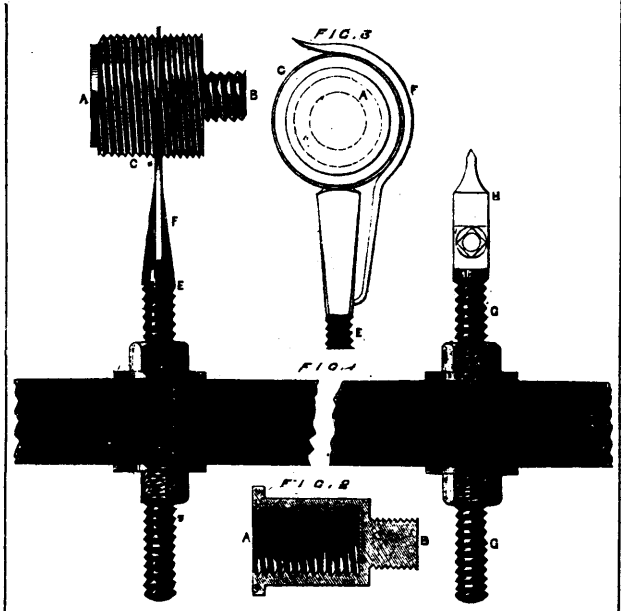
exhaust takes place ; and the percentage of siroke to be performed during compression after the exhaust has closed. It will be readily understood that a diagram which will show so much must necessarily exhibit a great deal more; for instance, when the eccentric centre line is drawn from the centre of the diagram (*i.e.*, of the crank shaft) through the desired cut-off on the arc G or H, on the same line can be found any travel of valve from ¼in. to 10in., graduating by quarters ; any lap of valve from ¼in. to 4½in. graduating by sixteenths, and any opening of port from ⅛in. to 3½in. graduating by sixteenths. Any required opening of port with the requisit travel and lap of valve can therefore be selected for the point of cut-off fixed upon. To the designer of steam-engines the diagram is necessarily of considerable value, for by its aid he can find the exact sizes of the eccentrics and the slide valve, and obtain a graphic representation of the effect of different lengths of connecting-rod upon the distribution of steam with any given amount of lap and lead, and, *per contra*, can view the effects of different amounts of lap and lead. For use in classes the diagram should certainly be engraved upon slate (the inventor himself recommends slate where a little extra cost is no object), because lines can be clearly shown and as readily removed ; the teacher, in fact, drawing the eccentric to the exact size required and afterwards the valve, thus giving an ocular demonstration of the value of the diagram. The ordinary cardboard set up in a neat box will, however, answer all the purposes of the mechanic and slide-valve designer without requiring any knowledge of mathematics, or, for that matter, of even arithmetic, though as the scale is made for a stroke-line of 10in., and is divided into 100 parts, a little multiplication will be necessary when its applied for ascertaining the distribution of steam in engines of any other stroke. This fact is not the least feature of merit in the invention, for we cannot doubt that if the slide-valve were properly understood by those who own or have charge of engines, or even by those who make them, great improvement and a consequent economy of fuel would be the result. With this diagram and the accessories which accompany it, including the book of instructions, no one can fail to understand the working of the valve gear, while to those engaged in the construction of engines, it is at once a ready reckoner and an unerring draughtsman.

IMPROVEMENTS IN SCREW-CUTTING.

A somewhat novel way of arranging the guide for screw-cutting has been patented by Mr. W. R. Olivey, of Stormont-road, Lavender-hill, S.W. To the mandrel of a lathe he fits a chuck, say, about the length of an ordinary chuck and the screw of the mandrel combined. On the end of this chuck is a screw the same size and depth as that on the mandrel, to take on it any of the other chucks belonging to the lathe. The remainder of the chuck is turned to receive a hollow cylinder, on the outside of which is cut the screw to be copied, leaving on the chuck a rim to catch the end of the cylinder. Then having cut the screw to be copied on a cylinder of any suitable metal, he fixes it for use on the first-mentioned chuck in either of the following ways :— First, by inserting a small stud just in front of the rim to fit into a slot in the inside of the cylinder, in which case the cylinder is made just long enough to reach the insides of either of the other chucks when screwed against it ; or, secondly, by dispensing with the stud and letting the cylinder project just far enough over the end of the first-mentioned chuck to be kept in position by either of the other chucks being screwed on against it. To obviate the necessity of removing the work, the cylinder can be placed on the back of the chuck and secured by suitable means, such as a screw tapped into the chuck. A frame of wood or metal with a slot in it carries the guide and the tool-holder, the guide being provided with a spring clip to run in the grooves of the screw of the cylinder, and thus obviates the necessity of a rest. It is obvious that the guide can be made without the clip, and work upon any ordinary rest. The tool-holder and the guide are tapped with threads running nearly their whole length, so that they can be adjusted to the length required in accordance with the work. The tool-holder is flattened at the end to receive the tool on to which it is screwed so that the cutter can be placed to cut an outside or inside screw. The action is as follows :—The cylinder is placed on the chuck, the work being screwed up against or on the chuck in the ordinary way. The guide and the tool-holder being placed in proper position, the guide-clip is placed in the screw-grooves on the cylinder, and the tool against the work to be operated on. As the guide travels in the grooves of the thread the tool cuts a similar thread on the work, and this is repeated until the screw is finished. The cutter is either a single point or a chaser of the same pitched screw as the guide. Ordinary chucks can be used with these arrangements by dispensing with the rim on the back of the chuck, and putting the cylinder on from the back and confining it by a screw or spring. Fig. 1 is a plan, Fig. 2 a sectional view of chuck, and Fig. 3 end elevation, showing hollow cylinder with screw to be copied with guide and spring-clip. In these Figures A is the shuck, with screw B ; C, hollow cylinder, on which is cut the thread to be copied ; D, frame of wood or metal, with slot ; E, guide tapped with threads, as shown, so as to be adjusted to the length required ; F, spring clip to run in the grooves of the screw ; G, tool-holder tapped with threads, as shown, so that same can be adjuusted to the length required in accordance with the work ; M, cutting-tool screwed or secured on to the flattened end of the holder. The cutting-tool can be fixed to work an outside thread, as shown in Fig. 1, on an inside thread. The hollow cylinder C, with the thread thereon to be copied, is fixed on the chuck A, as before described ; the work is then screwed up against or on the chuck A in the ordinary way. The guide E with the spring clip F, and also the tool-holder G with the cutting-tool H, is then brought into position, as shown in Figs. 1 and 2, and as the guide E tavels in the grooves of the thread, the tool H cuts a live thread on the work, and this repeated until the screw is finished.



HOT AND COLD BLAST IRON.—Cold-blast is rather stronger than hot-blast iron, and mixtures are rather stronger than simple irons. This is the opinion of Bindon B. Stoney, C.E., and the following are the conclusions which the late Mr. Robert Stephenson deduced from a series of experiments on the transverse strength of cast-iron bars, made preparatory to the commencement of the High Level Bridge at Newcastle : (1) Hot-blast is less certain in its results than cold-blast ; (2) mixtures of cold-blast are more uniform than those of hot-blast ; (3) mixtures of hot and cold-blast give the best results ; (4) simple samples do not run so solid as mixtures ; (5) simple samples sometimes run too hard and sometimes too soft for practical purposes. From these conclusions Mr. Stoney says : "Having regard to the fact that hot-blast iron is now in general use, and that it seems to improve some kinds of iron—probably those of a hard nature—the best plant for the engineer to adopt is to specify the test which he requires the iron to stand, and let the founder bear the responsibility of producing the required result."

FUEL-SAVING INVENTIONS.—Among the American fuel-saving inventions are the following : A boiler advertised which saves 33 per cent of fuel, a valve which saves 15 per cent, a governor which saves 10 per cent, a cut-off which saves 10 per cent, a grate which saves 20 per cent, a metal packing which saves 12 per cent, and a lubricator which saves 1 per cent ; total, 101 per cent. Combining all these improvements, an engine would *run itself*, and produce a balance of fuel for culinary purposes !