PRACTICAL MECHANISM.

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TAPS AND DIES.

Taps should be forged of hammered square bar steel, and forged to as near the finished size as possible (so that they are large enough to true up), for the reasons already given with reference to tool steel.

The threads of taps of the smaller sizes should be finished by a chaser, so as to insure correctness in the angles and in the depth of the thread.

The taper tap should not be given more taper than the depth of the thread in the length of the tap, or it is liable to be used upon holes that are too small, which places more duty upon it than is necessary and than it should be required to perform; rendering it, in consequence, liable to break from the excessive strain, and causing the square end of the tap, where the wrench fits, to twist and the corners to become rounded.

A tap which has clearance placed upon its thread, by the screw-cutting tool or by a chaser, will cut very freely, and will answer for rough work: but such a tap does not cut a really good thread, and generally leaves the diameter of the thread in the hole larger than the diameter of the tap itself, because the tap is liable to wabble, and the least excess of pressure, on one end of the tap wrench more than on the other, causes the tap to lean towards the end of the wrench receiving the most pressure, and hence to tap a hole larger than itself. Especially is this liable to occur if the tap wrench has more than one square hole in it so as to enable the same wrench to be used on more than one size of tap; for in such a case, the holes being not in the center of the wrench, the weight of the wrench and the pressure placed on the end of the wrench will exert more pressure on one side of the tap than the other, in consequence of their greater distance or longer leverage from the tap. The same effects (from the use of such wrenches) are experienced in using taps having no clearance in the thread; but the thread in this latter case is so much nearer a fit to the hole that it serves as a guide and keeps the tap steady.

The only clearance necessary is to ease off the tops of the teeth of the tap back from the cutting edge, which will give the teeth sufficient clearance to make them cut clean, and leave the sides of the thread to fit the thread being cut, and thus prevent the tap from moving laterally.

The plain part of a tap, that is, that part from the thread to the end of the square where the wrench fits, should be turned down a little smaller in diameter than the bottom of the thread (unless in the case of very small taps), so that the tap can pass right through the hole in all cases where the hole passes through the work, thus saving time by obviating the necessity of winding the tap back, and furthermore preserving the cutting edges of the tap teeth by avoiding the abrasion caused by their being rubbed backwards against the metal of the hole. For special work, where the holes to be tapped do not pass through the work, and it is therefore compulsory to wind the tap backwards to take it out of the hole, the plain part of the tap may be left larger than the diameter of the thread, the advantage being that the squares of several different sizes of taps may be made alike, and therefore to suit one tap wrench.

Taps for use in holes to be tapped deeply should be made slightly larger in diameter than those used to tap shallow ones, because in deep holes the tap is held steady by its depth in the hole, and because whatever variation there may be, in the pitch of the threads in the hole and those on the bolt, is, of course, experienced to an extent greater as the length of the thread (that is, the number of threads) increases.

It is an excellent plan to finish the threads of a tap by passing it through a sizing die, that is, a solid die kept for that special purpose; but very little metal must be left on the tap for the solid die to take off, or it will soon wear and get larger. In making such a solid die, let its thickness be rather more than the diameter of the tap it is intended to cut, and make allowance for its shrinkage in hardening, for all holes shrink in hardening, while taps swell or become larger from that process; an allowance for this must therefore be made both in the case of the tap and the die. In the case of the solid die, it will be found that not only does the hole become smaller, but the external dimensions of the entire die have become larger by reason of the hardening, so that while the term shrinkage is correct, as applied to the hole, it is incorrect as applied to the die, the fact being that the metal of the die (the same as the metal of the tap) has expanded, extending its dimensions in all directions, and therefore in the direction of the center of the hole, hence causing a decrease in its diameter or bore.

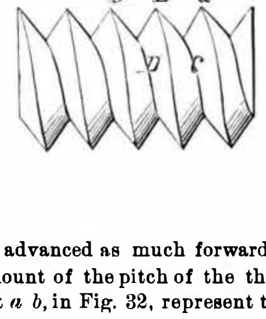
Three flutes are all that are necessary to small taps (that is, those up to an inch in diameter), which leave the tap stronger and less liable to wabble, especially in holes that are not round, than if it had four flutes. Taps of a larger size may have more flutes, but the number should always be an odd one, so that the tap will do its work steadily.

ADJUSTABLE DIES.

that is, those which take more than one cut to make a full thread, should never be used in cases where a solid die will answer the purpose, because adjustable dies take every cut at a different angle to the center line of the bolt, as explained by Figs. 31 and 32.

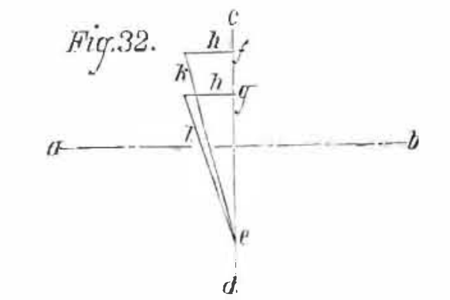
Fig. 31 represents an ordinary screw. It is evident that the pitch from a to B is the same as from C to D, the one being the top, the other the bottom, of the thread. It is also evident that a piece of cord wound once around the top of the thread will be longer than one wound once around the bottom of the thread, and yet, in passing once around the

Fig. 31.



thread, the latter advanced as much forward as the former, that is, to the amount of the pitch of the thread. To illustrate this fact, let a b, in Fig. 32, represent the center line of

Fig. 32.



the bolt lengthwise, and c d a line at right angles to it: then let from the point, e, to the point, f, represent the circumference of the top of the thread, and from e to g, the circumference of the bottom of the thread, the lines, h h, representing their respective pitches; and we have the line, k, as representing the angle of the top of the thread to the center line, a b, of the bolt, and the line, l, as representing the angle of the bottom of the thread to the center line, a b, of the bolt, from which it becomes apparent that the top and the bottom of the thread are at different angles to the center line of the bolt.

The tops of the teeth of adjustable dies are themselves at the greatest angle, while they commence to cut the thread on the bolt at its largest diameter, where it possesses the least angle, so that the dies cut a wrong angle at first, and gradually approach the correct angle as they cut the depth of the thread.

From what has been already said, it will be perceived that the angle of thread, cut by the first cuts taken by adjustable dies, is neither that of the teeth of the dies nor that required by the bolt, so that the dies cannot cut clean because the teeth do not fit the grooves they cut, and drag in consequence.

DIES FOR USE IN HAND STOCKS

are cut from hubs of a larger diameter than the size of bolt the dies are intended to cut; this being done to cause the dies to cut at the cutting edges of the teeth which are at or near the center of each die, so that the threads on each side of each die act as guides to steady the dies and prevent them from wabbling as they otherwise would do; the result of this is that the angle of the thread in the dies is not the correct angle for the thread of the bolt, even when the dies are the closest together, and hence taking the finishing cuts on the thread, although the dies are nearer the correct angle when in that position than in any other. A very little practice at cutting threads with stocks and dies will demonstrate that the tops of the threads on a bolt, cut by them, are larger than was the diameter of the bolt before the thread was commenced to be cut, which arises from the pressure, placed on the sides of the thread of the bolt. by the sides of the thread on the dies, in consequence of the difference in their angles; which pressure compresses the sides of the bolt thread (the metal being softer than that of the dies) and causes a corresponding increase in its diameter. It is in consequence of the variation of angle in adjustable dies that a square thread cannot be cut by them, and that they do not cut a good V thread.

In the case of a solid die, the teeth or threads are cut by a hub the correct size, and they therefore stand at the proper angle; furthermore, each diameter in the depth of the teeth of the die cuts the corresponding diameter on the bolt, so that there is no strain upon the sides of the thread save that due to the force necessary to cut the metal of the bolt thread.

Recent Researches on Flame.

M. G. Hirn has been experimenting upon the optical properties of flame, and theorizing upon the incandescent bodies of the sun's atmosphere. (*Ann. Chim. Phys.*, XXX, p. 319.) In considering these researches we must remind the reader of Davy's theory of the luminosity of flame. It is that, if any solid substance be ignited to a sufficiently high point, let us say 1,000° Fah., it becomes luminous, while gaseous matter requires a much higher temperature. But if solid particles be introduced into a gas of a high temperature, they instantly begin to throw off light in all directions; and as the temperature of the particles rises so does the color vary through all the gradations of the colors of the spectrum. Thus, commencing with a red heat, it passes through yellow and what is termed a white heat, while a very intense heat produces violet rays. Such is Davy's theory, which, to a certain extent, is accepted at the present day. It has, however, been qualified by the researches of Dr. Frankland, who was first to point out that we can have highly luminous flames which do not, or would not, probably, contain solid particles. As examples, let us take the pretty familiar experiments of the combustion of phosphorus or bisulphide of carbon in oxygen. Most of our readers who have attended a course of lectures upon chemistry will remember the dazzling light given off in these experiments. So rich are the lights obtained in this manner in actinism that they have been used very successfully in taken instantaneous photographs.

The researches of Dr. Frankland may be generalized as follows: That gaseous substances have a point of incandescence which depends chiefly upon the density of the gas, and it follows that gases of low density become luminous much more readily than those of a high density; also, that gases which are not luminous at all at our ordinary atmospheric pressure (let us say hydrogen, for instance), when submitted to increased pressure become luminous. Thus a jet of hydrogen, burning in a vessel in which the pressure was increased, gave a light, by which a newspaper could be read two feet from the flame, on producing a pressure of two atmospheres.

Some connection may be observed, between the theory of Davy and the experiments of Frankland, from the experiments of Dr. Andrews, who has lately demonstrated the continuity of the liquid and gaseous state; or in other words, that, when operating upon gases capable of taking the liquid form with great pressure, a certain stage is at last reached where there is no perceptible physical difference between the liquid and gasseous conditions. Dr. Draper, of New York, in experimenting upon Davy's theory, has, however, found that, if, on heating a strip of platinum to a temperature of 1,280° by the voltaic current, a red heat was obtained which extended up to the line F (yellow) in the solar spectrum, at 1,325° the spectrum was prolonged into the bluish green; at 1,440°, beyond the line G; and at 2,190° a pure and intense spectrum, reaching as far as H in the violet, was obtained. These high temperatures were measured by the expansion of platinum wire itself.

Now, it is extremely easy "in the mind's eye" to conceive the intense actinic power of the rays emanating from the incandescent vapors of the sun, whose beams are the storehouse of actinic power which actuates, we may safely say, this world of ours. We may extend these theories on luminosity to the sun itself without a great stretch of imagination; for it would seem to be merely one gigantic mass of incandescent elements, similar in every respect to those we meet with in our earthly experience. But here the temperatures which we would consider intense are only to be compared to the color spaces observed upon the face of the sun; the red and white heats of our forges would appear black by contrast to the intensely ignited mass beyond if placed upon the face of the sun. What were some few years since thought to be breaks in the photosphere of the sun are now known to be incandescent clouds of vapor of a lower temperature than the brilliant background. There is hardly a gaseous element, even at a low pressure, which is not capable of becoming intensely luminous; in fact, we can conceive no limit to the phenomenon.

M. Hirn accepts the theory of Davy, and believes that the greater part of the luminosity of flame is due to solid particles being formed or precipitated into the incandescent flame. If there were opaque solid particles in flame, light would be reflected and would become polarized. Arago, years ago, observed that light from a flame is not polarized, and M. Hirn has confirmed these observations. Therefore, the latter named experimenter comes to the conclusion that the solid particles, as they became incandescent, become perfectly transparent; and the rather curious observation that a flat flame, such as we meet with in a fishtail gas burner, radiates light quickly in all directions, although so irregular in shape, is thus explained. The real shadows produced by particles of carbon, says M. Hirn, which have escaped combustion, or the fumes of burning phosphorus, when compared with the striated and feebly colored shadows given by flames of very considerable solidity, show that the precipitated particles do not affect the transparency of flame, and, consequently that, when they become incandescent, they become at the same time diaphanous (transparent).

A slight contradiction is noticed in connection with the magnesium light, which projects a real, and not simply a striated, shadow. Were this radical change in the optical properties of the solid particles not to take place—that is to say, the change from opacity to transparency—it is obvious that not only would such particles hinder the transparency of flame, but they would only illuminate from a very thin envelope.

It is easy to perceive the importance which these facts acquire when the temperature of an incandescent body, such as the sun, is studied. If the particles were opaque, they would serve as screens, one for another, of all those situated in a straight line. Only the nearest to us would send out light; and these, besides being under less pressure, would be really less luminous.

It must also be recollected that other investigations than those referred to above tend to show that the upper layers of the sun's atmosphere are the coolest, and consist of hydrogen, sodium, and magnesium; that we have layers of iron and calcium at a higher temperature; and again, layers of nickel, cobalt, copper, and zinc at a higher temperature still. M. Hirn's observation about magnesium is curious, and hardly seems to agree with the observation of Mr. Lockyer in the examination of one of the bright stripes called "faculæ." In this bright surface upon the sun's disk, Mr. Lockyer observed a cloud which his spectroscope determined to consist of magnesium vapor. We, however, see at once how the different layers of vapors pass rays through their diaphanous or transparent brethren, and thus we get the full effect of the incandescence of those metals which are so rich in chemical force.—*British Journal of Photography.*