adjustable dead stop. The spindle of the machine should be capable of reversal when required.

A most important point, and one which is overlooked on too many machines of this class, is the provision for automatic lubrication. When an operator has a number of machines under his charge it is clear that he has not a great deal of time to attend to oil holes and lubricators all over the machines. The headstock and other gears should preferably run in oil, and all bearings should be of the self-oiling type.

Another point sometimes overlooked is the provision of means for stopping the machine should anything happen to any of the tools. A tool may occasionally break during the operator's absence, and in such a case, means should be provided so that the breakage is confined to this tool and is not followed by a breakdown of the machine itself. Some form of slipping device should be used for this purpose, and the simplest form of such a device is to drive the speed motion and the spindle of the machine by means of belts which would slip and be thrown off in case of accident.

General Considerations

Attention may profitably be called to the material to be machined. An occasional hard casting in a lot may necessitate slowing down the machine for every casting with a consequent decrease in output. The same may be said of castings which are irregular, as the machine must, of course, be set for the outside dimensions of the largest pieces; hence time is wasted on all the castings on account of an occasional lump on one. The user of automatic turning machines, therefore, can increase the output of these machines by inaugurating some improvements in his pattern shop and foundry, and the time spent in these places will be regained over and over again in the machine shop.

Cast-iron articles should be annealed, and when this is done they may be made of a much harder grade of cast iron, and hence are stronger, but as easily machined. Castings should also be pickled to save tool grinding. Most of these recommendations are applicable to work machined by any method, but are especially necessary when continuous running is aimed at, as in automatic turning machines.

Lastly, looking at the question of the desirability of automatic turning machines from the workman's standpoint, it may be said that their use enables reasonable wages to be paid, and there is more change, variety and opportunity for mental exercise in the running of four machines by one man—all, perhaps, employed on different jobs—than there is in the operation of an ordinary engine lathe using a single cutting tool.

* * *

The Bureau of Steam Engineering, Navy Department, Washington, D. C., has recently issued new specifications covering the composition of metals and materials supplied to the United States Navy Department. The specifications cover the composition of commercial brass, Muntz metals, brazing metal, gun-bronze, journal-bronze, valve-bronze, ingot-copper, manganese-bronze, monel-metal, cast naval brass, phosphor-bronze, screw pipe fittings of brass, metallic nickel, tin, lead, thrust-rings, monel-metal ingots, admiralty metals, benedict-nickel, sheet brass and tubing, brass rods, copper, manganese-bronze and rolled naval brass. The specifications also give the required tensile strength, yield point and elongation of the various metals, together with other general information relating to the tests to which the metals are subjected in order to determine their qualities.

* * *

As a result of recent tests, Prof. F. M. Goss estimates that of 90,000,000 tons of coal consumed by 51,000 locomotives in the United States in 1906, 720,000 tons were lost through incomplete combustion of gases, more than 10,000,000 tons were lost through the heat of the gases discharged through the smokestack, more than 8,600,000 tons were lost through cinders and sparks, and the equivalent of nearly 3,000,000 tons were lost through unconsumed fuel in the ashes. These figures indicate the economy that might be possible with improved furnaces insuring more perfect combustion.

MACHINE SHOP PRACTICE

HAND SCRAPING

By H. P. FAIRFIELD*

Hand scraping in metal working is done to accomplish three specific objects:

1. To produce an ornamental surface for the sake of appearance only. This is known in shop nomenclature as "frosting," "snow-flaking," or under the general head of "spotting," and consists in using the hand scraping tool in such a way as to obtain "spots" upon the surface to be ornamented. The

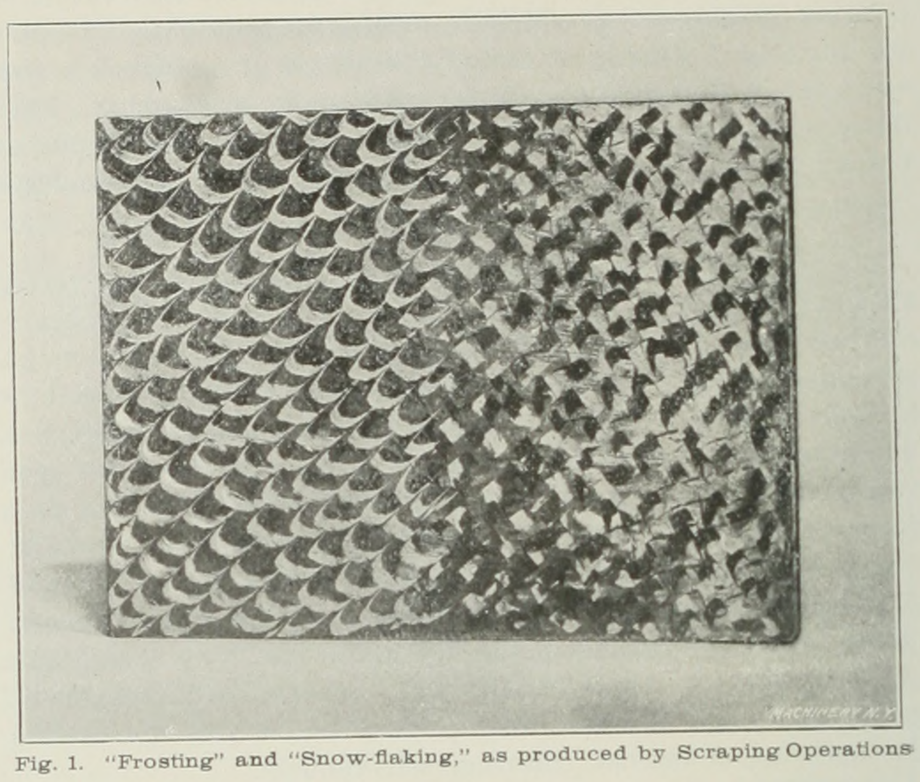

Fig. 1. "Frosting" and "Snow-flaking," as produced by Scraping Operations

spotted surfaces, as shown in Fig. 1, are of two kinds, one having small square spots arranged as indicated, and one having "half-moon" spots. The former is termed "snow-flaking," and the latter "frosting." In the former, the scraping tool is pushed squarely ahead to give spots of an established size and at established intervals. Similar spots are then made to fill the intervening spaces, using the scraper at right angles to the previous direction of motion or push. Frosting is accomplished by giving the scraping tool a peculiar "wiggle," as the cut is made; this is not easy to do, and difficult to describe. However, if well done, it leaves a very handsome finish. A surface ornamented in this manner may have been most carefully hand scraped to an accurate and precise plane, or it may have been left as it came from the machine. Ornamenting by spotting a surface that has been hand scraped, is done to give a regularity to the impressions left by the tool. When a surface is ornamented without previous hand fitting by scraping, it may be done wholly as an ornamentation or, as is sometimes the case, to deceive the uninitiated, who are apt to consider it as proof of previous careful fitting.

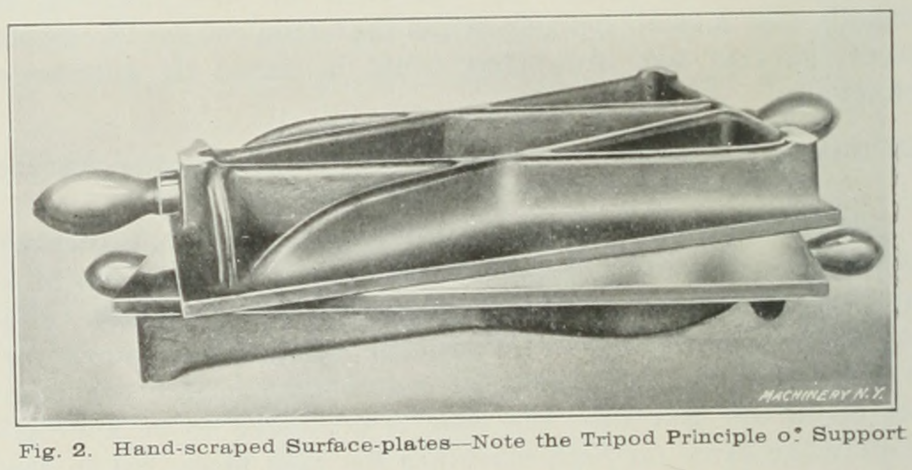

Fig. 2. Hand-scraped Surface-plates—Note the Tripod Principle of Support

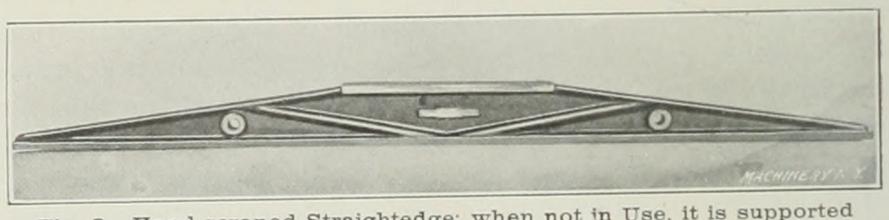

Fig. 3. Hand-scraped Straightedge; when not in Use, it is supported from the Holes shown, to prevent Unequal Stresses

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2. To fit two surfaces to each other more accurately than they can be fitted by machining. Examples of this kind are seen in such bearings as spindles and their boxes, in cylinders where a solid piston must fit without the presence of high spots or ridges on the surfaces, and in cases where it is impossible to use machinery for smoothing or finishing surfaces. An example of this latter case may be seen in repair jobs on

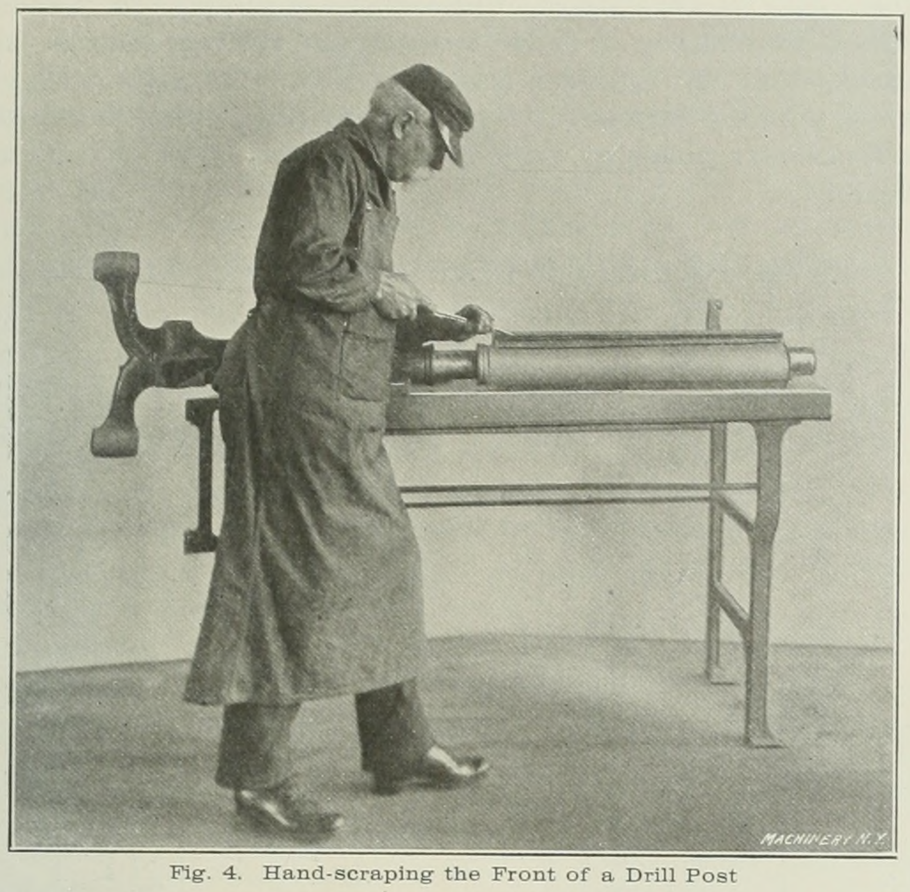


Fig. 4. Hand-scraping the Front of a Drill Post

babbitt-lined bearings, replaced in localities distant from all shop conveniences.

3. In the case of plane surfaces, where the surface is finished by hand scraping to conform to a previously prepared master plane surface, termed a surface plate. The hand scraping of plane surfaces is undoubtedly one of the most skilled of the regular machine shop operations, and is always performed by a specially trained corps of employes. Perhaps the art of hand scraping plane surfaces can be illustrated in no better way than by describing the methods of producing a master surface-plate.

Commercial firms that produce standard surface-plates for sale have a large master plate to which all the master plates used by them in producing surface-plates can be referred. This plate, which might be termed "an original master plate," is used for test purposes only, and cared for as religiously as possible. Where no master plate is available for test purposes, it is necessary to make three plates if but one is desired. This is easily understood if one considers that two curved surfaces can be made to fit each other, but that a third surface could not fit both the curved surfaces. In other words, a surface cannot at the same time be concave and convex. Therefore, if each of three surfaces or straight edges will match each other, they must all be straight or plane surfaces.

Surface-plates are usually made from gray iron castings. The pattern is made with uniform ribs upon the back or under side, as shown in Fig. 2, if it is to be finished upon one side only. (If it is to be finished upon all sides, as, for example, a long bar of rectangular cross-section, it is built as a hollow box with suitable internal ribbing.) Besides having ribs, the under side is provided with three bosses used as feet, as shown, for resting the plate upon the bench or other support. These feet are so located as to evenly support the weight of the plate, and it should, at all times, whether in use or not, rest upon these spots. The castings are first rough-planed to approximately the finished size, and allowed to season for a period of several months that all internal cooling strains may adjust themselves. This process can be hastened somewhat by heating in an annealing oven, if care is used not to overheat. When suitably seasoned, a light finishing cut is made on the surface to be scraped, and a seasoning period is again allowed. Each plate is then carefully scraped to a smoothly finished surface, taking care to remove even amounts all over each surface. They are then scraped to fit one another by placing one upon another and rubbing the surfaces together until the high spots on each plate are located, and then scraping these off.

As an aid in locating the high spots upon the surfaces in contact, use is made of some pigment, as for example, venetian red. A thin film of this is rubbed over the surfaces before placing them together. The points at which the two plates touch are thus readily indicated. The workman with his hand scrapers removes a small amount of the stock at the indicated points, and repeats the process of locating the high points of contact between the several plates and afterward scraping them off, until the surfaces are interchangeable each with the other and are completely "freckled" over their upper surfaces with points of contact. These points of contact should be uniformly distributed over the entire surface, and the fitting should continue until at least 60 per cent of the surface of the plate is in contact with its mates. Evenness of distribution is of prime importance, as is also the requirement that all parts of the surface not actually in contact shall be an unmeasurable distance below the level of the parts which actually are in contact.

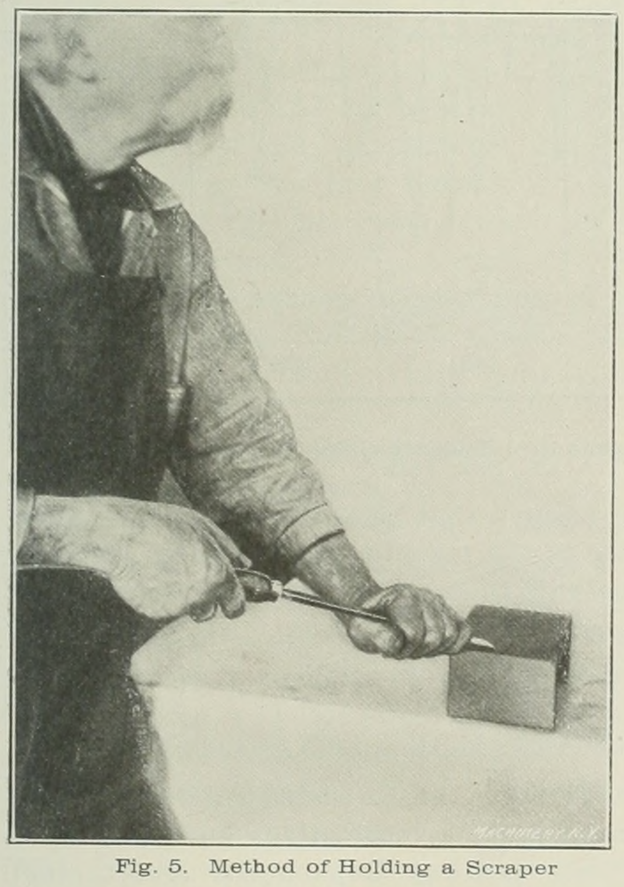


Fig. 5. Method of Holding a Scraper

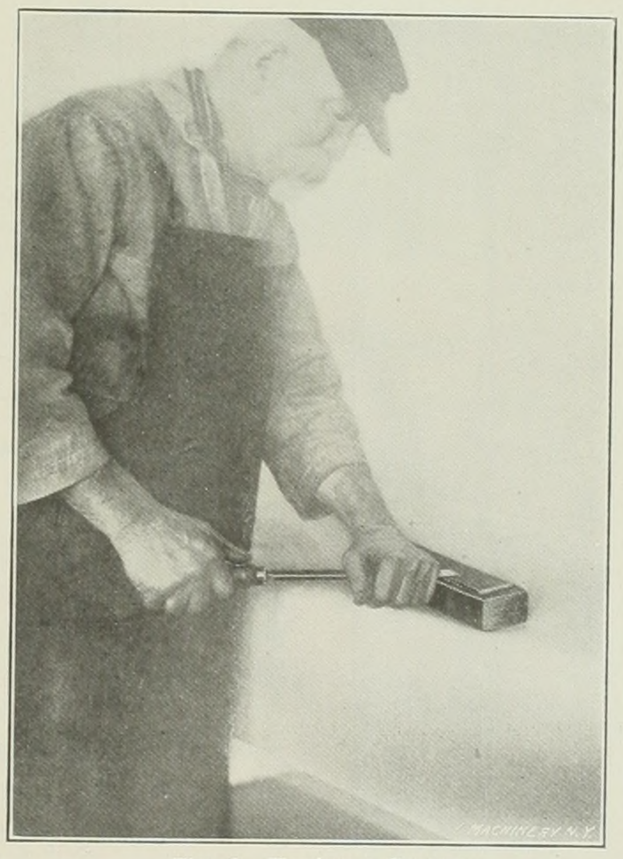


Fig. 6. Honing a Scraper

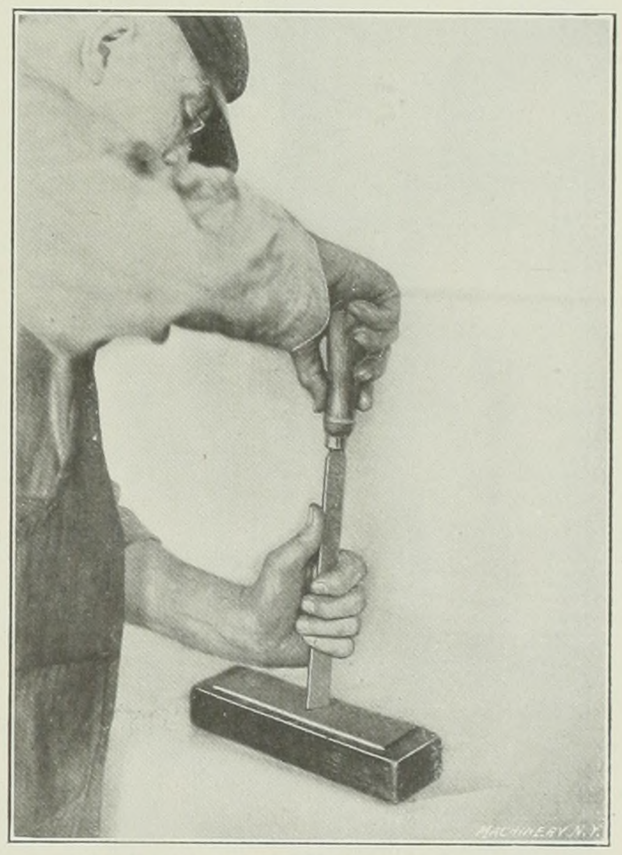


Fig. 7. Honing the Scraper on the End

For this class of hand scraping and for the spotting processes first described, tools resembling in outline a file, are ordinarily used, held as shown in the accompanying illustrations, Figs. 4 and 5. They are ground square across the end and are afterward honed upon a hard oilstone. When the honing is being done, they are held in a vertical position and inclined alternately to the right and to the left about 3 degrees. (See

Fig. 7.) The cutting edges are thus given a negative rake of 3 degrees, and the tendency to chatter in use is reduced. In this, as in all other purely hand operations, the personal element is supreme, and the difference between workmen in respect to quality and quantity of production is very marked. Fig. 4 shows a workman hand scraping the front of a drill post for its table and spindle brackets. In work of this character the surface-plate, or straightedge, Fig. 3, is placed upon the surface being scraped, but in the case of small pieces, the work is rubbed upon the plate instead. Whichever is done,

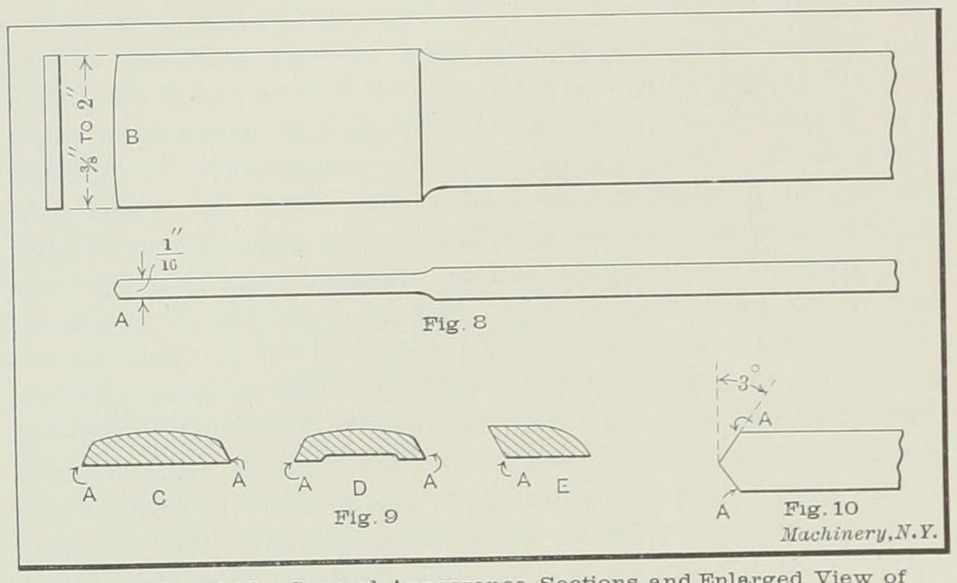


Fig. 8 Fig. 9 Fig. 10

Machinery, N.Y.

Figs. 8, 9 and 10. General Appearance, Sections and Enlarged View of End of Hand Scrapers

the surfaces should be carefully wiped to remove loose particles, and a light coating of pigment given them.

Hand scrapers, as shown in Fig. 11, resemble files in form and are often made from old files. This is not, however, good practice, and new special stock should be used. They are hardened glass-hard on the cutting edge and not "drawn" afterward. Then the cutting end is ground and honed upon an Arkansas oilstone, as already mentioned, leaving a cutting

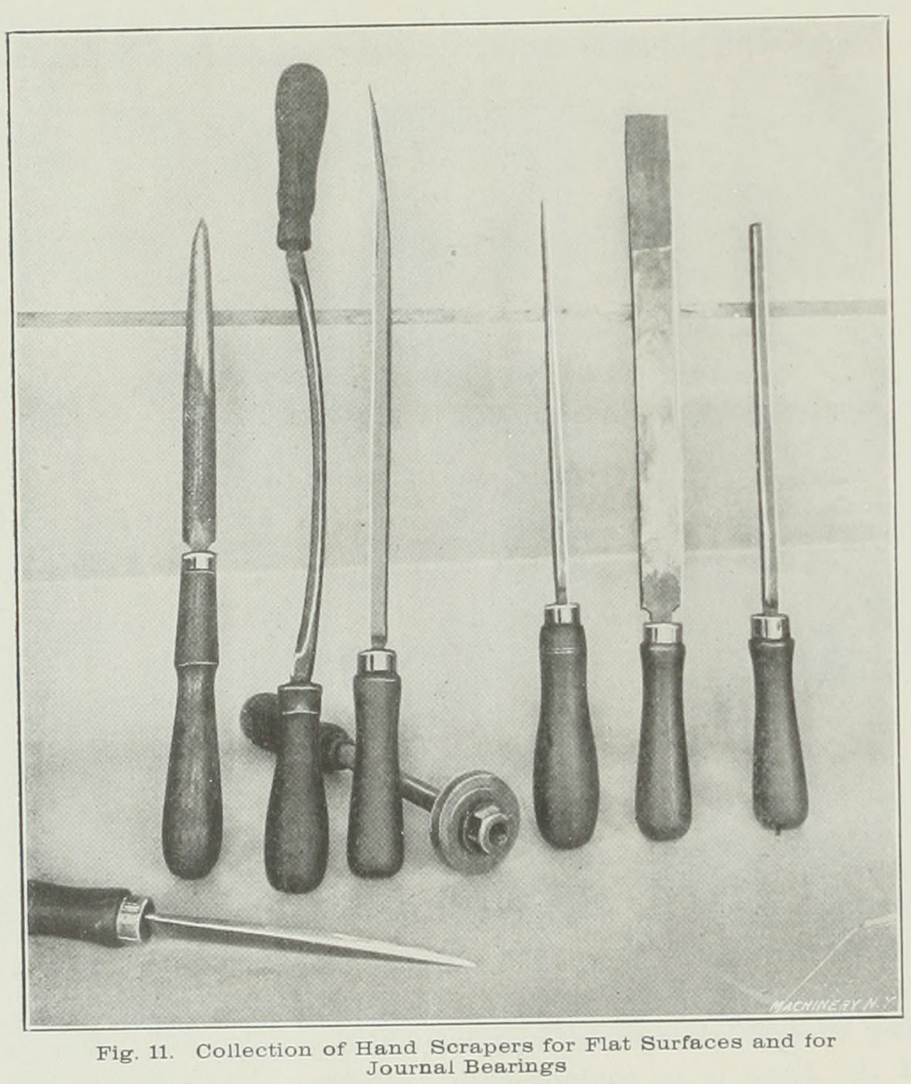


Fig. 11. Collection of Hand Scrapers for Flat Surfaces and for Journal Bearings

edge as shown exaggerated in Fig. 10. In use, the hand scraper is held at a sufficient angle with the work to make it "bite" the surface, and is then pushed from the workman along the surface being scraped. The length of stroke varies from that of several inches, when roughing off the surface, to almost no distance when the finishing touches are being made.

Flat hand scrapers vary in size to fit the jobs on which they are used. The usual range is from ⅜ inch wide by 6 inches long, to 2 inches wide by 24 inches long. The ordinary size used on machine tool work is about 1 inch by 18 inches.

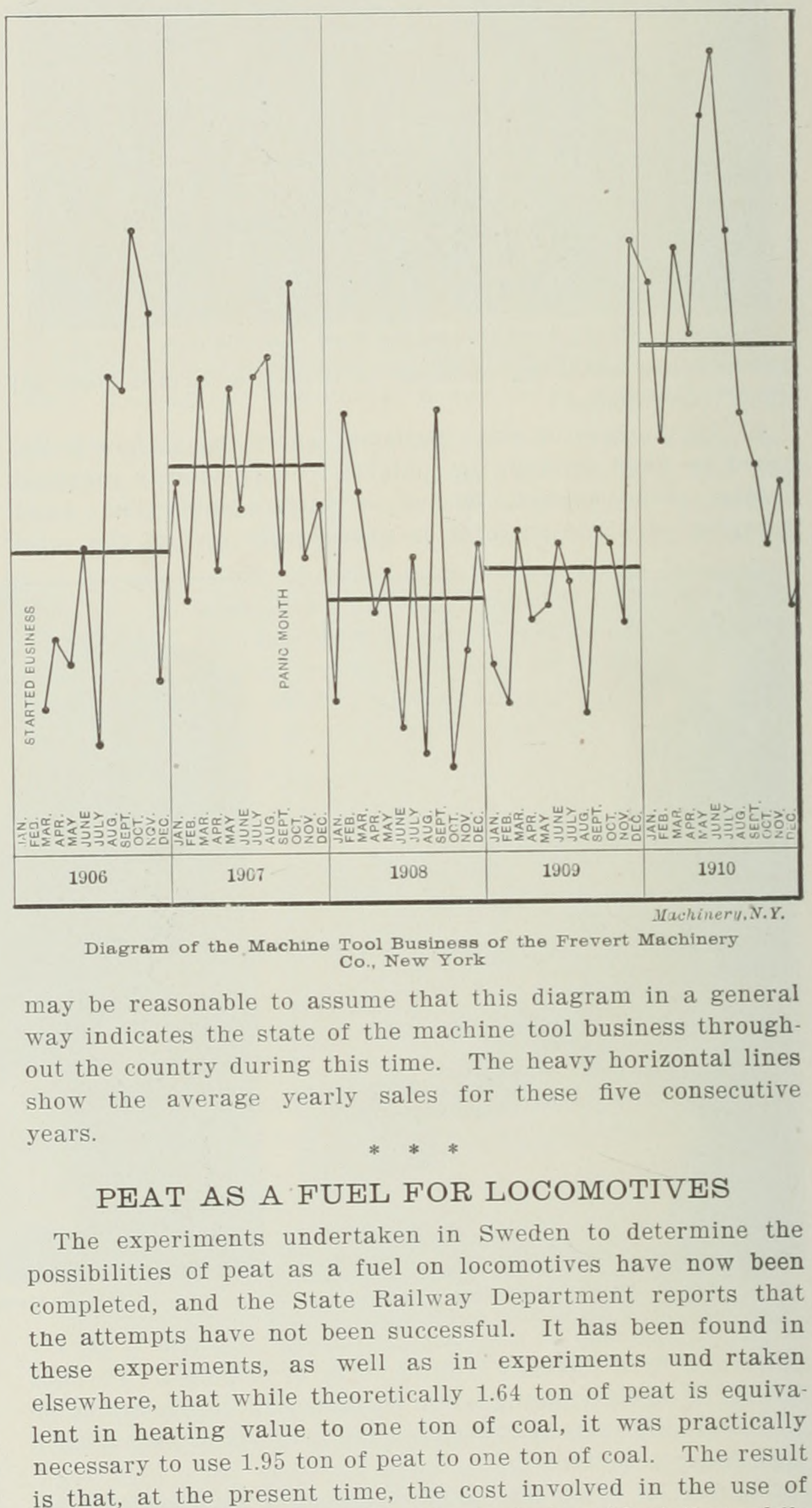
The curved scrapers shown in cross-section in Fig. 9 are used in finishing spindle boxes. Scrapers of this type are of a variety of cross-sections. They are used by pushing or pulling with a combination motion both around and lengthwise of the bearing.

In Fig. 8 is shown the ordinary flat hand scraper. It will be noticed that there is a slight curvature at the end *B* of the tool. In Fig. 9 are shown cross-sections of scrapers for spindle boxes, as mentioned; *A* represents the cutting edge in all cases. The cutting edges make an angle of from 3 to 15 degrees with the vertical. The cross-sections at *C* and *D* are for scrapers for roughing, and that at *E* for finishing spindle boxes.

* * *

FIVE YEARS OF MACHINE TOOL TRADE

The accompanying chart is based upon the sales of the Frevert Machinery Co., 18 Dey St., New York City, dealers in machine tools. The chart shows the variations in the business activity of this firm during the past five years, and it



Machinery, N.Y.

Diagram of the Machine Tool Business of the Frevert Machinery Co., New York

may be reasonable to assume that this diagram in a general way indicates the state of the machine tool business throughout the country during this time. The heavy horizontal lines show the average yearly sales for these five consecutive years.

* * *

PEAT AS A FUEL FOR LOCOMOTIVES

The experiments undertaken in Sweden to determine the possibilities of peat as a fuel on locomotives have now been completed, and the State Railway Department reports that the attempts have not been successful. It has been found in these experiments, as well as in experiments und rtaken elsewhere, that while theoretically 1.64 ton of peat is equivalent in heating value to one ton of coal, it was practically necessary to use 1.95 ton of peat to one ton of coal. The result is that, at the present time, the cost involved in the use of peat fuel exceeds that of using coal. It is evident that while the increased weight and bulk of peat for use on locomotives is a serious objection, apart from its cost there would be no such objection to its use in stationary power plants. The problem of how to get the peat into a state where it is suitable as boiler fuel without incurring excessive cost in the operations necessary for its preparation, eems, however, still to be unsolved.