face. If a wheel is hard and heats or chatters, it can often be made somewhat more effective by turning off a part of its cutting surface; but it should be clearly understood that while this will sometimes prevent a hard wheel from heating or chattering the work, such a wheel will not prove as economical as one of the full width and proper grade, for it should be borne in mind that the grade should always bear the proper relation to the width.

Pieces intended to be ground can frequently be profitably turned in the lathe to near the finished size before being tempered. *After hardening*, the pieces can then be accurately finished in the grinding machine, thus securing the utmost accuracy united with great durability. Many pieces of work require but one cut to prepare them for the grinding machine; if the tool has dulled or the work has sprung in hardening or in turning, it causes no trouble when being ground.

NOTE.—Emery is a granular mineral substance and belongs to the species corundum, but is not pure, being mixed with magnetic or hematite ores. Corundum is a mineral substance found in a crystalline form. Its hardness is next to the diamond. Emery is granular corundum more or less impure. As an abrasive, corundum cannot be excelled, its diamond-like hardness, brittleness and sharpness giving it lasting qualities.