PRACTICAL MECHANISM.

NUMBER I.

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Introduction.

The education of the machinist in the science governing the daily practice of his art has not received its proper share of attention at the hands of those authors who have written books upon mechanical subjects: and the artizan is, in consequence, deprived of the aid derivable from the experience of the thousands who have trodden the same path before him. Hence it takes years of practice and observation to acquire knowledge which could be gained in a comparatively short space of time by the aid of a little book learning.

To converse intelligently with the artizan, it is necessary to employ language and terms with which he is familiar; and in cases where calculations are required, they should be of as simple a nature as possible, because the practical machinist is not usually versed in algebra; and if he finds that the information of which he is in pursuit is treated only in formulas whose meanings are a mystery to him, he becomes discouraged and abandons the task of their elucidation. When, on the other hand, the mechanic is encouraged by the easy acquirement of the desired knowledge, it proves an incentive which leads him to higher paths of study, into the pursuit of which he had at first no idea of entering.

Practical workmanship is not a mere matter of accustoming the fingers to perform mechanical movements; but is governed by a series of distinct principles, simple and complex, the employment of which depends at all times upon the perception and judgment of the artizan. Nearly the whole distinction between an expert and an indifferent workman consists in their relative capability to perceive the principles applicable to particular work, and in their readiness in overcoming the innumerable little obstacles which present themselves, rendering a deviation, at times, from a common rule either highly advantageous or absolutely necessary.

The inexperienced or unobservant mechanic frequently fails to recognize the very principles he applies to his work, although conscious of a large class of conditions under which he would proceed by the same method; because experience has forced it upon him as indispensable in such cases. Being dependent upon the information which he may be able to gather from the particular pieces of work which chance to fall to his lot and to such scraps of disjointed instruction as a fellow workman may feel disposed to impart, it often occurs that, when he encounters a difficulty, the more experienced hand who helps him out of it neglects to explain the principle governing the means by which the difficulty was overcome, so that the uninitiated gains nothing by the experience, and fails to perceive the numerous applications of similar remedies to parallel obstacles.

The machinist is to iron what the carpenter, joiner, cabinet maker, wheelwright, etc., are to wood, with the disadvantage that he has to design and determine the shapes and temper of his tools, which vary so much (to suit the work) that the tool suitable for one piece may be totally inadequate to perform the same service upon another, although the proportions the texture, and the metals may be alike in both instances. We cannot, therefore, tell a good machinist by his tools, unless we know for what particular piece of work those tools were used. Nor can a machinist be judged from his shavings, because there are many kinds of work for which a tool keen enough to cut a thick and clean shaving cannot be used to advantage. Even the speeds, given in mechanical books, at which to cut metals tend to mislead, because the nature and size of the work, the depth and nature of the cut, and numerous other influences render the variation of the cutting speed at times one third greater or less than the given speed. A knowledge, however, of the general rules, together with an intelligent understanding of the principles governing the exceptions and deviations, will enable the artizan, when a difficulty arises, to at once perceive its precise cause, and to apply an adequate remedy, the conditions only requiring to be understood to render the application of the principles governing them palpably necessary and easy of accomplishment; thus rendering the learning of the trade more a matter of understanding and less a matter of unintelligent labor.

The aim, therefore, of the author of these papers is to develop from the promiscuous practice of the workshop its inherent science, and to present it to the mechanic so arranged that he will find each formula the natural sequence to its predecessor; and while explaining its positive conditions, to so present its negative ones that the mind will instinctively seek the remedy which its successor will supply.

Machine Tools.

FRONT OR TOP RAKE.

The principal consideration in determining the proper shape of a cutting tool for a machine is where it should have the rake necessary to make it keen enough to cut well, and this is governed by the nature of the work on which it is to be used. It is always desirable, when practicable, to place nearly all the rake on the top face of the tool, as shown in Fig. 1

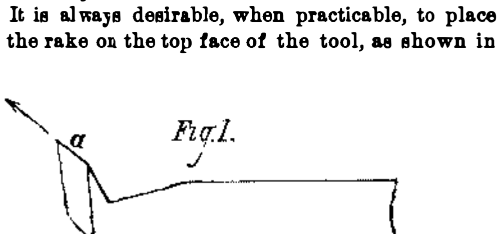
Fig. 1.

The line *a* represents the top face, the rake being its incline in the direction of the arrow. In those cases (to be hereafter specified) in which top rake is, from the nature of the work to be cut, impracticable, it must be taken off and given proportionately to the bottom face, as shown in Fig. 2,

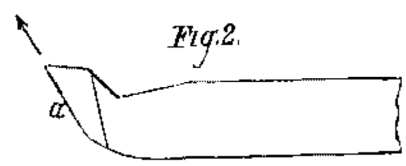
Fig. 2.

in which the line *a* represents the bottom or side face of the tool, the rake being its incline in the direction of the arrow.

The tool possessing the maximum of top rake, as shown in Fig. 1, is the strongest, because its cutting edge is the best supported by the metal beneath it, and is so presented to the metal to be cut that the tool edge cuts freely, having no tendency to scrape.

The shaving, as it is cut off, exerts a pressure upon the top face of the tool, the line of force of this pressure being at about a right angle to the face. If, therefore, the top face of the tool possesses much rake, this line of pressure will be in a direction to force the tool into its cut (causing it to spring into the cut and break), as shown in Fig. 3.

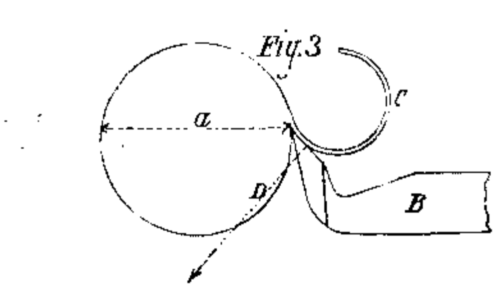
Fig. 3

A represents a shaft, B the tool, C the shaving being cut off and the dotted line D the line of force of the strain placed upon the tool by the shaving, from which it will be seen that, if the tool springs in consequence of this pressure, it will enter the cut deeper than it is intended to do. A plain cut (either inside or outside) admits of the application of a maximum of front or top rake, and of a minimum of bottom or side rake; but a tool of this description, if used upon work having a break in the cut (such as a keyway or slot), would run in and break off from the following causes:

If the strain upon the tool were equal in force at all times during the cut, the spring would also be equal, and the cut, therefore, a smooth one; but in taking a first cut, there may be, and usually is, more metal to be cut off the work in one place than in another; besides which there are inequalities in the texture of the metal, so that, when the harder parts come into contact with the tool, it springs more and cuts deeper than it does when cutting the softer parts, and therefore leaves the face of the work uneven. If less rake be given to the tool on its top and more on its side or bottom face, as is represented in Fig. 4,

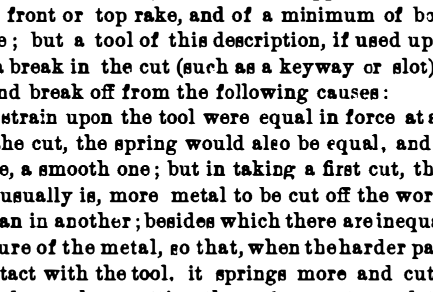
Fig. 4

a being the shaft as before, B the tool, and C the shaving, the dotted line D is the direction of the strain put upon the tool by the shaving, which has but very little, if any, tendency to spring the tool into its cut.

STRAINS ON TOOLS.

The strain referred to is not alone that due to the severing of the metal, but that, in addition, which is exerted to break or curl the shaving, which would come off, if permitted, in a straight line, like a piece of cord being unrolled from a cylinder; but on coming into contact with the face of the tool (immediately after it has left the cutting edge), it is forced, by that face, out of the straight line and takes circular form of more or less diameter according to the amount of top rake possessed by the tool. A glance at Fig. 3 will show that the shaving comes off the tool there represented at such an acute angle that but little force is required to bend it out of the straight line into circular form. An inspection of Fig. 4 demonstrates that the shaving comes off the tool there described at almost a right angle to the straight line, and the grain of the metal (already disintegrated in the cutting) fragments from the force necessary to bend it to such a degree.

It follows, then, that, if two tools are placed in position to take an equal cut off similar work, that which possesses the most top rake, while receiving the least strain from the shaving, receives it in a direction the most likely to spring it into its cut. It must not, therefore, be used upon any work having a tendency to draw the tool in, nor upon work to perform which the tool must stand far out from the tool post, for in either case it will spring into its cut.

Especially is this likely to occur if the cut has a break in it with a sharply defined edge, for example, when turning a shaft with a dovetail groove in, as presented in Fig. 5. For when the edge, *a*, of the dovetail strikes the point of the tool, B, it will spring it into the cut and break it, more particularly if the point, B, of the tool is placed above the center, in which position it cuts, in ordinary cases, to the best advantage. It is apparent, then, that tools for the above description of work must be given the form described in Fig.

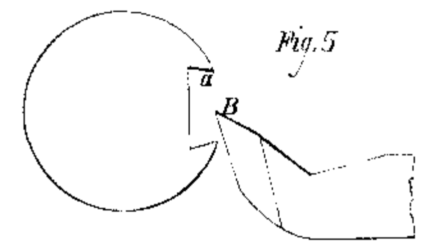
Fig. 5

4, not because it is the best tool to cut the metal, but because it is the least liable to spring into its cut.

Petroleum Fires Extinguished by Chloroform.

Some of the fiercest and most destructive conflagrations on record have been occasioned by the burning of large quantities of petroleum. It is hardly necessary to recall instances; the frequent fires in the large oil works in Brooklyn, the great conflagration in Philadelphia some years ago, and the fearful disaster on the Hudson River Railroad, due to the ignition of an oil train through collision, are within every ones recollection. Various processes have been suggested for rendering the petroleum incombustible, principally, however, based on the admixture with the oil of foreign substances and their subsequent removal before using the material. Abbé Moigno, the editor of *Les Mondes*, suggests in that journal a new means, which, he states, renders the oil absolutely proof against fire. He states that petroleum mixed in proportion of five to one with chloroform cannot be ignited; it becomes not only uninflammable but incombustible so long as the major part of the chloroform remains unvolatilized.

It is a remarkable fact, that if a quart of petroleum be poured upon a large shallow dish so that its depth will be about 0·3 of an inch, and in surfaces about three inches square, and then ignited and allowed to become well kindled, about one tenth of a gill of chloroform will extinguish the flames; and if attempts be made to relight the petroleum, the liquid will put out the match. Another experiment tried on a larger quantity of oil, though retaining the same superficial area, showed that the same amount of chloroform sufficed to repeat the result. Mixtures of explosive gases mingled with the vapors of chloroform also lose, it is stated, in a great measure their inflammability.

The chloroform must be pure and free from alcohol. If, however, the vapor of boiling chloroform or the liquid in a pure spray be introduced into the flame of burning alcohol, the latter becomes extinguished.

The composition of chloroform gives an explanation of these facts, which, however, are nevertheless very remarkable, inasmuch as most chemical treatises admit the inflammability of the substance. The formula CH,Cl^3 leads to the decomposition by heat, with the formation of Cl^2H, and Cl and C become free. An æolipile, covered externally with alcohol and internally with chloroform, gives off clouds of carbon accompanied with intense fumes of hydrochloric acid.

From the preceding it would seem that, for use aboard vessels or in large storehouses where great quantities of petroleum are massed, a reservoir of chloroform would furnish a means of keeping down conflagrations, the ravages of which at the present time it is almost impossible to check. This reservoir, Abbé Moigno suggests, might be so arranged that, in case of a fire occurring in the oil at a certain point, its contents would there be conducted and discharged.

We should imagine that a system of tubes, one leading to each tank, could be connected with some electromagnetic or other fire annunciator, the action of which, caused by the heat, would open a valve and so admit the chloroform. It is true that the high cost of the latter would be worthy of consideration, but a suitable provision once made, at an expense of few hundred dollars, would, if properly enclosed, last indefinitely; and besides, the expense would be trivial beside the saving effected, of a ship and her cargo or of a large warehouse.

The author says that if his experiments, conducted on a still larger scale, prove equally successful, as he confidently expects them to do, the resources of chemistry should furnish a means of making one or the other chloride of carbon very cheaply. In fact, already the tetrachloride of carbon, CCl^3, may be easily produced through the sulphide. The difference between the tetrachloride and chloroform is that the latter, CH,Cl^3, boils at 140° Fah., and its density is 1·48. CCl^4 boils at 172·4 Fah. and has a density of 1·6. The tetrachloride is transformed partially into chloroform by reactions indicated in chemical works.

THE LARGEST GAS METER IN THE WORLD.—The Gas Meter Company, Limited, have lately erected, at the Independent Gaslight Company's Works, Haggerstone, London, a station meter which is the largest yet made. Its capacity is 150,000 cubic feet of gas per hour, and its measuring drum delivers for each revolution 1,600 cubic feet. The cast iron tank, with its pilasters, cornices, etc., is of the Grecian order and of the following dimensions, namely: 19 feet 8 inches square, and the total hight from floor line to the top of pediment is 20 feet 2 inches, and when filled to the working waterline contains 21,000 gallons of water. The inlet and outlet connections are 30 inches diameter. The meter works well at three tenths of an inch pressure.

A NEW process for heliographic engraving is given in the *L'Année Scientifique*. A photographic proof is applied to a sheet of zinc, when the silver, transferred from the paper to the plate, produces a metallic layer which enables the zinc to be attacked by very dilute acids.